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Pathways and Protective Factors: Modelling the Effect of Chronic Conditions on Quality of Life in Midlife and Older Irish Adults

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Citation
Pathways and Protective Factors: Modelling the Effect of Chronic Conditions on Quality of Life in Midlife and Older Irish Adults

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Supervisors: Professor Anne Hickey, Dr Bellinda King-Kallimanis and Professor Richard Layte

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"Everyone who is born holds dual citizenship, in the kingdom of the well and in the kingdom of the sick"

Illness as Metaphor, Susan Sontag

"Grow old along with me!

The best is yet to be,

The last of life for which the first was made"

Robert Browning
Candidate Thesis Declaration

I declare that this thesis, which I submit to RCSI for examination in consideration of the award of a higher degree of Doctor of Philosophy, is my own personal effort. Where any of the content presented is the result of input or data from a related collaborative research programme this is duly acknowledged in the text such that it is possible to ascertain how much of the work is my own. I have not already obtained a degree in RCSI or elsewhere on the basis of this work. Furthermore, I took reasonable care to ensure that the work is original, and, to the best of my knowledge, does not breach copyright law, and has not been taken from other sources except where such work has been cited and acknowledged within the text.

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Student Number ______________________________________________

Date _______________________________________________________


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<td>ADL</td>
<td>Activities of Daily Living</td>
</tr>
<tr>
<td>AH</td>
<td>Anne Hickey (PhD Supervisor)</td>
</tr>
<tr>
<td>BHPS</td>
<td>British Health Panel Survey</td>
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<tr>
<td>BPNS</td>
<td>Basic Psychological Needs Satisfaction</td>
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<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>CA</td>
<td>Control/Autonomy</td>
</tr>
<tr>
<td>CAPI</td>
<td>Computer-Assisted Personal Interview</td>
</tr>
<tr>
<td>CASP</td>
<td>Control, Autonomy, Self-Realisation, Pleasure</td>
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<tr>
<td>CDC</td>
<td>Centre for Disease Control</td>
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<tr>
<td>CES-D</td>
<td>Centre for Epidemiological Studies-Depression</td>
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<tr>
<td>CFA</td>
<td>Confirmatory Factor Analysis</td>
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<td>CFI</td>
<td>Comparative Fit Index</td>
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<tr>
<td>CI</td>
<td>Confidence Interval</td>
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<tr>
<td>CIRS</td>
<td>Cumulative Illness Rating Scale</td>
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<tr>
<td>CKD</td>
<td>Chronic Kidney Disease</td>
</tr>
<tr>
<td>COPD</td>
<td>Chronic Obstructive Pulmonary Disease</td>
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<tr>
<td>df</td>
<td>degrees of freedom</td>
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<tr>
<td>DPM</td>
<td>Disablement Process Model</td>
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<tr>
<td>EFA</td>
<td>Exploratory Factor Analysis</td>
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<td>ELSA</td>
<td>English Longitudinal Study of Ageing</td>
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<td>EPC</td>
<td>Expected Parameter Change</td>
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<td>EQ-5D</td>
<td>Euro-Quality of Life Five Dimension</td>
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<td>ES</td>
<td>Eithne Sexton (PhD Candidate)</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FCI</td>
<td>Functional Comorbidity Index</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>GDS</td>
<td>Geriatric Depression Scale</td>
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<tr>
<td>GNI</td>
<td>Gross National Income</td>
</tr>
<tr>
<td>GP</td>
<td>General Practitioner</td>
</tr>
<tr>
<td>GS</td>
<td>George Savva (systematic review co-author)</td>
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<tr>
<td>HA</td>
<td>Health Assessment</td>
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<td>HRQoL</td>
<td>Health-Related Quality of Life</td>
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<td>HRS</td>
<td>Health and Retirement Survey</td>
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<td>HSE</td>
<td>Health Services Executive</td>
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<td>HUI</td>
<td>Health Utilities Index</td>
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<tr>
<td>IADL</td>
<td>Instrumental Activities of Daily Living</td>
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<tr>
<td>ICF</td>
<td>International Classification of Function, Disability and Health</td>
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<td>IHD</td>
<td>Ischaemic Heart Disease</td>
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<td>LASA</td>
<td>Longitudinal Ageing Study of Amsterdam</td>
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<tr>
<td>MAR</td>
<td>Missing at Random</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>MCAR</td>
<td>Missing Completely at Random</td>
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<tr>
<td>MNAR</td>
<td>Missing Not at Random</td>
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<tr>
<td>MCS</td>
<td>Mental Component Summary score</td>
</tr>
<tr>
<td>MH</td>
<td>Mental Health</td>
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<tr>
<td>MI</td>
<td>Myocardial Infarction</td>
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<tr>
<td>MI</td>
<td>Modification indices</td>
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<tr>
<td>MMSE</td>
<td>Mini-Mental State Examination</td>
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<tr>
<td>NA</td>
<td>Negative Affect</td>
</tr>
<tr>
<td>NHP</td>
<td>Nottingham Health Profile</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<td>OPQOL</td>
<td>Older People's Quality of Life</td>
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<td>PA</td>
<td>Positive Affect</td>
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<td>PAD</td>
<td>Peripheral Arterial Disease</td>
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<td>PCS</td>
<td>Physical Component Summary score</td>
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<td>PHI</td>
<td>Private Health Insurance</td>
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<td>Physical Function</td>
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<td>QNHS</td>
<td>Quarterly National Household Survey</td>
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<td>QoL</td>
<td>Quality of Life</td>
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<td>RMSEA</td>
<td>Root Mean Square Error of Approximation</td>
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<td>ROI</td>
<td>Republic of Ireland</td>
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<td>SCQ</td>
<td>Self-Completion Questionnaire</td>
</tr>
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<td>SD</td>
<td>Standard Deviation</td>
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<td>Structural Equation Modelling</td>
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<td>Socioeconomic Position</td>
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<td>Short-Form 6 item</td>
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<td>SHARE</td>
<td>Survey of Health, Ageing and Retirement in Europe</td>
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<td>SP</td>
<td>Self-Realisation/Pleasure</td>
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<td>SWB</td>
<td>Subjective Wellbeing</td>
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<tr>
<td>TILDA</td>
<td>The Irish Longitudinal Study of Ageing</td>
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<tr>
<td>TLI</td>
<td>Tucker Lewis Index</td>
</tr>
<tr>
<td>TUG</td>
<td>Timed Up and Go</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
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<td>USA</td>
<td>United States of America</td>
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<td>Wave 1</td>
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<td>W2</td>
<td>Wave 2</td>
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<td>WCM</td>
<td>Wilson Cleary Model</td>
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<td>WHO</td>
<td>World Health Organisation</td>
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<td>WHOQOL</td>
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Thesis Summary

**Background:** Quality of life (QoL) outcomes are increasingly important as a target for healthcare intervention and for measuring healthcare effectiveness. However, the effect of physical health on QoL at older ages is poorly understood. The aim of this thesis was to empirically test an explanatory model of the relationship between chronic conditions and QoL in older people in Ireland.

**Methods:** This is a cross-sectional and longitudinal cohort study, using data from the Irish Longitudinal Study of Ageing (TILDA), a general-population sample of community-dwelling adults aged 50+ in the Republic of Ireland (n=8,175). Exploratory and confirmatory factor analysis was used to evaluate and revise the CASP-19 measure of QoL. Structural equation modelling was used to test a model of the pathway between chronic conditions and QoL, via disability and affective wellbeing. Conditional change linear regression was used to evaluate longitudinal effects along this pathway, and to examine how these longitudinal effects were modified by personal characteristics (e.g., personality) and environmental factors (e.g., social support).

**Results:** A 12-item version of CASP-19 was developed, comprising two dimensions: control/autonomy and self-realisation/pleasure. The cross-sectional effect of chronic conditions on both QoL dimensions was mediated by physical impairment and affective wellbeing. Partner support reduced the effect of physical impairment on control/autonomy and religiosity reduced the effect of physical impairment on self-realisation/pleasure. Self-realisation/pleasure was less responsive to variation and change in physical health relative to control/autonomy.

**Conclusion:** The effect of chronic conditions on QoL in later life depends on the level of disability, the availability of environmental supports, and personal characteristics. Models of healthcare which focus on patient-specific goals, circumstances and health needs, rather than specific conditions and disease processes, may be more effective for improving QoL outcomes in chronic disease. Control/autonomy emerged as a useful indicator of QoL which is responsive to variation in physical health.
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Publications and Presentations

Publications


Conference Presentations

1. Living as married and with religious belief reduces the negative effect of disabling chronic conditions on QoL. European Health Psychology Society Conference, Innsbruck August 2014. **Oral Presentation.**

2. The Effect of Hypertension Diagnosis on Change in Quality of Life: The Role of Personality, Social Support and Initial Chronic Disease Status. International Society for Quality of Life Research Conference, Berlin October 2014. **Poster Presentation.**

3. Resilience in Older Age: Living as Married and with Religious Belief Reduce the Negative Effect of Increased Disability on Quality of Life Among Older People in Ireland. Irish Gerontological Society Conference, Galway October 2014. **Poster Presentation.**

4. Examining the ICF framework as a model of the cross-sectional relationship between chronic disease and quality of life at middle and older age. International Society for Quality of Life Research Conference, Miami October 2013. **Oral Presentation.**


Chapter 1  Introduction to the Thesis

1.1  Introduction

The aim of this thesis was to examine in detail the cross-sectional and longitudinal effects of chronic conditions on quality of life (QoL) in an older Irish cohort. Chapter 1 will briefly introduce the thesis background and describe initial aims and objectives. The relevance of the research to health services research and policy will be briefly discussed. The chapter will conclude with an outline of the thesis content.

1.2  Background

1.2.1  Population Ageing and Chronic Conditions

Need for healthcare is increasingly concentrated in two growing and overlapping groups: older people and people with chronic conditions. Currently, the population of Ireland is young relative to other Organisation for Economic Co-operation and Development (OECD) and European Union (EU) countries (1,2); nevertheless, it is projected to age rapidly in the coming decades. The proportion of the population aged 50+ is projected to rise from 28% in 2011 to 38% in 2046, with the proportion aged 65+ doubling from 12% to 23% (3). This has serious implications for health service delivery. Frequency of general practitioner (GP) visits rises steadily with age, with Irish adults aged 70+ reporting twice as many GP visits per year as those aged 44 or younger (4). In 2012, almost half of inpatient hospital episodes (48.5%) were for patients aged 55+, while this age group accounted for over two-thirds (68.4%) of all inpatient bed days (5).

These changing demographics, along with current and historic patterns of risk factors, are driving increases in chronic disease prevalence. Although smoking prevalence has reduced in the Irish population, it remains substantial – one in five adults aged 50+ is a smoker (6). Smoking is a major risk factor for conditions such as chronic obstructive pulmonary disease (COPD) and certain forms of cancer. One in three adults aged 50+ are obese, which is a major risk factor for diabetes and cardiovascular disease (6). It is estimated that between 2007 and 2020, the number of adults with hypertension, heart disease, diabetes or stroke
in the Republic of Ireland (ROI) will rise by 40% (7). Ireland is not alone in this trend - it has been estimated that by 2030 chronic diseases will make up 70% of the global disease burden (8). Estimates of the prevalence of multiple chronic conditions (multi-morbidity) vary, but indicate that more than half of adults aged 60+ have more than one chronic condition, with the number of chronic conditions rising with age (7,9,10).

Population ageing does not inevitably lead to increased morbidity and health service use. For example, a significant proportion of lifetime healthcare costs occur in the last year of life, suggesting that increased longevity will merely postpone these costs (11). The "compression of morbidity" hypothesis suggests that as the population grows older, illness and disability will be reduced, and overall levels of health will improve (12–14). Alternatively, the "dynamic equilibrium" hypothesis suggests that illness and disability will be delayed, but not reduced, so that overall levels of health will remain the same. A third hypothesis proposes that disease and disability will not be delayed, resulting in an expansion of morbidity (12–14).

Evidence has not been conclusive for any of these scenarios, and results depend on what aspect of morbidity is measured (14–16). Between 2005 and 2010, life expectancy at age 65 in Europe increased by one year, while there was a greater increase in years lived with chronic morbidity (1.6 for men, 1.3 for women), suggesting an expansion of morbidity. However, the number of years lived with disability remained the same (15). This suggests that while chronic morbidity may be increasing, diseases are having less of a disabling impact on older people. Increased prevalence of morbidity may reflect improved diagnosis and screening, rather than a worsening of health status (10). It is also worth noting that levels of health and disability vary widely across the globe. As Salomon points out, if all countries achieved levels of disability at older ages similar to Japan, then there would be widespread compression of morbidity (16). This highlights the considerable potential for improving outcomes in older populations.

1.2.2 Changing Health System Priorities

Given these shifts in the age and disease profile of the population, the focus of health services is similarly shifting towards the treatment and management of chronic disease. The need to re-organise the health system to facilitate optimal treatment and management
of chronic conditions has been identified as a major priority for the Irish health service (17–20). The objectives of healthcare for chronic conditions differ from the traditional (and still critically important) objectives of acute care, which are reducing morbidity and mortality. People live for a long time with chronic conditions: at age 50, women with diabetes can expect to live for 26 years (21) and those with arthritis for 30 more years (22). Men and women who have had a heart attack by age 50 can expect to live for 18 more years (23). Healthcare for chronic conditions is therefore not aimed just at extending life, but improving the quality of those additional years.

This requires a broader conception of health outcomes, beyond a focus on solving specific disease-related problems, to take account of the patient’s more general needs and goals (24,25). This broader approach is reflected in the WHO definition of health as "complete physical, mental and social wellbeing and not merely the absence of disease or infirmity" (26). It is also reflected in the WHO definition of QoL as "a broad ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, personal beliefs and their relationship to salient features of their environment" (27) (p. 1). The important key role of the health system in enhancing QoL and wellbeing outcomes is increasingly emphasised in an Irish policy context (19,28). The Healthy Ireland policy puts forward a vision of Irish society where "everyone can enjoy physical and mental health and wellbeing to their full potential, where wellbeing is valued and supported at every level of society" (19) (p. 15).

At the same time, with rising healthcare expectations and costs, pressure has increased to justify the effectiveness of the care that is provided. The measurement of health outcomes is key to assessing effectiveness of treatments, interventions and policies (29). Traditional outcome measures include mortality, morbidity, complications rates, and surrogate outcomes such as blood pressure or cholesterol. In line with the changing focus of health systems outlined above, and the increasing complexity of patients needs, emphasis on patient-centred approaches to care has increased. This requires measurement of less tangible outcomes, including those that are subjective to the patients themselves.

The measurement of patient-reported health outcomes, including QoL, is thus becoming an essential pillar of health systems and health system reform processes. Examples include the
Patient Centred Outcomes Institute in the United States (30), and the Patient Reported Outcome Measures (PROMs) programme in the UK (31). While the initial focus in the UK health system was on assessments of physical health or function, such as hip surgery outcomes (32), interest has increased in measures of broader concepts of QoL, which incorporate mental wellbeing. A mental wellbeing outcome measure is currently being assessed for use as a basis for funding allocations in mental health (33).

1.2.3 Effects of Chronic Conditions on QoL in Older People

If a major objective of healthcare is to help older people maintain or improve their QoL in a context of chronic conditions, then a good understanding is required of precisely how chronic conditions affect QoL among older people. For example, what are the mechanisms or mediating factors by which chronic conditions affect QoL? Which dimensions of QoL are most negatively affected by chronic conditions, and which are more likely to be maintained? Which factors help older adults to maintain their QoL in a context of chronic disease?

Examination of these questions is complicated by the fact that definitions of QoL are complex and contested. Identification of an appropriate definition of QoL among older people is particularly challenging. The most commonly used measures of QoL among older people are health-related QoL (HRQoL) measures. However, this approach to measuring QoL is focussed on physical health and function, and may not equate with older people’s own definitions and concepts of QoL (34,35).

Research with QoL measures that are distinct from health and function indicates that older people maintain good QoL as they age, despite declining physical health. Life satisfaction, affective wellbeing and overall QoL appear to increase with age, before decreasing or remaining constant at the oldest ages (approximately 70+) (36–39). The phenomenon of maintenance of good QoL in the face of poor health is not a novel finding – in the 1990s, Albrecht & Devlieger used the term "disability paradox" to describe high levels of wellbeing observed in people with poor health and low levels of function (40). Indeed, Walker notes that positive subjective wellbeing among older people living in adverse conditions is a "longstanding observation in gerontology" (41) (p. 63).
Notwithstanding evidence for maintenance of QoL in later life, it is unlikely that health is irrelevant to QoL among older people. Older people themselves cite health as an important aspect of QoL (42). This indicates the need to examine in detail the circumstances under which chronic conditions do have a negative effect on QoL. There may be specific chronic conditions, or specific sequelae of chronic conditions, which have a detrimental effect on QoL. Chronic conditions may have a detrimental effect on QoL through their negative effects on other domains of life, such as social participation. Alternatively, chronic conditions may negatively affect some domains of QoL, but not others. The effect of chronic conditions on QoL may vary according to the older person’s characteristics and circumstances. Contextual resources such as social support and personal resources such as personality traits may buffer the effect of chronic conditions and disability on QoL.

Disentangling the relationship between chronic conditions and QoL requires a measure of QoL that is distinct from physical health and function. This would allow examination of factors such as symptoms and physical function as mediators, making it possible to identify the mechanisms by which chronic conditions affect QoL. One such measure is the relatively recent CASP-19 (43,44). This measure was developed specifically for older people, and is based on Maslow's theory of needs satisfaction (45). QoL is defined as fulfilment of important "higher" needs – control, autonomy, self-realisation and pleasure. The measure involves a conceptual model of QoL which has a stronger theoretical basis than simpler evaluative measures such as life satisfaction. It is also multi-dimensional, facilitating separate examination of diverse aspects of QoL. However, problems have been identified with the psychometric properties of the CASP-19, and further work is required to evaluate its psychometric properties in general-population samples of older people (46,47).

Investigation of the complex relationship between chronic conditions and QoL requires detailed data on a wide range of health, social and psychological variables, from large general-population samples of older people. Fortunately, this type of data is increasingly available from large-scale studies of ageing populations. A number of these studies have been undertaken across several countries in recent years, partially in response to the challenges posed by changing demographic structures. These include the English Longitudinal Study of Ageing (ELSA) (48), the Health and Retirement Survey (HRS) (49), the Longitudinal Ageing Study of Amsterdam (LASA) (50) and the Survey of Health and
Retirement in Europe (SHARE) (51,52). In Ireland, the Irish Longitudinal Study of Ageing (TILDA) began field work in 2009. The first two waves of data are now available for analysis.

Following the sample profile of TILDA and similar large-scale surveys of ageing, the population of interest for this thesis is community-dwelling adults aged 50+. It thus includes adults who can be considered midlife, or young-old, as well as older adults. There are a number of insights to be gained from studying adults from midlife, rather than just focussing on an older cohort. The 50s and 60s have been described as the "Third Age": a period of life focussed on personal development and fulfilment once the challenges of career development and child-rearing have been met (53). It is also the time of life where many people experience the onset of chronic conditions. In TILDA, 20% of the population aged 50-64 have arthritis, while 30% have high blood pressure (6). It is thus an interesting time period to examine both the negative effects of emerging health conditions and the potential for positive outcomes. For the sake of simplicity, the over 50s cohort will be referred to as "older" throughout this thesis.

1.3 Thesis Aims and Objectives

The aim of this thesis was to evaluate an explanatory model of the relationship between chronic conditions and QoL among older people in Ireland. This explanatory model will include factors which mediate and moderate the effect of chronic conditions on QoL in this age group. The model will thus comprise a pathway from chronic conditions to QoL, and protective factors which modify relationships along the pathway. A hypothetical model will be developed based on the current empirical and theoretical literature, and empirically tested in a general-population sample of older people in Ireland. The primary outcome measure will be the CASP-19, a measure of QoL which has been designed specifically for older people. As part of the thesis, the psychometric properties of this measure will be evaluated with the Irish population aged 50+.

The initial aims and objectives of the thesis are displayed below. More specific research questions and hypotheses will be identified after review of the current empirical and theoretical literature in Chapters 2 to 4.
Aim 1: To systematically review current literature examining the effect of chronic conditions on QoL in middle-aged and older general populations.

Objectives:

a. To identify and critically assess the current evidence for effects of chronic conditions on QoL in older general-population samples.

b. To compare evidence for effects across different conditions, and different measures and domains of QoL.

c. To identify population-level evidence for factors that mediate and moderate the effect of chronic conditions on QoL.

Aim 2: To evaluate the psychometric validity of the CASP-19 measure of QoL in the Irish population aged 50+.

Objectives:

a. To evaluate the psychometric validity of two established measurement models for the CASP-19 in a general-population sample of Irish adults aged 50+.

b. If the established models are not valid, to identify an alternative factor structure and item composition which exhibits good psychometric properties, and is consistent with the conceptual model for the scale.

Aim 3: To identify and empirically test a cross-sectional model of the pathway between chronic conditions and QoL, using a general-population sample of older people in Ireland.

Objectives:

a. To identify a hypothetical structural model of the pathway between chronic conditions and QoL based on existing empirical and theoretical literature.

b. To identify mediators of the relationship between chronic conditions and QoL, by empirically testing a structural model of the overall pathway.
Aim 4: To identify factors which modify longitudinal effects along the pathway between chronic conditions and QoL.

Objectives:

a. To evaluate longitudinal effects, over a two-year period, along each stage of the pathway between chronic conditions and QoL.

b. To examine the extent to which characteristics of the person (e.g., personality) and their environment (e.g., social support) modify effects at each stage of the pathway.

1.4 Contribution to Health Services Research

This thesis contributes to health services research in a number of ways. By evaluating the psychometric validity of the CASP-19 measure of QoL and examining its associations with chronic disease, it contributes to knowledge on measurement of QoL. A detailed, empirically validated model of the relationship between chronic conditions and QoL also has the potential to inform development of services and policies aimed at the treatment of chronic conditions and improvement of QoL. The use of observational data to model relationships between exposures and outcomes, and the mechanisms by which interventions are likely to affect outcomes, is a key initial stage in the development of complex interventions in healthcare (54,55).

The contribution of the findings of this thesis to health services research and policy on ageing and health more generally, will be systematically evaluated using the Research Impact Framework (56). This framework was developed to provide researchers with a systematic way of identifying and describing the impact of their research. It identifies potential contributions of research under four headings: 1) research impact, 2) policy impact, 3) service impact and 4) societal impact.
1.5 Thesis Outline

This thesis is presented in ten chapters. The thesis will begin with a systematic review of current evidence for the effect of chronic conditions on QoL. This review will include studies with general-population samples of older people and examine evidence for a direct effect of chronic conditions on QoL, and for mediators and moderators of the effect (Chapter 2). Chapter 3 will review the broader theoretical and empirical literature in relation to QoL measurement. Chapter 4 will include a review of current theory and evidence regarding 1) causal pathways between chronic conditions and QoL, and 2) protective factors that moderate the effect of chronic conditions on QoL. Chapter 4 will conclude with a hypothesis statement for the thesis, proposing an explanatory model of the relationship between chronic conditions and QoL, which the thesis will seek to empirically test.

Chapter 5 will describe in detail the methods used in this thesis. This includes the data source (TILDA), the measures used, and three phases of statistical analysis. The results of these phases of analysis will then be reported in three results chapters. Chapter 6 will report the findings of a psychometric evaluation of the CASP-19 in TILDA, using a factor analytic approach. Chapter 7 will report findings of a cross-sectional analysis of the pathway between chronic conditions and QoL, using structural equation modelling. Chapter 8 will report findings of an analysis of longitudinal effects along the pathway between chronic conditions and QoL, and of factors which moderate these effects. Each results chapter will conclude with a short summary and a discussion of how the findings inform the next phase of analysis.

The thesis will conclude with a discussion of the thesis findings (Chapter 9), including how they relate to the existing literature and their relevance for research and policy. Methodological strengths and limitations will also be discussed in Chapter 9. The concluding chapter (Chapter 10) will reflect on the implications of the thesis findings for broader debates in research and policy in relation to health, QoL and ageing.
Chapter 2   Systematic Review: Chronic Disease and QoL in Older Populations

2.1 Introduction

This chapter describes a systematic review of the current evidence for the effect of chronic conditions on QoL in general-population samples of middle-aged and older people. Existing evidence for mediators and moderators of the effect will also be identified and presented in the review. The aim of the chapter is to build a picture of the current evidence on the thesis topic, primarily to identify gaps in the literature but also to inform a hypothetical model of the relationship between chronic conditions and QoL.

To date, a large number of studies have evaluated the relationship between chronic conditions and various measures of QoL. Previous reviews in this area have focussed on specific patient populations (e.g., breast cancer (57), hypertension (58) and glaucoma (59)). Patient-specific studies, however, do not provide evidence of the extent to which chronic conditions are associated with reduced QoL relative to the general population.

Three reviews were identified that examined evidence for effects of chronic conditions on QoL in the general population. A review by Fortin et al. focussed on the effects of multiple chronic conditions (multi-morbidity) on QoL in primary care and general adult populations (60). The authors concluded that multi-morbidity is clearly associated with physical health-related QoL (HRQoL) dimensions. However, the association for social and psychological domains was less well supported than for physical domains. The second review identified six studies examining the association between multi-morbidity and QoL, in the context of a broader review of multi-morbidity (9). Again, support was found for the effects of chronic disease on physical domains of QoL, with less consistent evidence for the psychosocial domains.

The third review compared the effect of a range of conditions on the Short-Form 36-item (SF-36) measure of HRQoL, synthesising several datasets that comprised a mixture of general-population and patient samples (61). Among individuals who had chronic conditions, those who reported musculoskeletal, neurological and sensory conditions...
tended to have the lowest physical HRQoL scores. Individuals with respiratory conditions and cancer reported the highest physical HRQoL scores, with cardiovascular (heart conditions and hypertension) and endocrinological conditions associated with HRQoL scores in the middle. For the mental component of HRQoL, people with neurological conditions and visual impairments tended to report the lowest HRQoL scores, with cardiovascular and musculoskeletal conditions associated with the highest scores. In datasets that included general-population samples, HRQoL was significantly lower among those with chronic conditions compared to those without.

More recently, the Global Burden of Disease Study series has attempted to quantify the mortality and disability burden arising from specific conditions worldwide (62). Data on the prevalence of 1,160 sequelae of 289 specific conditions were collected (63). The impact or burden of these sequelae was valued using disability weights, based on preferences for different health statuses, captured in a separate general-population survey (64). These general-population preferences assigned the greatest health impact to severe multiple sclerosis and acute schizophrenia, while mild sensory disabilities and mild anaemia were assigned the lowest health impact. These disability weights were then assigned to global disease-specific prevalence estimates, to identify the most burdensome conditions (65). Ischaemic heart disease was identified as the most burdensome condition, followed by lower respiratory infections and stroke.

The disability-weighting component of the Global Burden of Disease Study captured preferences attached to different health states by members of the overall population – i.e., how worse or better each health state is judged to be, relative to death and perfect health. This systematic review, in contrast, examines observational studies which evaluate empirical differences in how people with specific conditions rate their own QoL. This approach accounts for the fact that the perceived impact of an illness on QoL may be very different for people who actually have an illness, versus those who do not.

One of the most significant issues when synthesising evidence for the relationship between chronic conditions and QoL is the complexity of the concept itself, with multiple definitions and meanings attached to it (34,66,67). This makes it difficult to be precise about what it means to say that chronic disease has an effect on QoL. HRQoL measures (HRQoL), such as
the SF-36 (68) and EQ-5D (69), focus primarily on subjective appraisals of mental and physical health status. Measures of overall or generic QoL, such as the WHOQOL (70), may include multiple dimensions, covering physical, psychological and social life domains. Alternatively, a measure of overall QoL may simply capture a single-item evaluation of overall life quality. When identifying evidence for the relationship between chronic conditions and QoL, it is critical to be clear and precise about the measures and domains of QoL to which the evidence relates.

This review will differ from previous reviews of the effect of chronic conditions on QoL in a number of ways. Only studies based on older general-population samples will be included, so that evidence specific to older people will be identified. Effects of chronic disease on QoL in the *population* will therefore be evaluated, rather than in clinical samples, which may include individuals with more severe forms of conditions, and typically do not include a general-population comparison group. Chronic disease will be defined broadly, to include both studies of overall chronic disease status (e.g., number of conditions, or multimorbidity), and specific conditions. Evidence will also be identified for factors which play an important role in explaining the relationship (mediators) as well as factors which modify the effect (moderators), in order to build a more in-depth picture of current evidence concerning the relationship.

2.2 Methods

2.2.1 Inclusion Criteria

All studies reporting on population-representative cohorts that explored the association between chronic conditions and QoL, or mediators/moderators of that relationship, were included.

2.2.1.1 Population

Studies of general population-representative samples of middle-aged and older adults were included. A population-representative sample was defined as a sample based on a population sampling frame and random sampling. The population was generally defined on the basis of a specific geographical area but could be limited to a specific gender or ethnic
group (e.g., Mexican-Americans). Studies which recruited through a clinical or institutional setting, or through volunteer-recruitment, were excluded.

Middle-aged and older populations were defined as aged 35+. Studies with participants aged younger than 35 were therefore excluded, unless age-stratified results were reported for adults aged 35+ or older. The age range included in the review was therefore broader than the age range for the population of interest in the thesis as a whole (age 50+). This slightly more inclusive age-range ensured that the review would be as comprehensive as possible, while also retaining a focus on middle-aged and older adult samples.

Studies which compared a general-population sample with a representative registry-based disease-specific sample, such as a national stroke registry, were included as this approach is also likely to be free of selection bias. While samples recruited from institutional settings such as nursing homes were not included, it was possible for older adults living in nursing homes to be included in a study if these settings were not explicitly excluded from a population-based sampling frame.

2.2.1.2 Comparison: Chronic Disease

Studies which evaluated the cross-sectional or longitudinal association between one or more physical chronic conditions and QoL were included. The conditions selected for inclusion (displayed in Table 2-1) were those typically ascertained in cohort studies such as ELSA and HRS (49,71). These conditions are common in the older population and create a significant public health impact. Rarer chronic conditions are important but do not occur with sufficient frequency in population representative cohorts for an assessment of their effect on QoL to be feasible.

Psychological disorders such as depression, anxiety and substance abuse were not included, as the effects of these conditions on subjective QoL appraisals are likely to be different from physical chronic conditions. Disorders that seriously impair cognitive function such as dementia and Alzheimer’s were excluded for the same reasons, and also due to the difficulties in measuring QoL with these patient groups (72).
Health problems that are often included in expanded definitions of multi-morbidity, such as pain, incontinence or sensory disability, were also not included in the definition of chronic disease. This ensured a clear separation between underlying chronic disease diagnoses and their consequences or effects on symptoms and physical function.

Table 2-1: Chronic conditions included in systematic review of effects of chronic disease on QoL

<table>
<thead>
<tr>
<th>Abnormal heart rhythm</th>
<th>Congestive heart failure</th>
<th>High cholesterol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angina</td>
<td>Cirrhosis</td>
<td>Mini-stroke or TIA</td>
</tr>
<tr>
<td>Arthritis</td>
<td>Diabetes</td>
<td>Osteoporosis</td>
</tr>
<tr>
<td>Asthma</td>
<td>Emphysema</td>
<td>Parkinson’s disease</td>
</tr>
<tr>
<td>Cancer</td>
<td>Hypertension</td>
<td>Stomach ulcer</td>
</tr>
<tr>
<td>Chronic bronchitis</td>
<td>Heart attack</td>
<td>Stroke</td>
</tr>
<tr>
<td>Chronic lung disease</td>
<td>Heart murmur</td>
<td>Varicose ulcer</td>
</tr>
</tbody>
</table>

2.2.1.3 Outcome: Quality of Life (QoL)

Multiple concepts and definitions of QoL appear in the literature (66,67). It is difficult to identify the precise boundaries of the concept and hence distinguish studies which examine QoL, and those which examine other outcomes. There will be a detailed discussion of the definition and measurement of QoL in Chapter 3. For the purposes of this review, studies were selected for inclusion if a primary or secondary outcome measure was 1) described by the authors as a measure of QoL, 2) clearly defined, and 3) involved subjective evaluation of one or more aspects of the individual’s life. This was consistent with the WHO definition of QoL:

“WHO defines Quality of Life as an individuals’ perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, personal beliefs and their relationship to salient features of their environment.”

WHOQOL Group, 1997 (27) (p.1).
Studies examining related concepts such as life satisfaction or subjective wellbeing were not included. Evidence for the effect of chronic conditions on these measures, however, will be briefly reviewed in Section 2.4.7.

2.2.1.4 Study Type

Observational cross-sectional or longitudinal cohort studies which used a population sampling frame and random sampling, resulting in broadly population-representative samples, were included. Case-control studies were included where cases were drawn from a disease-registry and were therefore representative of the population with the disease, and controls were drawn from a general population-representative sample. Studies published in English in peer-reviewed journals between January 2001 and December 2013 were included. The timeframe was confined to the last twelve years, primarily for feasibility reasons and to focus on the most up-to-date evidence.

2.2.2 Information Sources

A wide range of electronic databases were searched: Pubmed, PsychInfo, CINAHL, EMBASE and Web of Science. Index terms (e.g., MeSH) and free text title and abstract terms were used to maximise sensitivity of the search strategy. A sample search strategy (for Pubmed) is provided in Appendix 1. The term "chronic disease" and synonyms were included, as well as terms relating to specific chronic conditions. Studies of older populations were identified using index, abstract and title searches for terms such as "older", "middle aged" and synonyms. Studies indexed as "children" or "adolescent" were excluded. The phrase “quality of life” was searched as an index, title and abstract term. Population based studies were identified through the use of relevant index and free text terms, such as “population sample”, “random sample”, “incidence” or “prevalence”. The last search of electronic databases was conducted on 10th January, 2014.

Supplementary Searches

Following this initial search, a snowball approach was used to identify further relevant studies, by examining reference lists of included articles. In addition, a list of representative population surveys of older populations was compiled based on references in the included
studies, and a list of studies which have been harmonised with the Health and Retirement Survey (HRS), known as the "HRS family of surveys" (Available at: http://g2aging.org/ [Last accessed 10/01/2015]). The initial search was repeated, substituting the names of known population-ageing studies for terms used to identify population studies in the initial search. This was intended to maximise detection of studies based on population samples.

2.2.3 Study Selection

Titles and abstracts were initially screened by the thesis author (ES) to exclude studies that were 1) not based on original research (e.g., commentary/narrative piece), 2) did not include general-population participants (e.g., patient sample); and 3) studies focussed on children and young people. The remaining abstracts were re-screened for the remaining criteria. A random selection (20%) of the first approximately 2,000 of these abstracts (related to 2001-2011) was double-screened by thesis supervisors AH and GS (10% each), as the remaining criteria were more complex to apply. Any differences were identified and resolved through discussion. This validation process led to revision of one aspect of the selection procedure. Studies had been excluded at the abstract stage if they examined general adult samples (aged 18+), because they did not focus on the population of interest (aged 35+). It was decided to re-examine the full text of these articles to check for any age-stratified analysis.

2.2.4 Data Collection

Once identified, information was extracted from each article using a standard form containing the data items displayed in Table 2-2. Information on each QoL measure and domain examined was collected. QoL measures were categorised as HRQoL measures or overall QoL measures. HRQoL measures capture appraisals of physical and mental health status and function. Measures of overall or generic QoL may involve generic appraisals of overall QoL, or capture evaluations of several life domains, for example, physical health, social relationships and the environment (66,67).

Within HRQoL measures, it was noted where preference-weights had been applied to construct a measure of utility. In a utility score, an individual's score is weighted based on
general-population valuations of the levels of health indicated by that particular combination of responses. The EQ-5D (69) and HUI (73,74) are generally used in this way.

The main potential source of bias in individual studies was adjustment for confounders. The following categories of confounder were examined: socio-demographic factors, lifestyle factors and depressive symptoms. Age is a major determinant of chronic disease risk and has a significant relationship with QoL (36,75,76). Sex is also associated with poorer health (77–79), although there is conflicting evidence regarding associations with QoL (36,76,80). Lower socio-economic position (SEP) is associated with a higher prevalence of chronic conditions among older adults (81,82) and with lower QoL (83–87).

Lifestyle factors may also confound the relationship between chronic conditions and QoL. Effects of lifestyle factors such as obesity, diet, smoking and physical activity on chronic disease risk are well known, and there is also evidence that these factors are associated with QoL (88–91). A recent review also highlighted the role of depressive symptoms in exacerbating the negative effect of physical chronic conditions on QoL (92).

It was also important to assess whether effects of specific conditions were adjusted for the effects of comorbid conditions (comorbidity). For example, effects of hypertension on QoL may be confounded by effects of frequent comorbid conditions, such as heart disease. Similarly, any adjustment for other clinical factors, such as physiological and functional indicators, was recorded. These variables can be considered sequelae of chronic conditions and potential mediators of the effect of the condition, rather than confounders of the effect on QoL. It was nevertheless important to examine whether these factors were adjusted for, to assess the extent to which they explained effects of chronic conditions on QoL.

For each included study, any factors which were explicitly tested as mediators were recorded, along with the size and statistical significance of the relationship, and any adjustment for confounding. To identify moderating factors, any testing of interaction effects was recorded, along with the size and statistical significance of the relationship, and any adjustment for confounding.
Handling of non-response was also examined across studies. Non-response to epidemiological studies tends to be linked to lower SEP and poorer mental and physical health. These excluded individuals may also be less resilient and experience a more negative impact on QoL as a result of chronic conditions (93), leading to a possible underestimate of the effect of chronic conditions on QoL.

### Table 2-2: Data items included in standard form

<table>
<thead>
<tr>
<th>Population</th>
<th>Description of the study population, including age, geographical location, and any reported inclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition and measure of chronic disease</td>
<td>Conditions included and how measured – for example, based on self-report, medical records or objective data; and as a category or count.</td>
</tr>
<tr>
<td>Definition and measure of QoL</td>
<td>Name of the measure, domains included, and measurement level (e.g., as continuous, categorical or binary variable). Each domain categorised as physical, psychosocial or overall. Use of preference or utility-weighting</td>
</tr>
<tr>
<td>Measure of effect size</td>
<td>Mean difference, regression coefficient or odds ratio, with standard errors, standard deviations or confidence intervals</td>
</tr>
<tr>
<td>Test of significance</td>
<td>P-value or test of significance for each association tested.</td>
</tr>
<tr>
<td>Adjustment for confounders</td>
<td>Socio-demographics (age; sex; SEP: education, income, assets, social class; marital status; race/ethnicity)</td>
</tr>
<tr>
<td></td>
<td>Comorbidity (if specific diseases examined separately)</td>
</tr>
<tr>
<td></td>
<td>Lifestyle factors (smoking, diet, obesity, physical activity, alcohol)</td>
</tr>
<tr>
<td></td>
<td>Psychological distress (e.g., depressive symptoms, anxiety)</td>
</tr>
<tr>
<td></td>
<td>Clinical factors: 1) symptoms, such as pain or breathing difficulties, 2) physical function, such as mobility or grip strength, 3) physiological indicators, such as blood pressure or 4) cognitive function.</td>
</tr>
<tr>
<td>Sampling strategy</td>
<td>The sampling strategy, including sampling frame, method of data collection and the use of any stratification.</td>
</tr>
<tr>
<td>Handling missing items and survey non-response</td>
<td>Methods used to handle missing data (e.g., case deletion, imputation methods) were recorded, as were any weights used to adjust for survey non-response.</td>
</tr>
<tr>
<td>Mediating Factors</td>
<td>Definition of mediating factors, effect size, and statistical significance</td>
</tr>
<tr>
<td>Moderating Factors</td>
<td>Any interaction terms tested: definitions of variables, effect size and statistical significance</td>
</tr>
</tbody>
</table>
2.2.5 Synthesis of Results

Results were primarily summarised in table format, displaying study characteristics and a summary of findings for each condition examined, including any differential results across domains of QoL. Results were reported separately for each QoL measure, with each measure categorised as HRQoL or overall QoL. The results of a small number of longitudinal studies (n=10) were reported separately. Findings concerning mediators and moderators were also reported separately.

Each measure was based on different descriptions or definitions of QoL domains and findings were described using the specific language of each measure. However, a general distinction was also made in the review between measures of physical and psychosocial domains of QoL. The term psychosocial was used to refer to psychological, social or mental domains of QoL and was useful for comparing across measures which involved different definitions of QoL domains.

It was not possible to meta-analyse estimates of effects across all studies, due to considerable heterogeneity in definitions of QoL. In addition, many of the results were reported as adjusted regression coefficients, which are difficult to standardise in a meaningful way (94). However, a large number of studies (n=25) reported mean differences for the SF-36 or SF-12, and it was possible to pool un-standardised mean differences across these studies, as results were reported using the same measure and scale.

The SF-36 comprises eight domains, four of which are considered physical QoL domains, and four of which are considered mental. Results can be reported as a physical component score (PCS) and mental component score (MCS); or as eight separate domain scores. Mean differences in the PCS and MCS were pooled in two separate random-effects meta-analyses. Where a study reported separate scores for the eight physical and mental domains, the scores for physical function (PF) and mental health (MH) domains were used in the meta-analysis, as these tend to be the most highly correlated with PCS and MCS respectively (http://www.sf-36.org/tools/sf36.shtml). Each specific condition was examined separately in sub-group analyses. A separate meta-analysis was also carried out for the sub-
set of studies which had adjusted for at least one key confounder. Confidence intervals for mean differences were calculated from reported standard deviations, standard errors, or confidence intervals of means, using methods described by Armitage & Berry (95) and the Cochrane Collaboration (96). Heterogeneity across studies was evaluated using the $I^2$ statistic, which quantifies the extent to which variation in effect size is due to factors other than sampling error (96). The metan procedure available in Stata 11.0 was used to carry out the meta-analysis.

One potential source of publication bias was identified. Some studies reported only final regression models with non-significant variables excluded, omitting information on analyses which failed to generate significant associations. Authors were contacted for this missing information, which was obtained for two (97,98) out of six studies (97–102). Data were also obtained from two authors where estimates of mean differences or odds ratios had been displayed only graphically in the published paper (103,104).

2.3 Results

2.3.1 Overview

The electronic search yielded a large number of articles (over 21,000). The majority of these were not original articles, or did not include a population-representative sample ($n = 14,306$, see Figure 2-1). A further 2,325 abstracts were then excluded, primarily as they did not examine the association between chronic disease and QoL. A total of 260 full-text articles were examined, leading to the inclusion of 77 articles. Nine additional articles were obtained from examination of reference lists and the data source-based search.

Just over 200 studies ($n = 205$) had been excluded at the abstract screening stage on the basis that the sample included adults aged <35, and therefore did not meet the population inclusion criteria for the review. Following discussions as part of the validation process, the full text of these articles were re-examined to check for age-stratified analyses. This re-examination resulted in the inclusion of 12 further articles. The final number of included studies was 98.
Total References = 21,350

Duplicates = 4,451

Excluded: 14,306
- Not population sample = 9,913
- Not original study = 3,525
- Not older population = 864

Original, empirical studies of general population samples n = 2,593

Excluded: 2,325
- Not older population = 205
- Chronic disease not examined = 701
- QoL not examined = 667
- Not general sample = 400
- Not study = 47
- Disease-specific measure = 20
- Not included chronic disease = 267
- Duplicate study = 2
- Wrong year = 4
- Conference paper = 12

Double screening of random 20% of abstracts

Fulltext not available = 8

Full text retrieved and screened n = 250

Re-check of 205 full text articles* n = 12

Data source search: n = 4

Snowball search: n = 5

Excluded: 183
- Not older population = 51
- Chronic disease not examined = 47
- Quality of life not examined = 26
- Not general sample = 42
- Conference presentation = 4
- Not included chronic disease = 7
- Same study = 5
- Language = 1

*Initially excluded as not focussed on older pop, re-checked for age-stratified analyses

Included articles n = 98

Figure 2-1: Flow chart for study selection process
Table 2-3 displays the study characteristics. Most studies (n=85, 87%) used HRQoL measures. Over half of the studies reviewed (n=51) used the SF-36 of a version thereof. The Euro-QoL five dimension measure (EQ-5D) (69), Health Utilities Index (HUI) (73,74) and Centre for Disease Control (CDC) Healthy Days (105) measures were also frequently used. Five studies used the generic WHOQOL measure (70), and five studies used the generic CASP-19 measure (43). The six most commonly used measures are described in Table 2-4.

Thirty-two studies (33%) included participants aged less than 50 years old, with only three of these including participants aged <40. Thirty-four studies (approximately one third) looked at chronic disease overall, either as a continuous, binary or categorical variable, while the remainder looked at one or more specific conditions separately. The most common conditions examined were arthritis, heart disease, diabetes, hypertension and respiratory conditions.

Just over a third of studies (36%) adjusted for non-response or missing data. The majority of studies adjusted for at least one socio-demographic characteristic (68%), such as age, sex or SEP. Just over a quarter adjusted for BMI (28%), and a similar proportion for other lifestyle factors including smoking, alcohol consumption, diet or physical activity (26%). Sixteen out of 98 studies adjusted for depression or some other measure of psychological distress (e.g., stress, anxiety). Twenty-seven studies (28%) examined the independent effects of specific chronic conditions by adjusting for comorbidity. Twenty-six studies (25.5%) adjusted for other clinical factors, such as function or disability, or symptoms such as incontinence or pain.
Table 2-3: Study characteristics: measures of QoL and chronic diseases, and study quality

<table>
<thead>
<tr>
<th>Measure</th>
<th>No. of Studies</th>
<th>N = 98</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36 / SF-12 / SF-6D</td>
<td>51</td>
<td>52.0</td>
</tr>
<tr>
<td>EQ-5D</td>
<td>15</td>
<td>15.3</td>
</tr>
<tr>
<td>CDC Healthy Days</td>
<td>7</td>
<td>7.1</td>
</tr>
<tr>
<td>HUI</td>
<td>6</td>
<td>6.1</td>
</tr>
<tr>
<td>Other HRQoL&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9</td>
<td>9.2</td>
</tr>
<tr>
<td>WHOQOL</td>
<td>5</td>
<td>5.1</td>
</tr>
<tr>
<td>CASP-19</td>
<td>5</td>
<td>5.1</td>
</tr>
<tr>
<td>Other Overall QoL&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6</td>
<td>6.1</td>
</tr>
</tbody>
</table>

Chronic Disease Measure<sup>c</sup>

<table>
<thead>
<tr>
<th>Measure</th>
<th>No. of Studies</th>
<th>N = 98</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Conditions (Continuous or Categorical)</td>
<td>19</td>
<td>19.4</td>
</tr>
<tr>
<td>One or More Conditions (Yes/No)</td>
<td>13</td>
<td>13.3</td>
</tr>
<tr>
<td>Two or More Conditions (Multi-morbidity)</td>
<td>2</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Specific Conditions:
- Arthritis                           | 33     | 33.7   |
- Heart Disease<sup>d</sup>             | 32     | 32.7   |
- Diabetes                             | 30     | 30.6   |
- Hypertension                         | 24     | 24.5   |
- Respiratory Conditions<sup>e</sup>    | 24     | 24.5   |
- Stroke or TIA                        | 21     | 21.4   |
- Cancer                               | 15     | 15.3   |
- Asthma                                | 11     | 11.2   |
- Other<sup>f</sup>                     | 16     | 16.3   |
Table 2-3 (contd.): Study Characteristics: Measures of QoL, Measures of Chronic Disease and Study Quality

<table>
<thead>
<tr>
<th>Study Quality</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustment for non-response / missing data</td>
<td>35</td>
<td>35.7</td>
</tr>
<tr>
<td>Adjusted For(^a):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio-demographics</td>
<td>67</td>
<td>68.4</td>
</tr>
<tr>
<td>BMI</td>
<td>27</td>
<td>27.6</td>
</tr>
<tr>
<td>Other Lifestyle Factors(^b)</td>
<td>25</td>
<td>25.5</td>
</tr>
<tr>
<td>Comorbidity</td>
<td>27</td>
<td>27.6</td>
</tr>
<tr>
<td>Other Clinical Factors(^i)</td>
<td>25</td>
<td>25.5</td>
</tr>
<tr>
<td>Psychological distress</td>
<td>16</td>
<td>16.3</td>
</tr>
</tbody>
</table>

\(^a\) Includes, for example, Duke Health Profile, EORTC-QLQ-C30, AQoL  
\(^b\) Includes, for example, Cantril’s Ladder, Gothenburg Quality of Life Instrument  
\(^c\) Chronic condition categories are mutually exclusive; however, studies could include more than one condition  
\(^d\) Includes heart failure, heart attack (MI), coronary heart disease, cardiac/heart disease, ischaemic heart disease, peripheral artery disease, angina and atrial fibrillation  
\(^e\) Includes lung disease, bronchitis, emphysema, COPD  
\(^f\) Includes renal disease, ulcers, osteoporosis, liver disease, high cholesterol  
\(^{i}\) Categories of confounders are mutually exclusive; however, studies could adjust for more than one confounder  
\(^{i}\) Includes smoking, obesity, diet, physical activity, alcohol consumption  
\(^{i}\) Includes, for example, symptoms, grip strength, fractures, disability, incontinence, sensory problems, frailty, functional capacity
<table>
<thead>
<tr>
<th>Name, Type</th>
<th>Domains</th>
<th>Sample Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36 / SF-12 / SF-6D (68)</td>
<td>Physical component: physical function (PF), bodily pain (BP), physical role function (RP) and general health (GH). Varying response options.</td>
<td>During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?</td>
</tr>
<tr>
<td>HRQoL</td>
<td>Mental component: mental health (MH), role emotional (RE), vitality (V) and social function (SF). Varying response options.</td>
<td>Have you felt so down in the dumps that nothing could cheer you up?</td>
</tr>
<tr>
<td>SF-6D version can be used as a measure of utility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EQ-5D (69)</td>
<td>Five single-item domains: mobility, self-care, pain, anxiety/depression and usual activities. Three response options: no difficulties, moderate difficulties, severe difficulties.</td>
<td>I have no problems in walking about</td>
</tr>
<tr>
<td>HRQoL</td>
<td>Visual Analogue Scale (VAS): single item rating scale from 0 (poor health) to 100 (good health)</td>
<td>We would like to know how good or bad your health is today</td>
</tr>
<tr>
<td>HUI (73,74)</td>
<td>Eight domains: hearing, vision, speech, cognition, mobility, dexterity, pain, and emotional wellbeing (happiness), captured by 39 items. Varying response options.</td>
<td>Which one of the following best describes your ability, during the past week, to walk?</td>
</tr>
<tr>
<td>HRQoL</td>
<td>Four single item domains: 1) overall rating of self-rated health; number of days in the last 30 that problems were experienced with 2) physical health, 3) activity limitations, 4) mental health.</td>
<td>For how many days during the past 30 days was your physical health not good?</td>
</tr>
<tr>
<td>CDC Healthy Days (105)</td>
<td>Six domains: Physical, Psychological, Social, Environmental, Independence and Spiritual, captured by 100 items. Brief version excludes Independence and Spiritual, and comprises 26 items. Varying response options.</td>
<td>How satisfied are you with your personal relationships?</td>
</tr>
<tr>
<td>HRQoL</td>
<td>Four domains: Control, Autonomy, Self-Realisation and Pleasure, captured by 19 items. Response options: Often, Sometimes, Rarely, Never</td>
<td>I choose to do things I have never done before</td>
</tr>
<tr>
<td>WHOQOL (70)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall QoL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CASP-19 (43)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall QoL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Bodily pain is also associated with the mental component*
2.3.2 SF-36/SF-12

The SF-36 comprises eight domains, with four categorised as physical components and four as mental components (see Table 2-4 for a detailed description). Forty-five studies were identified that assessed the cross-sectional association between chronic disease and the SF-36 or SF-12 measure of QoL. Table 2-5 displays the characteristics of each study, and whether significant effects were reported for physical or mental domains.

Twenty-six out of 45 studies reported summary scores for the physical component domains (PCS) and the mental component domains (MCS). For these studies, Table 2-5 displays whether significant effects were found for PCS or MCS. Sixteen studies reported scores for each of the eight domains (four physical, four mental). A small number reported scores for selected domains only (n = 4) (106–109). For each of these studies, Table 2-5 indicates whether significant effects were detected for all, some or none of the physical and mental domains. The studies are ordered by adjustment for confounding, with unadjusted findings reported at the top of the table, and studies with the most comprehensive adjustment for confounders at the bottom of the table. Three studies reported both unadjusted and adjusted estimates depending on the condition examined, and each of these appear twice in the table (110–112).

Sixteen out of 45 studies reported only unadjusted estimates. More than half (n = 28) adjusted for socio-demographics, with 21 also adjusting for lifestyle factors, comorbidity or clinical factors. Four studies adjusted for socio-demographics, lifestyle, comorbidity/clinical factors and depression. More than half of the studies (n = 26) reported mixed findings, with effects on at least some domains failing to reach significance. Taking into account each separate domain score, each condition, and each sub-group examined, 578 estimates of the association between chronic disease and QoL were reported. Of these, over two-thirds (67.5%) were statistically significant.

Studies examining overall chronic disease status (presence or number of conditions, n=11) tended to report significant effects on all domains examined, with only one study reporting mixed findings. Six of these studies included adjustment for socio-demographic factors, five of which also adjusted for lifestyle variables or other clinical factors. However, results were
less consistent for specific conditions, particularly for mental domains. In 12 studies, a significant negative effect on physical domains was reported for a specific condition, while no significant effect on mental domains was detected for the same condition (98,110,112–121). Overall, just over half of the comparisons for mental domains were statistically significant compared with three-quarters of comparisons for physical domains.

Twelve studies adjusted for socio-demographics, lifestyle factors and either comorbidity, other clinical factors or depression (100,104,106,109,110,115–118,120,122,123). Significant negative effects on physical domains were consistently identified for arthritis (n=4) and heart disease (n=3) with mixed results for stroke (n=5), diabetes (n=4), hypertension (n=4) and respiratory conditions (n=2). Mixed effects on mental domains were observed for all conditions. Four studies adjusted for depressive symptoms, with mixed results reported across studies.

Table 2-5: Study characteristics and results for SF-36/SF-12 studies

<table>
<thead>
<tr>
<th>Name, Year, Setting</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unadjusted for Confounders</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abbasimoghadam 2009 (124) Iran N = 5,600 Aged 60+</td>
<td>&gt;=1 condition</td>
<td>Total Score significant, domains not examined</td>
</tr>
<tr>
<td>Adams* 2006 (107), Australia N = 1,839 Aged 55+</td>
<td>Asthma &gt;=1 condition</td>
<td>PCS; MCS not examined</td>
</tr>
<tr>
<td>Arif 2005* (125), Texas, USA N = 3,021 Aged 65+</td>
<td>Asthma</td>
<td>PCS and MCS</td>
</tr>
<tr>
<td>Cernin 2010 (126), Detroit, USA N = 985 Aged 60+</td>
<td>No. of conditions</td>
<td>PCS and MCS</td>
</tr>
<tr>
<td>Chow 2003 (127), Australia N = nr Aged 50+</td>
<td>Renal Disease</td>
<td>PCS and MCS</td>
</tr>
<tr>
<td>Ng 2009 (128), Singapore N = 2,084 Aged 55+</td>
<td>COPD</td>
<td>PCS and MCS</td>
</tr>
<tr>
<td>Uhlig* 2007 (113), Norway N = 463 Aged 50-80</td>
<td>Rheumatoid Arthritis</td>
<td>PCS and MCS</td>
</tr>
<tr>
<td>Name, Year, Setting N, Age, Subgroup</td>
<td>Condition</td>
<td>Statistically Significant Findings by QoL Domain</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-----------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td><strong>Unadjusted for Confounders</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chin 2008 (110), Korea N = 944 Aged 65+</td>
<td>Diabetes</td>
<td>Not PCS, not MCS</td>
</tr>
<tr>
<td></td>
<td>Coronary Heart Disease</td>
<td>Not PCS, not MCS</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
<td>Not PCS, not MCS</td>
</tr>
<tr>
<td>Xie 2006 (129), USA N = 15,090 Aged 50+</td>
<td>Stroke</td>
<td>PCS and MCS</td>
</tr>
<tr>
<td>Xie 2008 (130), USA N = 14,219 Aged 50+</td>
<td>Coronary Heart Disease</td>
<td>PCS and MCS</td>
</tr>
<tr>
<td></td>
<td>MI</td>
<td>PCS and MCS</td>
</tr>
<tr>
<td>Stein 2002 (131), California, USA N = 1,359 Aged 50+</td>
<td>No. of conditions</td>
<td>PCS and MCS</td>
</tr>
<tr>
<td>Aghamolaei 2010 (132) Iran N = 1,000 Aged 60+</td>
<td>Arthritis</td>
<td>All Physical, some Mental</td>
</tr>
<tr>
<td></td>
<td>Diabetes</td>
<td>All Physical, all Mental</td>
</tr>
<tr>
<td></td>
<td>Heart Disease</td>
<td>Some Physical, no Mental</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
<td>Some Phys, some Mental</td>
</tr>
<tr>
<td>Arslantas 2008 (133), Turkey N = 1,193 Aged 50+</td>
<td>Hypertension</td>
<td>All Physical, all Mental</td>
</tr>
<tr>
<td>Canbaz 2003 (134), Turkey N = 300 Aged 65+</td>
<td>&gt;=1 condition</td>
<td>All Physical, all Mental</td>
</tr>
<tr>
<td>Lima 2009 (111) Sao Paulo, Brazil N = 1,958 Aged 60+</td>
<td>Arthritis</td>
<td>Some Physical, some Mental</td>
</tr>
<tr>
<td></td>
<td>Diabetes</td>
<td>Some Physical, all Mental</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
<td>All Physical, all Mental</td>
</tr>
<tr>
<td></td>
<td>Osteoporosis</td>
<td>All Physical, some Mental</td>
</tr>
<tr>
<td>Bardage 2001 (135) Sweden N = 2,700 Aged 45+</td>
<td>Hypertension 45-64 yrs</td>
<td>All Physical, all Mental</td>
</tr>
<tr>
<td></td>
<td>Hypertension 65-74 yrs</td>
<td>Some Physical, some Mental</td>
</tr>
<tr>
<td></td>
<td>Hypertension 75-84 yrs</td>
<td>Some Physical, no Mental</td>
</tr>
<tr>
<td>Falsarella 2012 (136) Brazil N = 2,209 Aged 60+</td>
<td>Rheumatoid Arthritis</td>
<td>Some Physical, no Mental</td>
</tr>
<tr>
<td>Larsson 2007 (137) Sweden N = 1,722 Aged 50-64</td>
<td>Asthma (Men)</td>
<td>Some Physical, some Mental</td>
</tr>
<tr>
<td></td>
<td>Asthma (Women)</td>
<td>All Physical, all Mental</td>
</tr>
<tr>
<td>Lopez Varela 2010 (112) Latin America N = 5,314 Aged 40+</td>
<td>COPD</td>
<td>PCS, not MCS</td>
</tr>
<tr>
<td>Name, Year, Setting</td>
<td>Confounders</td>
<td>Condition</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------</td>
<td>-----------</td>
</tr>
<tr>
<td><strong>Adjusted for socio-demographics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buckley 2013 (103), Australia</td>
<td>Age, sex</td>
<td>Arthritis</td>
</tr>
<tr>
<td>N = 1,400</td>
<td></td>
<td>Lung Disease</td>
</tr>
<tr>
<td>Aged 41-60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heidelberg 2011⁺ (138)</td>
<td>Age, SEP, marital status</td>
<td>Diabetes</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 983, Women aged 35-74</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Trentham-Dietz² 2008 (114)</strong></td>
<td>Age</td>
<td>Breast Cancer</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 2,656</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women aged 43-86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arnold 2004⁺ (108)</td>
<td>Age, sex, SEP, marital status</td>
<td>Lung Disorder</td>
</tr>
<tr>
<td>Groningen, Germany</td>
<td></td>
<td>Arthritis</td>
</tr>
<tr>
<td>N = 6,582</td>
<td></td>
<td>Diabetes</td>
</tr>
<tr>
<td>Aged 57+</td>
<td></td>
<td>Heart Disease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hypertension</td>
</tr>
<tr>
<td>Hobbs 2002⁺ (139), England</td>
<td>Age, sex, SEP</td>
<td>Angina</td>
</tr>
<tr>
<td>N = 5,961</td>
<td></td>
<td>Arthritis</td>
</tr>
<tr>
<td>Aged 45+</td>
<td></td>
<td>Heart Failure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hypertension</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bronchitis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Atrial Fibrillation</td>
</tr>
<tr>
<td>Peuckmann 2007 (140)</td>
<td>Age, SEP</td>
<td>Breast Cancer</td>
</tr>
<tr>
<td>Denmark</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 4420</td>
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<td></td>
</tr>
<tr>
<td>Women aged 40+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lima 2009⁺ (111)</td>
<td>Age, sex</td>
<td>Arthritis</td>
</tr>
<tr>
<td>Sao Paulo, Brazil</td>
<td></td>
<td>Diabetes</td>
</tr>
<tr>
<td>N = 1,957</td>
<td></td>
<td>Hypertension</td>
</tr>
<tr>
<td>Aged 60+</td>
<td></td>
<td>Osteoporosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stroke</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 condition</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3+ conditions</td>
</tr>
<tr>
<td><strong>Adjusted for socio-demographics &amp; lifestyle</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>de Belvis 2008 (141)</td>
<td>Age, sex, SEP, lifestyle</td>
<td>One condition</td>
</tr>
<tr>
<td>Italy, Aged 60+</td>
<td></td>
<td>2+ conditions</td>
</tr>
<tr>
<td>N = 33,744</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name, Year, Setting</td>
<td>Confounders</td>
<td>Condition</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------</td>
<td>-----------</td>
</tr>
<tr>
<td><strong>Adjusted for socio-demographics &amp; lifestyle</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banegas 2007\textsuperscript{a} (142)</td>
<td>Age, SEP, living alone, other lifestyle</td>
<td>Diabetes (M)</td>
</tr>
<tr>
<td>Spain - La Paz</td>
<td></td>
<td>Hypertension (M)</td>
</tr>
<tr>
<td>Men (M) Aged 60+</td>
<td></td>
<td>Hypertension and Diabetes (M)</td>
</tr>
<tr>
<td>n = 1,568</td>
<td></td>
<td>Diabetes (W)</td>
</tr>
<tr>
<td>Women (W) Aged 60+</td>
<td></td>
<td>Hypertension (W)</td>
</tr>
<tr>
<td>n = 1,999</td>
<td></td>
<td>Hypertension and Diabetes (W)</td>
</tr>
<tr>
<td><strong>Adjusted for socio-demographics + comorbidity / other clinical factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zhou 2011\textsuperscript{a} (143)</td>
<td>Age, sex, SEP, living alone, other lifestyle</td>
<td>No. of Conditions</td>
</tr>
<tr>
<td>China</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n = 4,230</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aged 60+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kim 2010\textsuperscript{a} (144)</td>
<td>Age, sex, BMI</td>
<td>Knee Rheumatoid Arthritis</td>
</tr>
<tr>
<td>Korea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n = 504</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aged 50+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>**Helgesson 2007\textsuperscript{a} (145)</td>
<td>Age, SEP, comorbidity</td>
<td>Cancer</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n = 836</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women aged 62-84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>**Garster 2009\textsuperscript{a} (146)</td>
<td>Age, sex, race, comorbidity</td>
<td>Coronary Heart Disease</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n = 3,844</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aged 35-89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>**Lopez Varela 2010\textsuperscript{a} (112)</td>
<td>Age, sex, SEP, ethnicity; other clinical</td>
<td>No. of conditions</td>
</tr>
<tr>
<td>Latin America</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 5,314</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aged 40+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>**van Schoor 2005 (119)</td>
<td>Age, sex, comorbidity</td>
<td>Osteoarthritis</td>
</tr>
<tr>
<td>Netherlands</td>
<td></td>
<td>Cancer</td>
</tr>
<tr>
<td>n = 336</td>
<td></td>
<td>Diabetes</td>
</tr>
<tr>
<td>Aged 65+</td>
<td></td>
<td>Cardiac Disease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>COPD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stroke</td>
</tr>
<tr>
<td>Name, Year, Setting</td>
<td>Confounders</td>
<td>Condition</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------</td>
<td>-----------</td>
</tr>
<tr>
<td><strong>Adjusted for socio-demographics + comorbidity / other clinical factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wolinsky 2004 (121) USA</td>
<td>Age, SEP, marital status, comorbidity, other clinical factors</td>
<td>Cancer</td>
</tr>
<tr>
<td>n = 998</td>
<td></td>
<td>Heart Disease</td>
</tr>
<tr>
<td>Aged 50-65</td>
<td></td>
<td>COPD</td>
</tr>
<tr>
<td><strong>Adjusted for socio-demographics + lifestyle + comorbidity / other clinical factors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dumville 2004 (115) Scotland</td>
<td>Age, sex, SEP, BMI, other lifestyle, other clinical factors</td>
<td>Angina</td>
</tr>
<tr>
<td>n = 925</td>
<td></td>
<td>Knee Osteoarthritis</td>
</tr>
<tr>
<td>Aged 77-86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muraki 2010&lt;sup&gt;a&lt;/sup&gt; (116) Japan, n = 2,126</td>
<td>Age, BMI, other clinical</td>
<td>Knee Osteoarthritis</td>
</tr>
<tr>
<td>Aged 40+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Felix 2011 (106) Spain, n = 824</td>
<td>Age, BMI, other clinical</td>
<td>1 condition PCS (MCS not tested)</td>
</tr>
<tr>
<td>Women aged 50+</td>
<td></td>
<td>2 conditions PCS (MCS not tested)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 +conditions PCS (MCS not tested)</td>
</tr>
<tr>
<td>Bindawas 2011&lt;sup&gt;b&lt;/sup&gt; (117) USA Mexican Americans</td>
<td>Age, sex, SEP, marital status, other lifestyle, BMI, comorbidity</td>
<td>Arthritis</td>
</tr>
<tr>
<td>n = 839</td>
<td></td>
<td>Diabetes</td>
</tr>
<tr>
<td>Aged 75+</td>
<td></td>
<td>Hypertension</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heart Attack</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Osteoporosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stroke</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horng (2013) (120) Taiwan</td>
<td>Age, SEP, marital status, comorbidity, BMI, other clinical factors</td>
<td>Hypertension</td>
</tr>
<tr>
<td>n = 4,696</td>
<td></td>
<td>Cardiovascular</td>
</tr>
<tr>
<td>Women aged 35-64</td>
<td></td>
<td>Diabetes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High Cholesterol</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stroke</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Asthma</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kidney Disease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Respiratory</td>
</tr>
<tr>
<td>Dennison 2006 (109) Hertfordshire, England</td>
<td>Age, SEP, comorbidity, BMI, other lifestyle</td>
<td>Diabetes (M)</td>
</tr>
<tr>
<td>N = 1,412</td>
<td></td>
<td>IHD (M)</td>
</tr>
<tr>
<td>Aged 59-72</td>
<td></td>
<td>Hypertension (M)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Osteoporosis (M)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stroke (M)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bronchitis (M)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diabetes (W)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IHD (W)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hypertension (W)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bronchitis (W)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stroke(W)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Osteoporosis (W)</td>
</tr>
</tbody>
</table>
### Adjusted for socio-demographics + lifestyle + comorbidity/other clinical factors

<table>
<thead>
<tr>
<th>Name, Year, Setting</th>
<th>Confounders</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Howard 2007** (118) USA</td>
<td>Age, sex, SEP, ethnicity, lifestyle, comorbidity, other clinical</td>
<td>Stroke</td>
<td>PCS and MCS</td>
</tr>
<tr>
<td>n = 21,959</td>
<td></td>
<td>TIA</td>
<td>PCS, not MCS</td>
</tr>
<tr>
<td>Aged 45+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Garcia 2005 (122) Spain</td>
<td>Age, sex, SEP, comorbidity, BMI, other lifestyle, other clinical</td>
<td>Osteoarthritis</td>
<td>All Physical, all Mental</td>
</tr>
<tr>
<td>N = 3,600</td>
<td></td>
<td>&gt;=1 condition</td>
<td>All Physical, all Mental</td>
</tr>
<tr>
<td>Aged 60+</td>
<td></td>
<td>Atrial Fibrillation</td>
<td>Some Physical, some Mental</td>
</tr>
</tbody>
</table>

### Adjusted for socio-demographics + lifestyle + comorbidity / clinical factors + depression

<table>
<thead>
<tr>
<th>Name, Year, Setting</th>
<th>Confounders</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lera 2013 (123) Chile, n = 2,143 Aged 60-92</td>
<td>Age, sex, SEP, BMI, other clinical, depression</td>
<td>&gt;=2 condition</td>
<td>PCS and MCS</td>
</tr>
<tr>
<td>Mikuls 2003 (100) Iowa, USA</td>
<td>Age, sex, SEP, lifestyle, comorbidity, other clinical, depression</td>
<td>Arthritis</td>
<td>PCS and MCS</td>
</tr>
<tr>
<td>n = 634</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women aged 70-84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chin 2008 (110) Korea</td>
<td>Age, sex, SEP, lifestyle, comorbidity, other clinical, depression</td>
<td>Renal Function</td>
<td>Not PCS, MCS</td>
</tr>
<tr>
<td>n = 944</td>
<td></td>
<td>Stroke</td>
<td>PCS and MCS</td>
</tr>
<tr>
<td>Aged 65+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corona 2006 (104) Europe, n = 3,369 Men aged 40-79</td>
<td>Age, SEP, lifestyle, comorbidity, other clinical, depression</td>
<td>Hypertension</td>
<td>PCS, not MCS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diabetes</td>
<td>Not PCS, not MCS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cardiovascular</td>
<td>PCS, not MCS</td>
</tr>
</tbody>
</table>

### Adjusted for comorbidity / clinical factors + depression

<table>
<thead>
<tr>
<th>Name, Year, Setting</th>
<th>Confounders</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tooth 2008** (98) Australia</td>
<td>Comorbidity, depression, other clinical factors</td>
<td>Chest pain</td>
<td>All Physical, all Mental</td>
</tr>
<tr>
<td>n = 10,434</td>
<td></td>
<td>Arthritis</td>
<td>All Physical, all Mental</td>
</tr>
<tr>
<td>Women aged 73-78</td>
<td></td>
<td>Cancer (ex. skin)</td>
<td>Some Physical, all Mental</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skin cancer</td>
<td>Some Physical, some Mental</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Asthma</td>
<td>All Physical, no Mental</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diabetes</td>
<td>All Physical, all Mental</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heart Disease</td>
<td>All Physical, some Mental</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hypertension</td>
<td>All Physical, no Mental</td>
</tr>
</tbody>
</table>

* Included in meta-analysis (see Figure 2-2 and Figure 2-3). BMI = Body Mass Index; nr = not reported. COPD = chronic obstructive pulmonary disease; TIA = transient ischaemic attack; MI = myocardial infarction; IHD = Ischaemic Heart Disease; SEP = socioeconomic position; M = Men; W = Women.

See Table 2-2 for definitions of confounders.

Note: In this table, where it says "All/some/no physical" and "All/some/no mental", the study reported findings for the some or all of the eight SF-36 domains, rather than the PCS and MCS.
Some studies which reported non-significant effects, however, had smaller samples relative to other studies. For example, Kim et al. (n=504) (144) failed to detect a significant negative effect of arthritis on mental HRQoL, while Tooth et al. (n=10,434) (98) did. To overcome small samples, meta-analysis was used to pool effects across studies, increasing sample size and power to detect effects. Twenty-five studies reported sufficient data to pool results for physical domains, and 21 to pool results for mental domains. Where results for the eight domains were reported, the physical function (PF) and mental health (MH) domains were used, as these are the domains most highly correlated with PCS and MCS respectively (see (http://www.sf-36.org/tools/sf36.shtml). Mean differences in PCS were pooled with mean differences in PF, and mean differences in MCS were pooled with mean differences in MH.

Pooled mean differences were statistically significant for all conditions (see Figure 2-2 and Figure 2-3). Effects on PCS and PF (physical) domains were consistently higher across conditions, relative to effects on MCS and MH (mental) scores. The I² statistics, which quantify the extent to which variation in effect size is due to factors other than sampling error (96), were high, indicating significant heterogeneity within most condition subgroups, particularly in effects on PCS and PF. This suggested that a high proportion of variation in HRQoL scores was due to factors other than chronic disease diagnoses.

Angina and arthritis were associated with the largest decrement in mental and physical domains, followed by respiratory conditions and stroke for the mental domain, and heart disease, respiratory conditions and stroke for the physical domain. Presence of any condition was associated with the greatest mean difference in physical HRQoL, although the confidence intervals for this estimate were wide, likely due to one of the studies having a small sample size (n = 300) (134). Diabetes, cancer, hypertension and osteoporosis tended to have the weakest effects on both QoL domains.

Pooled effects were smaller when only studies which adjusted for at least one confounder (socio-demographics, lifestyle or depression) were included (see Figure 2-4 and Figure 2-5). All effects remained significant, apart from the effect of respiratory conditions on mental HRQoL. Detailed forest plots, including the mean difference and confidence interval reported in each study, for each of the four meta-analyses are displayed in Appendix 2 (Figures A2.1 – A2.4).
### Figure 2-2: Random effects meta-analysis of effects on PCS/PF by condition

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Mean Difference</th>
<th>I²</th>
<th>Mean Difference</th>
<th>I²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Conditions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n = 2</td>
<td>-3.7</td>
<td>-0.5</td>
<td>98.6%**</td>
<td></td>
</tr>
<tr>
<td>Diabetes n = 8</td>
<td>-4.5</td>
<td>-2.1</td>
<td>95.5%**</td>
<td></td>
</tr>
<tr>
<td>Cancer n = 3</td>
<td>-5.2</td>
<td>-0.3</td>
<td>91.7%**</td>
<td></td>
</tr>
<tr>
<td>Hypertension n = 9</td>
<td>-6.3</td>
<td>-4.1</td>
<td>86.4%**</td>
<td></td>
</tr>
<tr>
<td>Osteoporosis n = 3</td>
<td>-6.5</td>
<td>-3.8</td>
<td>66.2%</td>
<td></td>
</tr>
<tr>
<td>Stroke n = 5</td>
<td>-7.7</td>
<td>-5.5</td>
<td>91.0%**</td>
<td></td>
</tr>
<tr>
<td>Respiratory n = 7</td>
<td>-8.3</td>
<td>-5.4</td>
<td>96.2%**</td>
<td></td>
</tr>
<tr>
<td>Heart Disease n = 7</td>
<td>-10.2</td>
<td>-6.3</td>
<td>97.7%**</td>
<td></td>
</tr>
<tr>
<td>Arthritis n = 9</td>
<td>-10.8</td>
<td>-6.5</td>
<td>97.4%**</td>
<td></td>
</tr>
<tr>
<td>Angina n = 2</td>
<td>-13.2</td>
<td>-10.3</td>
<td>86.4%**</td>
<td></td>
</tr>
<tr>
<td>Any Condition n = 2</td>
<td>-15.8</td>
<td>-0.1</td>
<td>91.0%**</td>
<td></td>
</tr>
<tr>
<td>Overall n = 25</td>
<td>-8.1</td>
<td>-7.0</td>
<td>98.1%**</td>
<td></td>
</tr>
</tbody>
</table>

**p<0.001, IV = inverse variance**

### Figure 2-3: Random effects meta-analysis of effects on MCS/MH by Condition

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Mean Difference</th>
<th>I²</th>
<th>Mean Difference</th>
<th>I²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes n = 8</td>
<td>-1.8</td>
<td>-0.7</td>
<td>78.8%**</td>
<td></td>
</tr>
<tr>
<td>Cancer n = 3</td>
<td>-1.9</td>
<td>-0.2</td>
<td>45.0%</td>
<td></td>
</tr>
<tr>
<td>Hypertension n = 9</td>
<td>-2.5</td>
<td>-1.3</td>
<td>60.2%**</td>
<td></td>
</tr>
<tr>
<td>Osteoporosis n = 3</td>
<td>-2.5</td>
<td>-0.5</td>
<td>61.8%</td>
<td></td>
</tr>
<tr>
<td>Heart Disease n = 7</td>
<td>-2.5</td>
<td>-1.6</td>
<td>79.2%**</td>
<td></td>
</tr>
<tr>
<td>Stroke n = 5</td>
<td>-3.4</td>
<td>-2.1</td>
<td>78.0%**</td>
<td></td>
</tr>
<tr>
<td>Respiratory n = 6</td>
<td>-3.4</td>
<td>-1.5</td>
<td>91.2%**</td>
<td></td>
</tr>
<tr>
<td>Arthritis n = 7</td>
<td>-4.0</td>
<td>-2.5</td>
<td>85.0%**</td>
<td></td>
</tr>
<tr>
<td>Angina n = 2</td>
<td>-5.2</td>
<td>-4.2</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>Overall n = 21</td>
<td>-2.9</td>
<td>-2.4</td>
<td>87.9%**</td>
<td></td>
</tr>
</tbody>
</table>

**p<0.001, IV = inverse variance**
Figure 2-4: Random effects meta-analysis of adjusted effects on PCS/PF by condition

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Mean Difference IV, random (95% CI)</th>
<th>I²</th>
<th>Mean Difference IV, random (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension n = 5</td>
<td>-1.3, -2.3, -0.4</td>
<td>28.2%</td>
<td></td>
</tr>
<tr>
<td>Stroke n = 3</td>
<td>-1.9, -3.0, -0.8</td>
<td>39.9%</td>
<td></td>
</tr>
<tr>
<td>Osteoporosis n = 2</td>
<td>-1.9, -3.0, -0.8</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>Cancer n = 3</td>
<td>-1.9, -3.6, -0.2</td>
<td>45.0%</td>
<td></td>
</tr>
<tr>
<td>Diabetes n = 6</td>
<td>-1.9, -3.2, -0.7</td>
<td>82.5%**</td>
<td></td>
</tr>
<tr>
<td>Heart Disease n = 5</td>
<td>-2.7, -4.2, -1.3</td>
<td>79.3%**</td>
<td></td>
</tr>
<tr>
<td>Arthritis n = 4</td>
<td>-2.9, -4.6, -1.3</td>
<td>81.7%**</td>
<td></td>
</tr>
<tr>
<td>Respiratory n = 3</td>
<td>-3.6, -7.6, 0.3</td>
<td>92.5%**</td>
<td></td>
</tr>
<tr>
<td>Angina n = 2</td>
<td>-5.2, -6.3, -4.2</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>Overall n = 11</td>
<td>-2.5, -3.1, -1.9</td>
<td>87.4%**</td>
<td></td>
</tr>
</tbody>
</table>

**p<0.001, IV = inverse variance

Figure 2-5: Random effects meta-analysis of adjusted effects on MCS/MH by condition

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Mean Difference IV, random (95% CI)</th>
<th>I²</th>
<th>Mean Difference IV, random (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension n = 5</td>
<td>-3.4, -5.3, -1.4</td>
<td>72.2%**</td>
<td></td>
</tr>
<tr>
<td>Number n = 2</td>
<td>-3.7, -6.8, -0.5</td>
<td>98.6%**</td>
<td></td>
</tr>
<tr>
<td>Diabetes n = 6</td>
<td>-4.5, -7.2, -1.9</td>
<td>96.5%**</td>
<td></td>
</tr>
<tr>
<td>Cancer n = 3</td>
<td>-5.2, -10.1, -0.3</td>
<td>91.7%**</td>
<td></td>
</tr>
<tr>
<td>Osteoporosis n = 2</td>
<td>-5.5, -7.0, -4.0</td>
<td>18.2%</td>
<td></td>
</tr>
<tr>
<td>Stroke n = 3</td>
<td>-7.3, -12.2, -2.4</td>
<td>96.4%**</td>
<td></td>
</tr>
<tr>
<td>Arthritis n = 6</td>
<td>-8.6, -12.9, -4.3</td>
<td>95.5%**</td>
<td></td>
</tr>
<tr>
<td>Heart Disease n = 5</td>
<td>-11.3, -17.9, -4.7</td>
<td>98.4%**</td>
<td></td>
</tr>
<tr>
<td>Respiratory n = 3</td>
<td>-12.4, -18.6, -6.2</td>
<td>94.0%**</td>
<td></td>
</tr>
<tr>
<td>Angina n = 2</td>
<td>-13.2, -16.1, -10.3</td>
<td>86.4%**</td>
<td></td>
</tr>
<tr>
<td>Overall n = 15</td>
<td>-7.5, -8.7, -6.2</td>
<td>98.4%**</td>
<td></td>
</tr>
</tbody>
</table>

**p<0.001, IV = inverse variance
2.3.2.1  SF-6D

Three studies examined the SF-6D (displayed in Table 2-6), which is a preference-weighted version of the short form measure. Having two or more conditions, arthritis or coronary heart disease were all associated with reduced scores on the weighted index, independent of socio-demographic factors and comorbidity.

Table 2-6: Study characteristics and results for SF-6D studies

<table>
<thead>
<tr>
<th>Name, Year Setting</th>
<th>N</th>
<th>Pop.</th>
<th>Confounders</th>
<th>Condition</th>
<th>Significant by domain findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lawson 2013 (93)</td>
<td></td>
<td></td>
<td>Age, sex</td>
<td>2+ conditions</td>
<td>Overall index</td>
</tr>
<tr>
<td>Scotland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 1,026</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aged 45+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Khanna 2011 (147)</td>
<td></td>
<td></td>
<td>Sex, race,</td>
<td>Arthritis</td>
<td>Overall index</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
<td>comorbidity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 3,844</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aged 35-89</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Garster 2009 (146)</td>
<td></td>
<td></td>
<td>Age, sex,</td>
<td>Coronary heart disease</td>
<td>Overall index</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
<td>race,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 3,844</td>
<td></td>
<td></td>
<td>comorbidity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aged 35-89</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See Table 2-2 for definitions of confounders.
2.3.3 EQ-5D

The EQ-5D comprises five domains: mobility, self-care, pain, anxiety/depression and usual activities, as well as a Visual Analogue Scale (VAS), where respondents are asked to rate their health from 0 (poor health) to 100 (good health). Fourteen cross-sectional studies were identified that used this measure. Study characteristics and findings are displayed in Table 2-7. A range of conditions were examined, with six studies examining more than one type of condition. The most common condition examined was heart disease (seven studies), followed by respiratory conditions (six studies). Eleven studies adjusted for socio-demographics and either lifestyle factors or comorbidity.

Of the four studies that examined domains separately, two reported significant effects on all domains for the conditions studied (COPD and >=1 condition) (148,149). The other two reported mixed effects across domains (150,151). Effects on overall index scores and VAS were almost all statistically significant. However, the results were mixed among studies which adjusted for comorbidity – that is, examined the independent effects of several conditions on overall index score. Saarni reported that only musculoskeletal conditions had a consistently significant effect across all age groups (152). Kim et al. reported that out of 12 conditions, only stroke and arthritis had an independent negative effect on overall EQ-5D index score (153). Lim et al. found that out of four conditions, only diabetes had a significant negative effect (154). Calvert et al., however, had a larger sample than the other studies and reported significant independent effects for 10 separate conditions, with non-significant effects reported only for myocardial infarction (MI) (99).
<table>
<thead>
<tr>
<th>Name, Year Setting</th>
<th>N</th>
<th>Pop.</th>
<th>Confounders</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unadjusted for confounders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miravitlles 2009 (155) Spain</td>
<td>1,196</td>
<td>40-80</td>
<td>None</td>
<td>COPD</td>
<td>Overall index, VAS</td>
</tr>
<tr>
<td>Sun 2011 (149) China</td>
<td>62,743</td>
<td>45+</td>
<td>None</td>
<td>&gt;=1 condition</td>
<td>VAS; all domains</td>
</tr>
<tr>
<td>Xie 2006 (129), USA</td>
<td>15,090</td>
<td>50+</td>
<td>None</td>
<td>Stroke</td>
<td>Overall index, VAS</td>
</tr>
<tr>
<td><strong>Adjusted for socio-demographics + lifestyle</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schweikert 2009 (150) Germany</td>
<td>1,902</td>
<td>54-93</td>
<td>Sex, SEP, BMI, other lifestyle</td>
<td>Acute MI</td>
<td>VAS, UA, P, AD; not M, SC</td>
</tr>
<tr>
<td>Arne 2009 (148) Sweden</td>
<td>10,755</td>
<td>40+</td>
<td>Sex, age, SEP, BMI, other lifestyle</td>
<td>COPD</td>
<td>All domains</td>
</tr>
<tr>
<td>Muraki 2010 (116) Japan</td>
<td>2,126</td>
<td>40+</td>
<td>Age, BMI, other lifestyle</td>
<td>Knee Osteoarthritis</td>
<td>Overall index</td>
</tr>
<tr>
<td><strong>Adjusted for socio-demographics + comorbidity / other clinical factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Khanna 2011 (147) USA</td>
<td>3,844</td>
<td>35-89</td>
<td>Sex, race, SEP, comorbidity</td>
<td>Arthritis</td>
<td>Overall index</td>
</tr>
<tr>
<td>Garster 2009 (146) USA</td>
<td>3,844</td>
<td>35-89</td>
<td>Age, sex, race, comorbidity</td>
<td>Coronary Heart Disease</td>
<td>Overall index</td>
</tr>
<tr>
<td>Hwang 2013 (156) Korea</td>
<td>nr²</td>
<td>60+</td>
<td>Age, sex, SEP, marital status, comorbidity</td>
<td>Heart Disease</td>
<td>Overall index, VAS</td>
</tr>
<tr>
<td>Hwang 2013 (156) Korea</td>
<td>300</td>
<td>65+</td>
<td>Age, sex, SEP, marital status, comorbidity</td>
<td>Heart Disease</td>
<td>Overall index, VAS</td>
</tr>
<tr>
<td>Lim 2013 (154) Korea</td>
<td>6,681*</td>
<td>45+</td>
<td>Sex, SEP, comorbidity, other clinical</td>
<td>Respiratory</td>
<td>Overall index (some age groups)</td>
</tr>
<tr>
<td>Saarni 2007 (152) Finland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name, Year Setting</td>
<td>N</td>
<td>Pop.</td>
<td>Confounders</td>
<td>Condition</td>
<td>Statistically Significant Findings by QoL domain</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----</td>
<td>------</td>
<td>------------------------------------------------------------------------------</td>
<td>--------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Hunger 2011 (151)</td>
<td>4,565</td>
<td>65+</td>
<td>Age, sex, SEP, BMI, comorbidity</td>
<td>Diabetes</td>
<td>M, SC, UA; not P, AD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Coronary Event</td>
<td>All domains</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stroke</td>
<td>All domains</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cancer</td>
<td>M, UA, AD, not P, SC</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bronchitis</td>
<td>All domains</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hypertension</td>
<td>M, P, AD, not SC, UA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diabetes x Heart Disease</td>
<td>SC, UA, P, AD, not M</td>
</tr>
<tr>
<td>Kim 2012 (153)</td>
<td>1,419</td>
<td>65+</td>
<td>Age, sex, SEP, marital status, BMI, comorbidity, other clinical</td>
<td>Stroke</td>
<td>Overall index</td>
</tr>
<tr>
<td>Korea</td>
<td></td>
<td></td>
<td></td>
<td>Arthritis</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Osteoporosis</td>
<td>Not overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>IHD</td>
<td>Not overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Peptic Ulcer</td>
<td>Not overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diabetes</td>
<td>Not overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hypertension</td>
<td>Not overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Respiratory</td>
<td>Not overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High Cholesterol</td>
<td>Not overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CKD</td>
<td>Not overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cancer</td>
<td>Not overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Liver Disease</td>
<td>Not overall index</td>
</tr>
<tr>
<td>Calvert 2013 (99),</td>
<td>5,343</td>
<td>40+</td>
<td>Age, sex, other lifestyle, comorbidity, depression</td>
<td>Angina</td>
<td>Overall index</td>
</tr>
<tr>
<td>South Asian and Afro-Caribbean adults in UK</td>
<td></td>
<td></td>
<td></td>
<td>Arrhythmia</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Arthritis</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Asthma</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cancer</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>COPD</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diabetes</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Heart Failure</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hypertension</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PAD</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MI</td>
<td>Not overall index</td>
</tr>
</tbody>
</table>

VAS = Visual Analogue Score, COPD = chronic obstructive pulmonary disease; MI = myocardial infarction; PAD = Peripheral Arterial Disease; BMI = Body Mass Index; IHD = Ischaemic Heart Disease; CKD = Chronic Kidney Disease; SEP = socioeconomic position; M = Mobility; SC = Self-Care; UA = Usual Activities; P = Pain; AD = Anxiety/Depression.

a analysis was stratified by age, n not reported for the sub-sample aged >=60

b analysis stratified by four age groups, therefore sample for each comparison was substantially smaller than 6000

See Table 2-2 for definitions of confounders.
2.3.4 Health Utilities Index

Five studies used the Health Utility Index (HUI) measure of QoL (described in Table 2-4). This measure comprises eight domains: hearing, vision, speech, cognition, mobility, dexterity, pain, and emotional wellbeing (happiness). All five studies involved North American populations. Three studies examined total index scores and one examined an overall disability cut-off (157). The remaining study reported an overall index score for having >=1 condition, and odds ratios for disability in each of the domains for specific conditions (158). Heart disease (n=4) and respiratory conditions (n=3) were the most frequently examined conditions. All studies adjusted for socio-demographics. Two studies adjusted for lifestyle variables, and two for comorbidity. Four out of five studies found statistically significant effects across all conditions examined. The only study of cancer reported a non-significant association (159), as did one of the two studies that examined hypertension (159,160).

Table 2-8: Study characteristics and results for HUI studies

<table>
<thead>
<tr>
<th>Name, Year Setting</th>
<th>N</th>
<th>Pop.</th>
<th>Confounders</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjusted for socio-demographics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sawka 2005 (160) Canada</td>
<td>3,750</td>
<td>65+ Age, sex</td>
<td>Respiratory</td>
<td>Overall index</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Heart Disease</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hypertension</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Arthritis</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Osteoporosis</td>
<td>Overall index</td>
</tr>
<tr>
<td>Socio-demographics + lifestyle / comorbidity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sawatsky 2007 (158) Canada</td>
<td>24,281</td>
<td>65+ Age, sex, BMI, other lifestyle</td>
<td>&gt;=1 condition</td>
<td>Overall index, all domains</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Musculoskeletal</td>
<td>All domains</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Respiratory</td>
<td>All domains</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Heart Disease</td>
<td>All domains</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diabetes</td>
<td>All domains</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stroke</td>
<td>All domains</td>
</tr>
<tr>
<td>Huguet 2008 (157) Canada &amp; USA</td>
<td>1,906</td>
<td>65+ Age, sex, SEP, married, ethnicity, other lifestyle</td>
<td>&gt;=1 condition</td>
<td>Disability cut-off</td>
<td></td>
</tr>
<tr>
<td>Garster 2009 (146) USA</td>
<td>3,844</td>
<td>35-89 Age, sex, race, comorbidity</td>
<td>Coronary heart Disease</td>
<td>Overall index</td>
<td></td>
</tr>
</tbody>
</table>

65
<table>
<thead>
<tr>
<th>Name, Year Setting</th>
<th>N</th>
<th>Pop.</th>
<th>Confounders</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schultz 2003 (159) Canada</td>
<td>32,382</td>
<td>45+</td>
<td>Sex, comorbidity</td>
<td>Stroke</td>
<td>Overall index (aged 45-64)³</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cancer</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Asthma</td>
<td>Overall index (sig for aged 65+, not for aged 45-64)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stomach Ulcer</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Heart Disease</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diabetes</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Respiratory</td>
<td>Overall index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hypertension</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Arthritis</td>
<td>Overall index</td>
</tr>
</tbody>
</table>

Pop. = Population; SEP = socioeconomic position; BMI = Body Mass Index
³Stroke not reported for age 65+ due to small numbers.
See Table 2-2 for definitions of confounders.

2.3.5 CDC Healthy Days

Seven studies, all using United States national or state-level data, examined the CDC Healthy Days measure (105). This measure includes one or more of the following domains: self-rating of overall health (SRH), number of days in the last 30 where poor physical (PH) or mental health (MH) was experienced (separately or together) and number of days of activity limitation (AL) (see Table 2-4). These studies are displayed in Table 2-9. Only four of the seven studies using this measure adjusted for any confounding variables.

Arthritis, peripheral arterial disease (PAD), asthma and hypertension had significant effects on self-rated health and physical health, with mixed effects for diabetes across two studies. Of the six studies which examined poor mental health days, three reported no statistically significant effects of chronic conditions, and one reported significant effects for only some age groups.
Table 2-9: Study characteristics and results for CDC Healthy Days studies

<table>
<thead>
<tr>
<th>Name, Year Setting</th>
<th>N</th>
<th>Pop.</th>
<th>Confounders</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unadjusted for confounders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mili 2003 (161)</td>
<td>nr²</td>
<td>45+</td>
<td>None</td>
<td>Arthritis</td>
<td>SRH</td>
</tr>
<tr>
<td>15 States, USA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ford 2003 (162)</td>
<td>163,773</td>
<td>45+</td>
<td>None</td>
<td>Asthma</td>
<td>PH, AL, MH for ages 45-74, not for age 75+</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furner 2011 (163)</td>
<td>1,051,708</td>
<td>45+</td>
<td>None</td>
<td>Arthritis</td>
<td>PH, AL, MH</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adjusted for socio-demographics + lifestyle + comorbidity / other clinical factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown 2004 (164)</td>
<td>37,054</td>
<td>50+</td>
<td>Age, sex, SEP, ethnicity, BMI, other lifestyle, comorbidity, other clinical factors</td>
<td>Diabetes</td>
<td>SRH, PH AL, <strong>not</strong> MH</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goins 2006 (165)</td>
<td>582</td>
<td>50+</td>
<td>Age, sex, SEP, marital status, BMI, comorbidity</td>
<td>Diabetes</td>
<td>None</td>
</tr>
<tr>
<td>USA American Indians</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Widener 2008 (166)</td>
<td>4,559</td>
<td>48+</td>
<td>Age, SEP, other lifestyle, comorbidity, other clinical factors</td>
<td>PAD</td>
<td>PH, <strong>not</strong> AL, MH</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baernholdt 2012 (167)</td>
<td>911</td>
<td>65+</td>
<td>Age, sex, SEP, marital status, ethnicity, other lifestyle, other clinical factors, depression</td>
<td>No. of Conditions</td>
<td>MH, PH</td>
</tr>
</tbody>
</table>

SEP = Socioeconomic Position; BMI = Body Mass Index; PAD = Peripheral Arterial Disease; SRH = Self-Rated Health; PH = Physical Health, AL = Activity Limitation, MH = Mental Health

²analysis was stratified by age, n not reported for the sub-sample aged >=60

See Table 2-2 for definitions of confounders.
2.3.6 Other HRQoL Measures

Eleven studies used other measures of HRQoL (displayed in Table 2-10). These included the Assessment of QoL (AQoL) (168), the Duke Health Profile (DHP) (169), the European Organisation for Research and Treatment of Cancer Quality of Life scale (EORTC-QLQ-C30) (170), the Quality of Wellbeing-Self Administered Questionnaire (QWB-SA) (171), the Health and Activity Limitation Index (HALex) (172), and the Nottingham Health Profile (NHP) (173,174). While the EORTC-QLQ-C30 was originally developed as a cancer-specific measure, it has been used in several studies with general-population samples (175–177), including the two reviewed here (178,179).

There was considerable heterogeneity in findings across studies. Six studies examined an overall HRQoL score, with four reporting mixed findings across conditions and/or age groups. Two studies examined osteoarthritis, and found a significant effect on HRQoL only for specific sites and higher levels of severity (180,181). Orfila et al. reported negative effects on HRQoL for arthritis and diabetes, but not for chronic bronchitis, heart problems, hypertension and stroke (79). Tannenbaum et al. found that number of conditions affected overall HRQoL only among participants aged 70+ (182). It is important to note that both of these studies (79,182) included a measure of physical function as a mediating factor (see Section 2.3.12), which may explain the non-significant findings.

Findings were mixed across the studies examining different domains of HRQoL. One study reported that heart disease affected both physical and mental domains, while another only identified effects on the mental domains. Arthritis and diabetes were found to affect physical but not mental domains. Two studies reported that hypertension did not affect any HRQoL domains (178,183).
Table 2-10: Study characteristics and results for other HRQoL measure studies

<table>
<thead>
<tr>
<th>Name, Year Setting</th>
<th>N</th>
<th>Pop.</th>
<th>Confounders</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assessment of Quality of Life (AQoL)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laslett 2012 (181) Tasmania</td>
<td>1,098</td>
<td>50-80</td>
<td>Age, sex, BMI, comorbidity, other clinical factors</td>
<td>Back osteoarthritis</td>
<td>Overall QoL score</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Osteoarthritis at other sites</td>
<td>None</td>
</tr>
<tr>
<td>Ackerman 2013 (180) Australia</td>
<td>1,157</td>
<td>40+</td>
<td>Age, sex</td>
<td>Osteoarthritis symptomatic</td>
<td>Overall QoL score</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Osteoarthritis asymptomatic</td>
<td>None</td>
</tr>
<tr>
<td>Allen 2013 (183) Australia</td>
<td>4,364</td>
<td>55+</td>
<td>Age, sex, SEP, marital status, retired, depression</td>
<td>Stroke</td>
<td>Physical, Mental</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Heart Disease</td>
<td>Physical, Mental</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diabetes</td>
<td>Physical, not Mental</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High Cholesterol</td>
<td>Physical, not Mental</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hypertension</td>
<td>None</td>
</tr>
<tr>
<td><strong>Duke Health Profile (DHP)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Physical &amp; psychosocial, except social health among men (all ages) and women (55-64 yrs)</td>
</tr>
<tr>
<td>Baumann 2011 (184) France</td>
<td>8,228</td>
<td>45-75</td>
<td>None</td>
<td>&gt;=1 condition</td>
<td></td>
</tr>
<tr>
<td><strong>EORTC-QLQ-C30</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Djarv 2012 (178) Sweden</td>
<td>4,910</td>
<td>40-79</td>
<td>Age, sex, SEP, other lifestyle, comorbidity</td>
<td>Hypertension Atrial Fibrillation History of MI Angina</td>
<td>None role, not physical, emotional or global physical, not role, emotional or global physical, not role, emotional or global physical, not role, emotional or global physical, not role, emotional or global physical, not role, emotional or global</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 Cardiovascular Disease</td>
<td>physical, not role, emotional or global</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 Cardiovascular Diseases</td>
<td>physical, not role, emotional or global</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3+ Cardiovascular Diseases</td>
<td>physical, not role, emotional or global</td>
</tr>
<tr>
<td>Michelson 2001 (179) Sweden</td>
<td>2,068</td>
<td>40-79</td>
<td>None</td>
<td>No. of Conditions</td>
<td>physical, social and global, for all ages role only for ages 49-69 cognitive only for age 40-59, 79-79 emotional only for age 40-59, 79-79</td>
</tr>
<tr>
<td>Name, Year Setting</td>
<td>N</td>
<td>Pop.</td>
<td>Confounders</td>
<td>Condition</td>
<td>Statistically Significant Findings by QoL domain</td>
</tr>
<tr>
<td>--------------------</td>
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<td>------------------------------</td>
<td>-------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td><strong>QWB-SA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Garster 2009 (146) USA</td>
<td>3,844</td>
<td>35-89</td>
<td>Age, sex, race, comorbidity</td>
<td>Coronary Heart Disease</td>
<td>Overall QoL index</td>
</tr>
<tr>
<td>Khanna 2011 (147) USA</td>
<td>3,844</td>
<td>35-89</td>
<td>Sex, race, SEP, comorbidity</td>
<td>Arthritis</td>
<td>Overall QoL index</td>
</tr>
<tr>
<td><strong>HALex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Garster 2009 (146) USA</td>
<td>3,844</td>
<td>35-89</td>
<td>Age, sex, race, comorbidity</td>
<td>Coronary Heart Disease</td>
<td>Overall QoL index</td>
</tr>
<tr>
<td>Khanna 2011 (147) USA</td>
<td>3,844</td>
<td>35-89</td>
<td>Sex, race, SEP, comorbidity</td>
<td>Arthritis</td>
<td>Overall QoL index</td>
</tr>
<tr>
<td><strong>Nottingham Health Profile</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orfila 2006 (79) Barcelona, Spain</td>
<td>544</td>
<td>72+</td>
<td>Age, sex, SEP, living alone, other lifestyle, other clinical</td>
<td>Arthritis</td>
<td>Overall QoL index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Chronic bronchitis</td>
<td>Not Overall QoL index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diabetes</td>
<td>Overall QoL index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Heart problems</td>
<td>Not Overall QoL index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hypertension</td>
<td>Not Overall QoL index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stroke</td>
<td>Not Overall QoL index</td>
</tr>
<tr>
<td><strong>Latent measure: EQ-5D VAS; SF-36: GH, VT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tannenbaum 2007 (182) Women, Canada</td>
<td>2,311</td>
<td>50+</td>
<td>Other lifestyle, Other clinical, mental health</td>
<td>No. of conditions</td>
<td>Significant for latent factor among age &gt;70, not significant for age &gt;= 70</td>
</tr>
<tr>
<td>John 2003 (102) Native Americans, USA</td>
<td>1,039</td>
<td>60+</td>
<td>Age, sex, SEP, depression, comorbidity</td>
<td>No. of conditions</td>
<td>physical, mental, health troubles stand in the way</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Severity index</td>
<td>physical, mental, health troubles stand in the way</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cardio-pulmonary</td>
<td>physical, not mental, health troubles stand in the way</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Arthritis</td>
<td>physical, not mental, health troubles stand in the way</td>
</tr>
</tbody>
</table>

Pop. = Population; BMI = Body Mass Index; SEP = Socioeconomic Position; MI = myocardial infarction; GH = General Health; VT = Vitality; VAS = Visual Analogue Scale

*This measure was a one-off measure developed for the study. It had some similarities with the CDC Healthy Days measure, and comprised 3 sub-scales – physical health, mental health and health troubles stand in my way.

See Table 2-2 for definitions of confounders.
2.3.7 WHOQOL

Five studies used either the full version or the brief version of the WHOQOL measure (70), described in Table 2-4. The brief version includes physical, psychological, social and environmental QoL domains, and the full version also captures independence and spiritual domains. Study characteristics and results are displayed in Table 2-11. One study used the full version of the measure (185), with four reporting on the brief version. Four out of five studies adjusted for socio-demographic factors, with two studies also adjusting for depression or lifestyle factors.

Two studies examined the effect of having one or more conditions, two examined number of conditions and one examined heart disease. All studies reported significant effects on the physical domain of QoL. Most studies (n=3) found no significant association for psychological domains, with Baumann et al. (186) reporting a significant effect on psychological domains among women only. Two out of four studies examining social domains reported no significant effects of chronic conditions.
### Table 2-11: Study characteristics and results for WHOQOL studies

<table>
<thead>
<tr>
<th>Name, Year Setting</th>
<th>N</th>
<th>Pop.</th>
<th>Confounders</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unadjusted for confounders</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baumann 2010 (186) France</td>
<td>8,297</td>
<td>45-75</td>
<td>None</td>
<td>&gt;=1 condition</td>
<td>Physical, Social; <strong>not</strong> Psychological</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Men</td>
<td>Physical, Social</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Women</td>
<td>Psychological</td>
</tr>
<tr>
<td><strong>Adjusted for socio-demographics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reklaitiene 2009 (185) Lithuania</td>
<td>1,457</td>
<td>45-72</td>
<td>Age, sex, SEP, marital status</td>
<td>&gt;=1 condition</td>
<td>Physical, Psychological, Independence, Overall <strong>not</strong> Environmental, Spiritual</td>
</tr>
<tr>
<td><strong>Adjusted for socio-demographics + lifestyle/comorbidity/other clinical factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brett 2012 (101) Lothian, Scotland</td>
<td>1,641</td>
<td>70-79</td>
<td>SEP, living alone, depression, other clinical factors</td>
<td>Heart Disease</td>
<td>Physical, Overall, <strong>not</strong> Social, Psychological, Environmental</td>
</tr>
<tr>
<td>Gobbens 2012 (187) Netherlands</td>
<td>213</td>
<td>75+</td>
<td>Age, sex, SEP, other lifestyle, other clinical factors</td>
<td>No. of conditions</td>
<td>Physical, Environmental, <strong>not</strong> Social, Psychological</td>
</tr>
<tr>
<td>Mottus 2012 (97) Lothian, Scotland</td>
<td>1,091</td>
<td>70+</td>
<td>Sex, SEP, other clinical factors</td>
<td>No. of conditions</td>
<td>Physical, Social, Environmental, <strong>not</strong> Psychological</td>
</tr>
</tbody>
</table>

Pop. = Population; SEP = Socioeconomic Position
See Table 2-2 for definitions of confounders.
2.3.8 CASP-19

Four cross-sectional studies were identified that examined effects of chronic conditions on the CASP-19 measure of overall QoL, and are displayed in Table 2-12. CASP-19 captures four dimensions of QoL, equating to four higher human needs: control, autonomy, self-realisation and pleasure (see Table 2-4). Three studies adjusted for socio-demographic factors. One of these also adjusted for depression and other clinical factors.

Three studies examined an overall, summed CASP-19 score. All three reported significant effects for having one or more conditions, with one study reporting significant independent effects for eight separate conditions (188). One study examined the four dimensions of the CASP separately (189). In this study, having one condition had no effect on any dimension, while having two or three had a significant effect on all dimensions (189). Four or more conditions did not have a significant effect on the control dimension, although this may have been to do with a small number of participants with this number of conditions.
Table 2-12: Study characteristics and results for CASP-19 studies

<table>
<thead>
<tr>
<th>Name, Year Setting</th>
<th>N</th>
<th>Pop.</th>
<th>Confounders</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wu 2013 (189)</td>
<td>699</td>
<td>55+</td>
<td>None</td>
<td>1 condition</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2-3 conditions</td>
<td>Control, Autonomy, Self-realisation, Pleasure</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4 conditions</td>
<td>Autonomy, Self-realisation, Pleasure, not Control</td>
</tr>
<tr>
<td>Netuveli 2005 (190)</td>
<td>9298</td>
<td>50+</td>
<td>Age, sex</td>
<td>Longstanding illness</td>
<td>Overall QoL</td>
</tr>
<tr>
<td>Wikman 2011 (188)</td>
<td>11,523</td>
<td>50+</td>
<td>Age, sex, SEP</td>
<td>Cancer</td>
<td>Overall QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Osteoarthritis</td>
<td>Overall QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Asthma</td>
<td>Overall QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diabetes</td>
<td>Overall QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CHD</td>
<td>Overall QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rheumatoid Arthritis</td>
<td>Overall QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Chronic lung disease</td>
<td>Overall QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stroke</td>
<td>Overall QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No. of Conditions</td>
<td>Overall QoL</td>
</tr>
<tr>
<td>Zaninotto 2009 (191)</td>
<td>11,392</td>
<td>50+</td>
<td>Age, sex, SEP, marital status, depression, other clinical factors</td>
<td>Limiting longstanding illness</td>
<td>Overall QoL</td>
</tr>
</tbody>
</table>

SEP = Socioeconomic Position; Pop. = population; CHD = Coronary Heart Disease

The measure of chronic disease status referred to "longstanding" rather than "chronic" illness. It was assumed that longstanding illnesses could be considered chronic.

See Table 2-2 for definition of confounders.
2.3.9 Other Overall QoL Measures

Five studies were identified that used alternative general QoL measures. These included Cantril's Ladder (n=2), the Gothenburg Quality of Life Index (n=1), a single-item measure of QoL (n=1), and two measures developed specifically for the studies. The types of measures examined were diverse, and the results were heterogeneous. The studies are summarised in Table 2-13.

One study of the two studies that examined Cantril's ladder investigated the independent effect of several conditions, and reported significant effects only for lung disorders (108). The other study that examined Cantril's ladder also investigated effects of respiratory conditions, reporting significant effects of asthma across domains, with the exception of future QoL among women (192). Asthma also had a significant effect on all domains of the Gothenberg Quality of Life Index for men, but not women (192).

Paul et al used a five-item measure of overall QoL, designed specifically for their study (193). Participants with up to three conditions did not report reduced QoL, while those reporting four or more did. Rana et al. also developed a measure specifically for their study (194). The authors found that arthritis did not have an effect of any of a range of QoL domains examined; however, joint pain was adjusted for, which could have confounded the negative effects of arthritis. McDaid et al. examined independent effects of several condition categories on a single-item measure of QoL. Independent negative effects on QoL were identified for cardiovascular conditions, respiratory conditions, diabetes and for having multiple conditions (195).
### Table 2-13: Study characteristics and results for other overall QoL measure studies

<table>
<thead>
<tr>
<th>Name, Year Setting</th>
<th>N</th>
<th>Pop.</th>
<th>Confounders</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cantril's Ladder</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arnold 2004 (108) Groningen, Netherlands</td>
<td>6,583</td>
<td>57+</td>
<td>Age, sex, SEP, comorbidity</td>
<td>Lung Disorder</td>
<td>Overall QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Heart Disease</td>
<td><strong>Not</strong> Overall QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hypertension</td>
<td><strong>Not</strong> Overall QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diabetes</td>
<td><strong>Not</strong> Overall QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Arthritis</td>
<td><strong>Not</strong> Overall QoL</td>
</tr>
<tr>
<td><strong>Syk 2012 (192) Stockholm, Sweden</strong></td>
<td>2,924</td>
<td>45+</td>
<td>None</td>
<td>Asthma (Men): Present, past and future</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Asthma (Women): Present and past, <strong>not</strong> future</td>
<td></td>
</tr>
<tr>
<td><strong>Gothenburg Quality of Life Instrument (GQLI)</strong></td>
<td></td>
<td></td>
<td></td>
<td>Asthma (Men): Social, Mental, Physical</td>
<td></td>
</tr>
<tr>
<td>Syk 2012 (192) Stockholm, Sweden</td>
<td>2,924</td>
<td>45+</td>
<td>None</td>
<td>Asthma (Women): Social, <strong>not</strong> Mental, Physical</td>
<td></td>
</tr>
<tr>
<td><strong>Study-Specific Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td>1 condition</td>
<td><strong>Not</strong> Overall QoL²</td>
</tr>
<tr>
<td>Paul 2007 (193) Great Britain</td>
<td>999</td>
<td>65+</td>
<td>None</td>
<td></td>
<td>2-3 conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4-5 conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6+ conditions</td>
</tr>
<tr>
<td>Rana 2009 (194) Bangladesh</td>
<td>850</td>
<td>60+</td>
<td>Clinical factors</td>
<td>Arthritis</td>
<td><strong>Not</strong> Physical, Psychological, Spiritual, Social, Economic, Environmental</td>
</tr>
<tr>
<td>McDaid 2012 (195) Island of Ireland</td>
<td>6,159</td>
<td>50+</td>
<td>Age, sex, SEP, marital status</td>
<td>Multiple conditions</td>
<td>Single-item QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Respiratory Disease</td>
<td>Single-item QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diabetes</td>
<td>Single-item QoL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CVD</td>
<td>Single-item QoL</td>
</tr>
</tbody>
</table>

Pop. = Population, SEP = Socioeconomic Position, CVD = cardiovascular disease

*Overall QoL measured by five items: subjective QoL, done things wanted in life, financial situation, peer comparison, expectations.

See Table 2-2 for definitions of confounders.
Across all measures, the effect of chronic disease on psychosocial domains of QoL was less consistent than the effect on physical domains. Meta-analysis of selected studies using the SF-36/SF-12 measure found that the pooled effect on psychosocial domains was statistically significant – however, it was smaller in size than the effect on physical domains. In addition, where an overall QoL index which combined physical and psychosocial domains (e.g., EQ-5D, HUI) was examined, effects were more likely to be significant. Items capturing psychosocial domains of QoL (e.g., depression, emotional wellbeing) constitute a minority of the items in these measures, so that negative effects on the physical domains tend to dominate the overall result. The maintenance of psychosocial domains of QoL may therefore be obscured when using these measures.

Overall chronic disease status, i.e., having any conditions, or number of conditions, had a consistently negative effect on physical and mental domains of HRQoL. However, four studies using the WHOQOL measure reported that number of conditions did not have a significant effect on one or more psychosocial domains of QoL (97,185–187). Two further studies examining generic measures of QoL reported that a single chronic condition was not associated with decreased QoL, while multiple conditions were (189,193).

Across measures, findings for stroke, arthritis and respiratory conditions were more consistently statistically significant than findings for cancer, diabetes and hypertension. This ranking was broadly consistent with the results of the meta-analysis of SF-36/SF-12 studies (Figure 2-2- Figure 2-5). Ten studies compared the independent effects of several conditions, using measures other than the SF-36/SF-12. The rankings observed in each of these studies are displayed in Table 2-14. Arthritis and stroke were among the top three conditions that were most harmful to QoL in almost all the studies in which they were examined. Cancer, diabetes and hypertension had a weaker effect in all but two studies. The rankings of heart disease and respiratory conditions varied across studies. Overall, disease rankings were far from uniform. For example, Orfila et al. found that diabetes was associated with the greatest negative effect on HRQoL (79) and that stroke did not have a significant negative effect.
Table 2-14: Ranking of specific conditions across selected studies

<table>
<thead>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
<td>4,565</td>
<td>1,419</td>
<td>6,681</td>
<td>5,343</td>
<td>3,750</td>
<td>32,282</td>
<td>4,364</td>
<td>544</td>
<td>6,583</td>
<td>11,523</td>
</tr>
<tr>
<td>1</td>
<td>Stroke*</td>
<td>Stroke*</td>
<td>Musculoskeletal*/Neurological*</td>
<td>Stroke*</td>
<td>Arthritis*</td>
<td>Stroke*</td>
<td>Arthritis*</td>
<td>Stroke* / Stroke*</td>
<td>Heart Disease* / Stroke*</td>
<td>Diabetes*</td>
<td>Lung disorder*</td>
</tr>
<tr>
<td>2</td>
<td>Respiratory*</td>
<td>Arthritis*</td>
<td>Respiratory/Cardiovascular*</td>
<td>Heart Failure, PAD*</td>
<td>Respiratory*</td>
<td>Respiratory*</td>
<td>Arthritis*</td>
<td>Respiratory*</td>
<td>Diabetes / Hypertension</td>
<td>Diabetes*</td>
<td>Arthritis*</td>
</tr>
<tr>
<td>3</td>
<td>Heart Disease*</td>
<td>Peptic Ulcer</td>
<td>Respiratory</td>
<td>Arthritis*</td>
<td>Respiratory*</td>
<td>Stomach Ulcer</td>
<td>Heart Disease*</td>
<td>Heart Disease*</td>
<td>High Cholesterol</td>
<td>Stroke</td>
<td>Arthritis</td>
</tr>
<tr>
<td>4</td>
<td>Cancer</td>
<td>Diabetes</td>
<td>Arrhythmia</td>
<td>Diabetes*</td>
<td>Heart Disease*</td>
<td>Asthma</td>
<td>Hypertension</td>
<td>Cancer</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>5</td>
<td>Diabetes</td>
<td>Heart Disease</td>
<td>Respiratory*</td>
<td>Cancer*</td>
<td>Hypertension*</td>
<td>Hypertension*</td>
<td>Cancer</td>
<td>Diabetes</td>
<td></td>
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</tr>
<tr>
<td>6</td>
<td>Hypertension</td>
<td>Osteoporosis</td>
<td>Respiratory</td>
<td>Angina*</td>
<td>Hypertension*</td>
<td>Angina*</td>
<td></td>
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</tr>
<tr>
<td>7</td>
<td>Hypertension</td>
<td>Hypertension</td>
<td>Kidney disease</td>
<td></td>
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</tr>
<tr>
<td>8</td>
<td>Cancer</td>
<td>Liver Disease</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>9</td>
<td>Liver Disease</td>
<td></td>
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</tr>
</tbody>
</table>

*aOrder depends on age group.

*bOrder depends on QoL domain.

*p<0.05
2.3.11 Longitudinal Effects of Chronic Disease on QoL

Ten studies were identified that examined the effect of chronic conditions on change in QoL over time. Study characteristics and findings are displayed in Table 2-15. Similar to the cross-sectional studies, most studies (n=6) reported results for the SF-36, followed by other HRQoL measures (n=3), with one study reporting results for CASP-19. Four studies examined the effect of chronic conditions at baseline on change in QoL, four examined the effect of incident conditions and two examined both baseline and incident conditions.

Statistically significant decline in QoL was reported by all three studies examining the effect of number of incident conditions, or any incident condition. Incident breast cancer and arthritis had a significant effect on physical but not mental HRQoL (114,196). Incident stroke was associated with significant decline in both mental and physical domains of HRQoL (197).

Findings for the effect of baseline conditions were mixed, with no clear pattern. Baseline respiratory conditions were associated with decline in QoL in two out of three studies, although Buckley et al. only detected a negative effect for severe lung disease (103). Of the three studies which investigated baseline cardiovascular disease, one found no global decline in HRQoL (198), one only detected low/intermediate decline, while one reported a decline only in mental domains of the SF-36 (103). Similarly inconsistent results were reported for baseline diabetes, cancer and osteoporosis. Three studies examined baseline arthritis. Dale et al. found that baseline arthritis was associated with a higher probability of decline in EQ-5D score (199), relative to maintenance of QoL. Parkinson also reported that arthritis was associated with decline in most of the SF-36 domains (196). On the other hand, Laslett found decline only for osteoarthritis of the back (181).

The study by Wolinsky et al., which reported significant decline for only two out of 11 baseline conditions, required a reduction in score on at least four of the eight SF-36 domains to constitute global decline (198). This higher threshold for decline makes it more likely that the differences detected were clinically meaningful: a small decline in one or two HRQoL domains may be statistically significant, but of little impact with regard to how
significant it is for the individual involved. Issues related to minimally important differences in QoL measures will be discussed in Section 2.4.2.

Table 2-15: Study characteristics and results for longitudinal studies

<table>
<thead>
<tr>
<th>Name, Year Setting</th>
<th>N</th>
<th>Pop.</th>
<th>Confounders</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL domain</th>
</tr>
</thead>
</table>
| SF-36
<p>| Haley 2011 (197) USA | 272 | 46-90 | Age, sex, SE, living alone | Incident stroke | Decline in MCS, PCS |
| Trentham-Dietz 2008 (114) USA | 2,656 | 43-86 | Age, BMI, comorbidity | Incident breast cancer | Decline in PCS, no decline in MCS |
| Dennison 2010 (200) Hertfordshire, England | 642 | 65-74 | Age, sex, SE, BMI, other lifestyle, comorbidity, other clinical | Baseline Osteoporosis (M) | No decline in Physical, decline in some Mental domains |
|  |  |  |  | Baseline Osteoporosis (W) | No decline in Physical or Mental domains |
| Wolinsky 2009 (198) St Louis, USA | 846 | 53-68 | Age, sex, SE, marital status, race, BMI, other lifestyle, comorbidity, other clinical | Baseline Cancer | Global decline* |
|  |  |  |  | Baseline COPD | Global decline |
|  |  |  |  | Baseline Angina | No global decline |
|  |  |  |  | Baseline Arthritis | No global decline |
|  |  |  |  | Baseline Asthma | No global decline |
|  |  |  |  | Baseline CHF | No global decline |
|  |  |  |  | Baseline Diabetes | No global decline |
|  |  |  |  | Baseline Heart Attack | No global decline |
|  |  |  |  | Baseline Hypertension | No global decline |
|  |  |  |  | Baseline CKD | No global decline |
|  |  |  |  | Baseline Stroke | No global decline |
|  |  |  |  | 1 incident condition | Global decline |
|  |  |  |  | 2+ incident conditions | Global decline |</p>
<table>
<thead>
<tr>
<th>Name, Year Setting, Measure</th>
<th>N</th>
<th>Pop.</th>
<th>Confounders</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Parkinson 2010 (196) Women, Australia</td>
<td>7,088</td>
<td>77-85</td>
<td>SEP, marital status, ethnicity, BMI, other lifestyle, comorbidity, other clinical, depression</td>
<td>Incident arthritis</td>
<td>Decline in all Physical, some Mental</td>
</tr>
<tr>
<td>Buckley 2013 (103) North West Adelaide, Australia</td>
<td>1,400</td>
<td>41-60</td>
<td>SEP, BMI, other lifestyle, depression</td>
<td>Baseline Severe lung disease</td>
<td>Decline in PCS, MCS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Baseline CVD</td>
<td>Decline in MCS, not PCS</td>
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<tr>
<td></td>
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<tr>
<td>Other HRQoL</td>
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</tr>
<tr>
<td>Asakawa 2012 (201) Canada HUI</td>
<td>5,082</td>
<td>40+</td>
<td>Age, sex, SEP, marital status, race, other lifestyle</td>
<td>1 incident condition</td>
<td>Decline in overall HUI index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 incident conditions</td>
<td>Decline in overall HUI index</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&gt;2 incident conditions</td>
<td>Decline in overall HUI index</td>
</tr>
<tr>
<td>Laslett 2012 (181) Tasmania AQoL</td>
<td>1,098</td>
<td>50-80</td>
<td>Age, sex, BMI, comorbidity, other clinical</td>
<td>Baseline back osteoarthritis</td>
<td>Decline in overall AQoL index</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Baseline osteoarthritis at other sites</td>
<td>No decline in overall AQoL index</td>
</tr>
<tr>
<td>Dale 2013 (199) Women Great Britain EQ-5D</td>
<td>1,846</td>
<td>60-79</td>
<td>Age, SEP, living alone, BMI, comorbidity, other clinical</td>
<td>Baseline CVD</td>
<td>Intermediate / low decline in EQ-5D, not high decline</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Baseline Diabetes</td>
<td>Intermediate / low decline in EQ-5D, not high decline</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Baseline Cancer</td>
<td>Not high, intermediate, or low decline in EQ-5D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Baseline Respiratory</td>
<td>Not high, intermediate, or low decline in EQ-5D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Baseline Osteoporosis</td>
<td>Intermediate / low decline in EQ-5D, not high decline</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Baseline Arthritis</td>
<td>High, intermediate, or low decline in EQ-5D</td>
</tr>
<tr>
<td>Name, Year Setting</td>
<td>N</td>
<td>Pop.</td>
<td>Confounders</td>
<td>Condition</td>
<td>Statistically Significant Findings by QoL domain</td>
</tr>
<tr>
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<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Webb 2011 (202) England</td>
<td>4,848</td>
<td>50+</td>
<td>Age, sex, SEP, marital status, other clinical, depression</td>
<td>Incident longstanding illness&lt;sup&gt;d&lt;/sup&gt;</td>
<td>decrease in CASP-19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Incident longstanding limiting illness&lt;sup&gt;d&lt;/sup&gt;</td>
<td>decrease in CASP-19</td>
</tr>
</tbody>
</table>

MCS = Mental Component Summary score; PCS = Physical Component Summary score; BMI = Body Mass Index; M = Men; W = Women; COPD = chronic obstructive pulmonary disorder; CHF = congestive heart failure; CKD = chronic kidney disease; CVD = cardiovascular disease; HUI = Health Utilities Index; EQ-5D = Euro-QoL 5 Dimensions; SEP = Socioeconomic Position; CASP = Control, Autonomy, Self-Realisation, Pleasure

<sup>a</sup>Global decline was defined as a decrease in score of 4 or more SF domains.

<sup>b</sup>The psychological distress domain was excluded in sensitivity analysis, in an attempt to account for the confounding role of psychological disorders

<sup>c</sup>Four patterns of change were identified in the sample: Maintenance of high EQ-5D score, and three trajectories of high, moderate and low decline

<sup>d</sup>Chronic disease was captured by asking participants if they had a "longstanding illness".

See Table 2-2 for definitions of confounders.
2.3.12 Mediating Factors

Four studies examined factors mediating the relationship between chronic disease and QoL (79,158,182,187). Study characteristics and findings are displayed in Table 2-16. Three examined HRQoL: NHP overall score (79); separate domains of the HUI (158); and a latent health perceptions factor comprising the EQ-5D VAS and two SF-36 domains – general health and vitality (182). The fourth study examined four domains of the WHOQOL – physical, social, psychological and environmental (187).

Studies varied in how distinct the mediating factors were from the QoL outcome measures. One study examined objective functional capacity as a mediator (79), while another captured self-report of calories burned (158). Both of these measures are reasonably distinct from QoL. The measure of physical frailty used in the study by Gobbens et al. was also relatively distinct, capturing concrete aspects of health and functioning (187). These included decline in nutrition, mobility, physical activity, strength, endurance, balance and sensory functions. Measures of social and psychological frailty were more subjective, capturing subjective assessment of social relations, social support, cognition, mood and coping. In the fourth study, there was considerably more overlap between mediating factors and QoL (182). Measures of all mediators and outcomes were based on items from the SF-36.

All four studies reported that physical function mediated the effect of chronic conditions on physical HRQoL (158,182), overall HRQoL (79), or the physical health domain of the WHOQOL (187). Two studies also examined physical function as a mediator of the effect of chronic conditions on psychosocial domains of QoL, with mixed findings. For example, physical function did not mediate the effect of number of conditions on social and environmental domains of the WHOQOL (187), while it did mediate the effect of heart disease and musculoskeletal conditions on emotional wellbeing (144).

Two studies examined psychological and social function as mediators, reporting mixed results. Psychological function mediated the effect of chronic conditions on all domains of the WHOQOL (187) but not on overall health perceptions (79). Social function mediated the
effect of chronic conditions on social and environmental domains of the WHOQOL, but again, not on overall health perceptions.

<table>
<thead>
<tr>
<th>Name, Year Setting Measure</th>
<th>N</th>
<th>Pop</th>
<th>Confounders</th>
<th>Mediating Factor</th>
<th>Condition</th>
<th>Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sawatsky 2007 (158) Canada HUI</td>
<td>24,281</td>
<td>65+</td>
<td>Age, sex, BMI, other lifestyle</td>
<td>Physical Activity (self-report of calories burned)</td>
<td>Musculoskeletal Mobility, Pain, Emotional Wellbeing, not Dexterity, Cognition</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Respiratory Mobility, not Pain, Emotional Wellbeing, Dexterity, Cognition</td>
<td></td>
</tr>
<tr>
<td>Heart Disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Heart Disease Mobility, Pain, Emotional Wellbeing, not Dexterity, Cognition</td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diabetes Mobility, Pain, not Emotional Wellbeing, Dexterity, Cognition</td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stroke Mobility, not Pain, Emotional Wellbeing, Dexterity, Cognition</td>
<td></td>
</tr>
<tr>
<td>Orfila 2006(79) Spain, NHP</td>
<td>544</td>
<td>72+</td>
<td>Age, sex, SEP, living alone, other lifestyle</td>
<td>Objective Functional Capacity</td>
<td>No. of Conditions</td>
<td>NHP Total Score</td>
</tr>
</tbody>
</table>

84
<table>
<thead>
<tr>
<th>Name, Year Setting Measure</th>
<th>N</th>
<th>Pop</th>
<th>Confounders</th>
<th>Mediating Factor</th>
<th>Condition</th>
<th>Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gobbens 2012 (187)</td>
<td>213</td>
<td>75+</td>
<td>Age, sex, SEP, other lifestyle</td>
<td>Physical Frailty</td>
<td>No. of Conditions</td>
<td>Physical, Psychological, not Social, Environmental</td>
</tr>
<tr>
<td>Netherlands WHOQOL</td>
<td></td>
<td></td>
<td></td>
<td>Psychological Frailty</td>
<td>No. of Conditions</td>
<td>Physical, Social, Psychological, Environmental</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Social Frailty</td>
<td>No. of Conditions</td>
<td>Social, Environmental, not Physical, Psychological</td>
</tr>
<tr>
<td>Tannenbaum 2007 (182)</td>
<td>2,311</td>
<td>50+</td>
<td>Other lifestyle</td>
<td>Physical Health</td>
<td>No. of conditions</td>
<td>overall health perceptions</td>
</tr>
<tr>
<td>Women, Canada EQ-5D/SF-36</td>
<td></td>
<td></td>
<td></td>
<td>Mental Health</td>
<td>No. of conditions</td>
<td>not overall health perceptions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Social Health</td>
<td>No. of conditions</td>
<td>not overall health perceptions</td>
</tr>
</tbody>
</table>

Pop. = Population; SEP = Socioeconomic Position; BMI = Body Mass Index; NHP = Nottingham Health Profile. See Table 2-2 for definitions of confounders.
2.3.13 Moderating Factors

Twelve studies reported differences in how chronic conditions affected QoL across subgroups defined by age, sex and other factors, and are displayed in Table 2-17. Eleven examined HRQoL, with one study looking at effects on the WHOQOL measure (186). The most common moderating factor examined was age (n=8), followed by sex (n=4), socioeconomic indicators (n=2) and obesity (n=2).

Five out of eight studies reported some evidence for the moderating role of age. In four of these, older age was associated with a reduced effect of chronic disease on QoL. Two of the eight studies examining age compared older adults with the general adult population aged 18+. One of these (Ford et al.) found that chronic disease had a weaker effect on psychosocial domains at older ages, but a stronger effect on physical domains (162). The other of these two reported no significant moderating effect of age (129). The overall evidence for the moderating role of age was therefore mixed.

Five studies examined moderating effects of sex. Two studies found an increased negative effect on HRQoL among women: one which studied having one or more condition (184), and another which examined asthma (137). The remaining three studies examined myocardial infarction and stroke, and did not find any moderating effects of sex.

Moderating effects of socioeconomic indicators and ethnicity were also examined. Higher area-level deprivation was associated with an increased effect of multi-morbidity on QoL (93), while income did not interact with stroke in its effect on QoL (197). Mixed findings were reported in two studies that examined race and stroke in American populations. Haley et al. found that the negative effects of stroke on HRQoL did not vary by race (197). In a study by Xie et al., which included a larger sample, a greater negative effect of stroke among black people was found, compared with people of other races (129).

Obesity was examined in two studies, with one finding that it was associated with an increased effect of peripheral arterial disease (PAD) on physical HRQoL (166), and the other finding no significant interaction effect (138). One study investigated the role of depression, finding no evidence of interaction with diabetes (138).
Table 2-17: Study characteristics and results for moderating factors

<table>
<thead>
<tr>
<th>Name, Year Setting, N Measure</th>
<th>Pop.</th>
<th>Confounders</th>
<th>Interaction Tested</th>
<th>Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Larsson 2007 Sweden, n = 1,722 SF-36 (137)</td>
<td>50-64</td>
<td>None</td>
<td>Asthma X sex</td>
<td>Increased effect on some phys and some mental domains for women.</td>
</tr>
<tr>
<td>Haley 2011 (197) USA, n = 272 SF-36</td>
<td>46-90</td>
<td>Age, sex, SEP, living alone, race</td>
<td>Stroke x age</td>
<td>no difference for PCS, MCS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stroke x sex</td>
<td>no difference for PCS, MCS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stroke x race</td>
<td>no difference for PCS, MCS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stroke x income</td>
<td>no difference for PCS, MCS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stroke x living alone</td>
<td>no difference for PCS, MCS</td>
</tr>
<tr>
<td>Heidelberg 2011 (138) Augsburg, Germany, Women n = 983 SF-36</td>
<td>35-74</td>
<td>Age, SEP, marital status</td>
<td>Diabetes x depression</td>
<td>no difference for PCS, MCS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Diabetes x obesity</td>
<td>no difference for PCS, MCS</td>
</tr>
<tr>
<td>Xie 2006 (129) USA, n = 39,680 SF-36</td>
<td>18+</td>
<td>Age, sex, SEP, race, other lifestyle comorbidity</td>
<td>Stroke x black race</td>
<td>Increased effect on SF-6D index for greater deprivation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stroke x age</td>
<td>no difference for PCS, MCS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stroke x sex</td>
<td>no difference for PCS, MCS</td>
</tr>
<tr>
<td>Lawson 2013 (93) Scotland, n = 1,026 SF-6D</td>
<td>45+</td>
<td>Age, sex</td>
<td>Multi-morbidity x deprivation</td>
<td>Increased effect on SF-6D index for greater deprivation</td>
</tr>
<tr>
<td>EQ-5D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schweikert 2009 (150) Germany, n = 1,902 EQ-5D</td>
<td>54-93</td>
<td>Age, SEP, BMI, other lifestyles</td>
<td>MI x age</td>
<td>Some domains of EQ-5D reduced negative effect for older age.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MI x sex</td>
<td>not EQ-5D</td>
</tr>
<tr>
<td>Name, Year N</td>
<td>Pop. N</td>
<td>Confounders</td>
<td>Interaction Tested</td>
<td>Significant Findings by QoL domain</td>
</tr>
<tr>
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<tr>
<td>Saarni 2007 (152) Finland, n = 6,681 EQ-5D</td>
<td>45+</td>
<td>Sex, SEP, comorbidity, other clinical factors</td>
<td>Respiratory x age</td>
<td>not EQ-5D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Musculoskeletal x age</td>
<td>EQ-5D, reduced negative effect for older age</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cardiovascular x age</td>
<td>not EQ-5D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Neurological x age</td>
<td>not EQ-5D</td>
</tr>
<tr>
<td><strong>CDC Healthy Days</strong></td>
<td></td>
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</tr>
<tr>
<td>Ford 2003 (162) USA, n = 163,773</td>
<td>18+</td>
<td>Age, sex, SEP, ethnicity, BMI, other lifestyle</td>
<td>Asthma x age</td>
<td>Increased effect for PH days, reduced effect for MH days for older people</td>
</tr>
<tr>
<td>Widener 2008 (166) USA, n = 4,559 CDC Healthy Days</td>
<td>48+</td>
<td>Age, SEP, other lifestyle, comorbidity, other clinical</td>
<td>PAD x obesity</td>
<td>Increased effect on PH days</td>
</tr>
<tr>
<td><strong>Other HRQoL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Khanna 2011 (147) USA, n = 3,844 Multiple HRQOL measures</td>
<td>35-89</td>
<td>Sex, SEP, comorbidity</td>
<td>Arthritis x age</td>
<td>no effect for MCS, PCS, EQ-5D, QWB-SA, HUI, PCS, HAlex</td>
</tr>
<tr>
<td>Baumann 2011 (184) France, n = 8,228 Duke Health Profile</td>
<td>45-75</td>
<td>None</td>
<td>&gt;=1 condition x age</td>
<td>Reduced effect for older age on some domains only: perceived health, depression</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt;=1 condition x sex</td>
<td>Increased effect for women on physical health, general health and pain.</td>
</tr>
<tr>
<td><strong>WHOQOL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baumann 2010 (186) France, n = 8,297 WHOQOL</td>
<td>45-75</td>
<td>None</td>
<td>&gt;=1 condition x age</td>
<td>Reduced effect for older people on all domains.</td>
</tr>
</tbody>
</table>

Pop. = Population; SEP = Socioeconomic Position; BMI = Body Mass Index; M = Men; W = Women; PH = Physical Health, MH = Mental Health, MCS = Mental Component Summary score, PCS = Physical Component Summary Score, PAD = Peripheral Arterial Disease; MI = myocardial infarction

Notes: See Table 2-2 for definitions of confounders.
2.4 Discussion

2.4.1 Summary of Findings

This chapter reviewed current evidence for the relationship between chronic disease and QoL among general-population samples of middle-aged and older people. Ninety-eight studies which met the inclusion criteria were identified. There was evidence for cross-sectional effects of a range of chronic conditions on both physical and psychosocial domains of HRQoL, and overall QoL. However, the results were far from uniform. In particular, the effects on psychosocial domains of QoL were less consistent and, where identified, tended to be weaker than the effects on physical domains. In addition, the evidence related to broader, general measures of QoL was more sparse. Fifteen studies were identified and these reported mixed results. Few studies went beyond cross-sectional analysis of main effects. Ten studies were identified which examined the longitudinal effects of incident or baseline chronic conditions on QoL. Twelve studies examined moderating factors, with four examining mediating factors. In summary, the evidence for effects of chronic conditions on QoL among older, general-population samples is largely limited to direct, cross-sectional main effects on physical HRQoL domains.

Two-thirds of studies adjusted for at least some key socio-demographic variables, such as age and sex, (n = 67), with just over a third (n = 37) adjusting for lifestyle factors such as BMI and smoking. This contrasts with a previous review of effects of multi-morbidity on QoL, which found that few studies (two out of 30) adjusted for lifestyle or behavioural factors (60). However, consistent with that previous review, few studies (n=16) adjusted for comorbid psychological distress or disorders, which have been found to exacerbate the effect of physical chronic conditions on QoL (203).

Just over a third of studies (n=35) reported how missing data or study non-response was handled. This has implications for findings of weak effects of chronic conditions on QoL: surveys of ageing populations may suffer from a selection effect, where only more "resilient" individuals participate, biasing the estimates of negative effects towards zero.
2.4.2 Measures and Domains of QoL

This review confirmed the on-going dominance of the SF-36/SF-12 measure of HRQoL in QoL research, as well as the frequent use of other HRQoL measures such as EQ-5D, HUI and CDC Healthy Days. This dominance remains despite widespread arguments that these scales are not adequate measures of QoL among older people due to their focus on physical function and health (34,66,204). They do not capture the potential for older people to see themselves as having good QoL in a context of disability. The use of HRQoL measures in older populations will be discussed further in Section 3.2 in Chapter 3.

Within studies of HRQoL measures, evidence for effects on physical domains was stronger than evidence for the effect on mental or psychosocial domains, consistent with previous reviews of multi-morbidity and QoL (9,60). Meta-analysis of studies using the SF-36/SF-12 measure suggested that chronic conditions have a negative effect on the mental domain, but that this effect is smaller than that for physical domains. The pooled difference in the mental domains of the SF-36/SF-12 was approximately five points or fewer across all conditions, and less than three points for most conditions. Despite its ubiquity in research, there is little consensus concerning minimally important differences in the SF-36 measure (205). Sprangers refers to Ware’s advice (206) that two points constitutes a negligible difference (61). The minimum detectable state change, or one better response level on just one item, equates to a five point difference in the PF or MH scales (207). Expert consensus, on the other hand, suggests that for most conditions, a 10 point difference constitutes a clinically relevant difference (207). While the use of expert consensus to determine a minimally important difference in this way has been disputed (205), it at least suggests that the differences in the mental domain reported here may not be of clinical importance.

Fifteen studies examined the effect of chronic disease on generic, overall measures of QoL. These included the WHOQOL (n=5), CASP-19 (n=5), Cantril’s ladder (n=2), the GQLI (n=1), a single-item measure of QoL (n=1) and two study-specific measures. Studies using the WHOQOL (n=5) examined differential effects on different domains of QoL, and all of these reported non-significant results for having one or more chronic conditions on at least one psychosocial domain. In contrast, the CASP-19 was examined as a summed score in four out of five studies, which meant that it was not possible to examine if there were
differential effects on QoL across the four dimensions of need satisfaction (control, autonomy, self-realisation and pleasure). Examining differences in an overall summary score for QoL, in both health-related and general QoL measures, may obscure differential effects across diverse dimensions of QoL. Jenkinson (1995) has emphasised that domains of QoL should be analysed and reported separately in order to adequately represent these differential effects (204). The current review has confirmed the importance of this – out of 68 studies that examined effects of chronic conditions on separate domains of QoL, over two-thirds (n = 46) reported differential effects by QoL domain. Reporting of differential effects would improve conceptual clarity around what we mean when we say that chronic conditions affect QoL, by making clear precisely which domains are affected.

2.4.3 Comparing Conditions

The most common conditions for which QoL outcomes were examined were arthritis, heart disease, diabetes, hypertension, respiratory conditions (including asthma), stroke and cancer. Arthritis, respiratory conditions and stroke had a more consistent statistically significant negative effect on all domains and measures of QoL, relative to heart disease, hypertension, diabetes and cancer. Meta-analysis of studies using the SF-36/SF-12 measure was consistent with this, indicating that arthritis, respiratory conditions and stroke had the greatest negative effect on QoL, cardiovascular conditions had a moderate effect, and cancer, hypertension and diabetes displayed the weakest effects (see Figures 2-2 to 2-5). A similar ranking of conditions was reported within studies which compared the effects of specific conditions (see Section 2.3.10).

These results had some inconsistencies with a previous synthesis of datasets using the SF-36/SF-12 measure, which included samples of all ages (61). In particular, heart disease and respiratory conditions had a greater negative effect on HRQoL in the present review. In the previous study, hypertension was included in an aggregated definition of heart disease. This may have diluted the effect of heart disease, as in the current review hypertension had a weaker effect on SF-36/SF-12 scores relative to other conditions. Similarly, an aggregated definition of respiratory conditions may include conditions of varying severity, e.g., asthma and COPD. Differing definitions of respiratory and heart conditions, in terms of the conditions included, may explain why the rankings of these conditions tended to vary
across studies (see Table 2-14). This highlights the difficulty of aggregating distinct conditions, which may be associated with very different illness experiences.

Clearly, specific chronic conditions vary in their effects on QoL. This variation is the rationale for weighted indices of chronic conditions, which measure overall chronic disease burden by assigning various weights to conditions of different severity (208,209). However, the same diagnosis may have different effects on QoL across individuals, depending on, for example, symptom severity, functional impact or other factors related to the individual and their circumstances. This review identified significant heterogeneity in effects of chronic conditions on physical HRQoL, suggesting that diagnoses in themselves may not be the best predictor of health status. To understand why chronic conditions have differential effects on QoL, it may be more helpful to identify what characteristics or sequelae of conditions have a detrimental effect on QoL, rather than ranking conditions according to severity. These factors may explain why arthritis, stroke and respiratory conditions were associated with a greater impact on HRQoL in this review. Evidence for these mediating factors is examined next.

2.4.4 Mediating Factors

Four studies were identified which examined mediators of the relationship between chronic conditions and QoL in general-population samples of older people (79,158,182,187). There was considerable variation in definitions of mediators and QoL outcomes. All four studies found evidence for the role of physical function as a mediator of the relationship between chronic disease and physical domains of QoL. Two studies also examined physical function as a mediator of effects of chronic conditions on psychosocial domains of QoL, with inconsistent findings across the two studies (158,187). Two studies investigated psychological and social factors as mediators, again reporting mixed results (182,187).

An important methodological issue which arose in these four studies was conceptual overlap between mediator and outcome measures. Many of the significant associations involved relationships between measures capturing subjective appraisal of the same life domain – for example, perceived decline in social relations and support mediated the effect
of chronic conditions on social QoL (187); subjective activity limitations mediated the effect of chronic conditions on overall health perceptions (182); self-reported physical activity mediated the effect of chronic conditions on self-reported mobility (158). The study by Orfila et al. involved somewhat greater conceptual separation, by examining how objective functional capacity mediated the effect of chronic conditions on subjective appraisals of HRQoL (79).

It is possible to distinguish three types of health status measures: measures of performance, perception and evaluation (210). Performance measures objectively measure an action, for example, walking up stairs. Perception measures capture straightforward self-report, for example, asking a respondent if they can climb one flight of stairs. Evaluation measures require a respondent to make a subjective judgement, for example, by asking them how difficult they find it to walk up stairs. Evaluations are dependent on the standards and expectations of the respondent. Measurement of QoL is dependent on such evaluations, which are rooted in the subjective perspective of the respondent. However, when investigating the effects of physical health on QoL, it is useful if measures of physical health are based on measures of performance or perception, rather than evaluation. This allows greater conceptual distinction between physical function and QoL, and facilitates a more coherent disentangling of the factors responsible for the relationship between chronic conditions and QoL.

Overall, the studies identified in this review lacked a coherent conceptual framework for how different factors are related to chronic conditions and QoL. Health or clinical indicators, such as pain or measures of function, were adjusted for in several analyses of the effect of chronic conditions across measures of QoL. However, these factors may mediate rather than confound the effect of chronic conditions on QoL. A path analysis approach allows examination of these variables in a more appropriate way, by taking into account their position along a structural pathway composed of direct and indirect effects. A theoretical review in the next chapter will inform the development of a coherent conceptual framework and causal model for this thesis.
2.4.5 Moderating Factors

Twelve studies examined factors that modify the relationship between chronic conditions and QoL, most focussing on age (n = 8). There was some evidence for a reduced impact of chronic conditions on QoL at older ages. One study suggested differential domain effects, with a greater impact on physical QoL and a reduced impact on mental QoL with increasing age (162). It is possible that chronic conditions are more disabling among older people, but they are perceived as having less of an impact as expectations and standards for health and QoL are re-adjusted (211). Older people may expect some decline in physical health as they age, and shift their internal standards in relation to health accordingly, as well as re-define the importance of health to their QoL. This shifting in standards and definitions is often referred to as response shift (211,212). Response shift is not specific to older populations, and can occur with younger adults with disabling illnesses. However, response shift may explain why older people with chronic conditions experience less of an impact on QoL, as the ageing process leads to shifting standards and expectations for health, and potentially a re-conceptualisation of QoL. Response shift will be discussed further in Section 3.2 of Chapter 3.

Mixed findings were reported for the moderating effect of depression, socioeconomic indicators and race. In sum, while the evidence suggests that both characteristics of the person and their context can modify the relationship between chronic conditions and QoL, the current evidence from general-population samples is limited. Further research, particularly with broader, overall measures of QoL, is required.

Identification of moderating factors is important because main effects observed in the general population may obscure complexities in how different groups respond to adverse circumstances. For example, a finding that older people with chronic conditions maintain QoL comparable to healthier counterparts might obscure the fact that this is only true among those who, for example, have adequate financial resources; or strong social supports. Moderating factors might also explain the heterogeneity of effects of chronic conditions identified in this review. Current evidence for moderating effects on the relationship between physical health and QoL will be discussed further in Section 4.3 in Chapter 4.
2.4.6 Limitations

This is a vast body of literature, and it is possible that the search strategy did not identify every relevant article. The search was confined to the peer-reviewed literature, and there may have been relevant studies in the grey literature, particularly as this mode of dissemination is common in large-scale survey type research. Nevertheless, the large number of abstracts screened indicates that the review was relatively comprehensive. In addition, relatively few additional articles were identified through the supplementary search strategies, suggesting that the initial search may have been close to saturation.

There was considerable heterogeneity in results across studies, highlighted in the meta-analysis. As noted above, this may have reflected the diversity in severity and sequelae of specific conditions. However, it is also important to acknowledge other potential sources of heterogeneity. Differences in setting across studies may have influenced the results in a number of ways. Healthcare access may vary both across and within countries, and difficulties with healthcare access may increase the effect of chronic conditions on QoL. In addition, people from different cultures may vary in how they respond to QoL measures. Within Europe, inhabitants of different countries vary in how they rate their own health, with some over-stating and others under-stating their health (213). Similarly, members of some cultures may be more or less optimistic in how they appraise and report their QoL relative to others.

The review was limited to studies that explicitly examined QoL, excluding studies that examined closely related concepts such as subjective wellbeing (SWB). Research on QoL and SWB have tended to exist in parallel silos, despite considerable conceptual overlap (214). SWB, which is generally measured by items capturing global life satisfaction, is closer to measures of overall QoL than to HRQoL. Evidence from these studies may therefore go some way to filling the gap in studies examining overall QoL. A number of recent articles have reviewed the evidence for the effects of chronic conditions, or physical health more broadly, on SWB. Findings from these reviews are discussed in Section 2.4.7, along with some more recent studies.
2.4.7 Chronic Conditions and Life Satisfaction

Subjective wellbeing (SWB) comprises two dimensions: cognitive appraisals of life satisfaction, and affective or emotional wellbeing (215,216). In recent years definitions of QoL and SWB have converged (214). For example, Diener et al. have defined SWB as follows:

"An umbrella term for different valuations that people make regarding their lives, the events happening to them, their bodies and minds, and the circumstances in which they live"

Diener et al., 2006 (217) (p. 153)

This is very similar to the WHO definition of QoL outlined in Section 2.2.1.3 (p. 39). In particular, the cognitive component of SWB, or life satisfaction, is very close conceptually to QoL evaluations. On that basis, this section briefly summarises evidence for effects of chronic conditions on life satisfaction among older adults.

A recent paper reviewed evidence for the effects of physical health on life satisfaction among older people (38). Self-rated health and disability were found to have negative effects on life satisfaction, though effects of disability tended to be weaker than effects of self-rated health. However, no studies examining the effects of chronic conditions on QoL were cited. A second review by Gwozdz et al. similarly reported strong evidence for effects of subjective health on life satisfaction in older people, with weaker evidence for objective measures of health (218). Gwozdz et al. identified two studies which specifically examined effects of chronic disease on life satisfaction at older ages. The authors also reported their own original findings concerning effects of chronic disease on QoL. The results of these three studies, plus two further studies, are summarised in Table 2-18.

Two of the studies examined effects of specific conditions, while three examined effects of the number of chronic conditions. All five studies adjusted for at least some socio-demographic factors. Overall, findings were mixed. Two of the studies reported that number of chronic conditions was associated with reduced life satisfaction (219,220). One of these, however, reported that the negative effects of functional measures and subjective
health were stronger (219). A third study examining number of conditions, which adjusted for depression, reported no association (221). Gwozdz et al. reported that several chronic conditions had no significant independent effect on life satisfaction (218). Again, this study adjusted for levels of depression. Berg et al. (2008) also examined the effects of specific chronic conditions (222). Stroke had a negative effect on life satisfaction, whereas the effects of ulcer and angina varied by sex.

Table 2-18: Study characteristics and results for studies of life satisfaction

<table>
<thead>
<tr>
<th>Name, Year Setting</th>
<th>N</th>
<th>Pop.</th>
<th>Confounders</th>
<th>Condition</th>
<th>Statistically Significant Findings by QoL domain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Life Satisfaction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Berg 2006 (221) Sweden</td>
<td>315</td>
<td>80+</td>
<td>Age, SEP other clinical factors, depression</td>
<td>No. of Conditions</td>
<td>Not life satisfaction</td>
</tr>
<tr>
<td>Smith 2002 (219) Berlin</td>
<td>516</td>
<td>70+</td>
<td>Age, sex, SEP, other clinical factors</td>
<td>No. of Conditions</td>
<td>Life satisfaction</td>
</tr>
<tr>
<td>Gwozdz 2010 (218) Germany</td>
<td>3,008</td>
<td>50+</td>
<td>Age, SEP, BMI, comorbidity, other clinical, depression</td>
<td>Heart attack</td>
<td>Not life satisfaction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hypertension</td>
<td>Not life satisfaction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>High cholesterol</td>
<td>Not life satisfaction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stroke</td>
<td>Not life satisfaction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Diabetes</td>
<td>Not life satisfaction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lung disease</td>
<td>Not life satisfaction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Asthma</td>
<td>Not life satisfaction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Arthritis</td>
<td>Not life satisfaction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Osteoporosis</td>
<td>Not life satisfaction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cancer</td>
<td>Not life satisfaction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ulcer</td>
<td>Not life satisfaction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Parkinson's</td>
<td>Not life satisfaction</td>
</tr>
<tr>
<td>Berg 2008 (222) Sweden</td>
<td>392</td>
<td>80+</td>
<td>SEP</td>
<td>Stroke</td>
<td>Life satisfaction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ulcer</td>
<td>Life satisfaction only in women</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Angina</td>
<td>Life satisfaction only in men</td>
</tr>
<tr>
<td>Berg 2011 (220) Sweden</td>
<td>370</td>
<td>80+</td>
<td>Age, sex, SEP</td>
<td>No. of Conditions</td>
<td>Life satisfaction</td>
</tr>
</tbody>
</table>

SEP = Socio-economic position; BMI = Body Mass Index
See Table 2-2 for definition of confounders.
Similar to measures of QoL, the evidence related to the effects of chronic conditions on life satisfaction is mixed. The consensus appears to be that while chronic disease burden is related to life satisfaction, indicators of self-rated health and disability are stronger predictors (38,215,218). A meta-analysis of just over 100 studies found strong evidence for disability (ADLs and IADLS) as a predictor of life satisfaction and happiness (223). In discussing the weak effect of chronic conditions on SWB, Berg et al. echo the point made in this chapter: diagnoses may not be a good predictor of wellbeing because of the heterogeneity of health status even across individuals with the same condition (220,222). While there is evidence that people maintain life satisfaction in a context of chronic disease, the scope of adaptation may depend on a number of factors. These include the disabling effect of the disease, its impact on other life domains (such as social participation), and the resources available to the person to cope with their situation (215,218). The central aim of this thesis is to empirically evaluate the role that these factors play in the complex relationship between chronic conditions and QoL.

2.4.8 Conclusions and Relevance for the Thesis

In conclusion, it appears that much existing evidence from older, general-population samples on the relationship between chronic conditions and QoL relates to HRQoL outcomes. The current evidence thus limits what we can actually say with confidence about the effects of chronic conditions on QoL. In addition, there is considerable heterogeneity in findings across studies, suggesting that there may be important factors that mediate and moderate this relationship. Few studies have explored these factors to date. This is partly related to the widespread use of HRQoL measures, which have considerable conceptual overlap with potential mediators of the relationship, such as physical function. It is also clear that while there is potential for maintenance of some domains of QoL in chronic disease, effects of chronic conditions may vary across sub-groups. Analysis of main effects alone may obscure these differences, indicating the need for comprehensive evaluation of interaction effects.

The aim of this thesis was to address some of these gaps. Analysis of the relationship between chronic conditions and QoL must be based on a coherent conceptual framework and causal model which distinguishes chronic conditions and QoL from mediating factors,
moderating factors and covariates. The measure of QoL used must have a clear definition and conceptual model, and capture a concept of QoL that is broader than health status. In addition, where it makes conceptual sense, different domains of QoL must be examined separately. For example, CASP-19 has tended to be examined as a summed score capturing overall QoL. CASP-19 includes four dimensions of need satisfaction – control, autonomy, self-realisation and pleasure, and it is possible that the effect of chronic conditions varies across these dimensions. These potential differential effects have not yet been explored.

The next chapter (Chapter 3) will discuss in greater detail the challenges associated with measurement of QoL among older people. It will attempt to clearly describe the theoretical basis for the CASP-19 measure of QoL, and locate it in relation to other measurement approaches. The following chapter (Chapter 4) will identify a conceptual framework and theoretical causal model for the relationship between chronic conditions and QoL, drawing on the broader theoretical and empirical literature.
Chapter 3  Measuring Quality of Life in Older Adults

3.1 Introduction

Countries and institutions have long used objective indicators, such as gross domestic product (GDP), or mortality rates, as measures of social and human progress. In recent decades, interest in more subjective measures of health and wellbeing has grown (224–226). QoL has emerged as a critically important concept in this area. However, the field is hampered by the lack of clear definition and delineation of QoL across studies, reflected in the large and growing literature on the conceptualisation and measurement of the concept (66,67,227).

QoL is not something that can be directly observed or measured. It is a latent variable or construct, which means that it can only be measured indirectly, by using observable indicators, such as responses to survey items (228). Any measure of QoL, therefore, requires an a priori assumption of what constitutes QoL. The WHO definition of QoL, referred to in Section 2.2.1.3 on p.39, offers some guidance. It suggests that QoL must be based on "individuals' perception of their position in life ... in relation to their goals expectations, standards and concerns" (27) (p. 1). This indicates that QoL assessments must be based on an individual's subjective evaluation of one or more aspects of their life. It also suggests that it is a "broad ranging" concept, implying that it should take account of multiple life domains.

However, even if we accept this definition, questions remain. Is QoL entirely subjective to the individual, or must certain conditions be met for someone to have good QoL, such as good physical health, housing or social networks? Related to this, how can we distinguish the constituents from the determinants of QoL (43,44,66)? Are things like physical health or function part of QoL, or something that influence it? The answers to these questions are complex and contested, and it is possible that there will always be debate around what constitutes "good" QoL. This requires QoL researchers to be clear in their underlying assumptions, and explicitly describe and justify their approach to defining and measuring QoL.
This chapter provides an overview of approaches to QoL measurement, and how each approach addresses these ontological issues of what constitutes QoL. The systematic literature review reported in Chapter 2 demonstrated the range of QoL measures used to examine effects of chronic conditions in older people, but also the dominance of a narrow range of health-related QoL (HRQoL) measures. This chapter will begin with a critical discussion of HRQoL measures (Section 3.2). This will be followed by a discussion of recent approaches to measuring QoL specifically in older populations (Section 3.3). Section 3.4 will cover simple evaluative measures of QoL, such as life satisfaction. The concept of eudaimonic wellbeing will be discussed in Section 3.5. Section 3.6 will include a discussion of the CASP-19 measure of QoL, which is the measure used in this thesis. The measure will be critically evaluated and located in relation to other approaches to QoL measurement.

3.2 Health-Related QoL

HRQoL measures focus on individual assessment of QoL domains that are closely related to health. As demonstrated in Chapter 2, measures of HRQoL are frequently used when examining the relationship between chronic conditions and QoL, with the SF-36 (or a version thereof) the most prominent and frequently used (34,229,230). The SF-36 emerged from research into measuring health status, but quickly became frequently used as a QoL measure - reflected in its use in the International Quality of Life Assessment Project during the 1990s (229). Utility-based measures such as the EQ-5D (231) and the HUI (232) (described in Sections 2.2.4, 2.3.3 and 2.3.4) also fall within the HRQoL family of measures.

It has been argued that these types of measures are too focussed on health and physical function to adequately capture QoL (204), and are more appropriately defined as measures of health status rather than QoL (66,204,230). This is not just an issue of terminology: if QoL is equated with health status, we may obscure the capacity of people in poor health to see themselves as having good QoL. All definitions and measures of QoL involve implicit value judgements – however, it is important that these value judgements are appropriate and compatible with the values of the population under study. As Hickey et al. put it, HRQoL measures may “impose an external value system on patients/responders that may have little meaning for that person at that particular point in time” (34) (p. 988).
In particular, definitions of QoL based on health status may be inappropriate for older people. Schwartz et al. describe a process of response shift, whereby the basis of people's responses to QoL measures change as their circumstances change (211,212). People can adapt to worsening circumstances, and rather than report a lower QoL score, can shift their internal standards or priorities in relation to QoL. There are three types of response shift: change in standards (re-calibration), priorities (re-prioritisation) or meanings (re-conceptualisation). For example, as people age, they may undergo a downward shift in internal standards and expectations in relation to physical function and overall health (233–235). Alternatively, older people may reduce the importance they attach to physical health domains of QoL, or re-define QoL to exclude domains related to physical health.

Qualitative evidence suggests that older people themselves do identify health as a critical component of QoL (236). However, they also value other life domains, such as social contacts, activities and family relationships, at least as much as health and function (237). Furthermore, the value of factors such as health and wealth may lie in the extent to which they facilitate more fundamental needs, which are essential to QoL: attachment, social roles, enjoyment, security and control (238). Quantitative evidence, outlined in Chapter 2, also shows that chronic conditions have weak relationships with mental domains of HRQoL, highlighting the possibilities for good QoL in a context of poor health.

A disparity between older people's conceptions and researcher-led conceptions of QoL is also reflected in research on "successful ageing" (239). The concept of successful ageing can be defined in a number of ways, but can broadly be equated to the idea of having good QoL in older age. The majority of studies in this area define successful ageing in terms of physical health and/or function (35). However, these studies tend to detect a lower proportion of "successfully aged" older people, compared with those which define successful ageing in terms of life satisfaction (35). Similarly, one study which examined older people's self-ratings of successful ageing found that 92% of the sample considered themselves "successfully aged", despite the fact that 85% had chronic conditions, and 78% had at least some functional impairment (240).

Of course, this does not suggest that good health and physical function are irrelevant to older people's QoL. Good physical health can be an important facilitator of good QoL across
life domains, including social relationships and participation. Nevertheless, it is not necessary or sufficient for good QoL and is therefore an inappropriate primary end-point. It is necessary to also take into account the individual’s overall subjective appraisal of their life.

In conclusion, while HRQoL measures are frequently used when examining the consequences of chronic disease among older people, they do not adequately capture the multi-dimensional nature of QoL. A number of alternatives have been recommended. First, measures have been developed that capture a broader range of QoL domains, focusing on those that are relevant for older people. Two of these are the Older People’s QoL Questionnaire (OPQOL) and the World Health Organisation Quality of Life – Old (WHOQOL-OLD) module, which are discussed in Section 3.3. Second, Moons et al. recommend the use of simple evaluative measures of QoL, such as life satisfaction or single-item QoL measures (66), which avoid making any assumptions regarding the nature of QoL. This approach is discussed in Section 3.4. Finally, a third approach attempts to identify a theoretical basis for a definition of QoL that is applicable across individuals. This approach is exemplified by eudaimonic measures of wellbeing, and the CASP-19 measure, which are discussed in Section 3.5 and 3.6 respectively.

3.3 Measuring QoL at Older Ages – OPQOL and WHOQOL-OLD

The Older People’s QoL questionnaire (OPQOL), and the World Health Organisation Quality of Life–Old (WHOQOL-OLD) measures of QoL, were developed specifically for older people. The OPQOL was constructed on the basis of a large-scale British national survey of older people (aged 65+) (241). The measure comprises a broad range of life domains: psychological wellbeing and positive outlook, health and functioning, social relationships, leisure activities, neighbourhood resources, adequate financial circumstances and independence (242). The WHOQOL-OLD (243) is a supplementary module to the general-population WHOQOL measure of QoL, known as the WHOQOL-100 (244). The module was developed using a combination of focus groups with older people and an expert-led Delphi method, to identify QoL domains that were important to older people but not captured by the WHOQOL-100 measure (243). In addition to the broad WHOQOL domains: physical, psychological, social and environmental, the WHOQOL-OLD module comprises the
following further sub-scales: sensory abilities; autonomy; past, present and future activities; social participation; death and dying; and intimacy.

To date, most of the studies using the OPQOL have focussed on its psychometric properties, rather than empirical associations with health or other factors (245,246). In one study that did evaluate the effects of physical health on the OPQOL measure, an overall measure of biomedical factors (chronic disease and disability) was associated with a reduced OPQOL score at 7-8 years follow-up (247). However, this study did not compare effects of physical health across different domains of the OPQOL. In addition, the association was not significant once psychological factors – perceived self-efficacy and optimism – were adjusted for.

In the systematic review reported in Chapter 2, five studies were identified that examined the relationship between chronic disease and the general WHOQOL measure of QoL (97,101,185–187) (see Section 2.3.7). Chronic conditions affected the physical domains of the WHOQOL, but effects on psychological, social and environmental domains were less consistent. No general-population study was identified which examined how chronic disease affects the WHOQOL-OLD supplementary domains.

Both the OPQOL and WHOQOL are undoubtedly useful in the study of QoL among older people. They are grounded in empirical examination of older people's lay conceptions of QoL, particularly the OPQOL, which is based on a national survey. They are multi-dimensional, and cover a range of facets that are likely to be important to older people's QoL. However, in specifying the content of QoL as a series of important life domains, these measures do not have a clear delineation between constituents and determinants of QoL. They do not allow examination of the complex ways in which factors such as health, financial circumstances or social relationships operate together and separately to influence a person's overall QoL. For example, perceived self-efficacy and optimism were identified as the most important determinants of total OPQOL score (247). However, items capturing these constructs are included in the OPQOL: *I have a lot of control over the important things in my life* (self-efficacy) and *I tend to look on the bright side* (optimism).
This problem is also present in one alternative method to capturing QoL. Individualised QoL measures allow respondents to nominate, rate and weight their own QoL domains (248,249). An overall QoL score is then calculated based on the weighted ratings, allowing respondents to attach differential importance to different life domains, while nevertheless capturing an overall score that is comparable across individuals. However, this approach still makes it difficult to examine the determinants of QoL, as they are incorporated into the overall QoL score. As noted above, it has been suggested that the only approach that avoids making an assumption about the nature of QoL, and conflating its constituents and determinants, is to use simple evaluative measures (66). These are discussed in the next section.

3.4 Simple Evaluative Measures of QoL

Two examples of simple evaluative measures of QoL were identified in the literature review outlined in Chapter 2: Cantril's "ladder of life" (250) and single-item QoL measures (195) (see Section 2.3.9). Both types of measures ask respondents to rate the quality of their life on a numeric rating scale, usually with between five and 10 points. Bowling (2007) notes that the value of these measures lies in the fact that "respondents can base their overall ratings on whatever is pertinent to them, rather than being restricted to a pre-determined list" (251) (p. 311). Single-item QoL ratings have been found to be negatively affected by chronic conditions and disability, and physical health overall explains a significant amount of the variance in ratings (195,251,252).

Another commonly used simple evaluative measure of QoL is life satisfaction. Existing studies indicate mixed evidence for the effect of chronic conditions on life satisfaction among older people (see Section 2.4.7). Life satisfaction is a core constituent of subjective wellbeing (SWB). As noted in Chapter 2, SWB and QoL are close conceptually with convergent definitions. However, the two literatures have existed somewhat apart (214). Life satisfaction is conceived of as a cognitive appraisal of a person's life situation relative to an overall standard, which is specific to the person (215,216,253). This appraisal is based not on the sum-total of a person's negative and positive experiences, but rather how those experiences are processed to construct an overall representation of a person's life (254). This approach emphasises individual subjective satisfaction or happiness with life, and is
often referred to as hedonic wellbeing. Multi-item measures of life satisfaction are available (255), though single-item measures have been found to be as reliable and valid as multi-item measures (38).

Life satisfaction is a useful construct for measuring QoL, and is particularly useful for avoiding conflating constituents and determinants. It avoids making any assumption regarding the nature of QoL, beyond a simple cognitive appraisal of life quality. However, its simplicity is also its major disadvantage. As noted in Chapter 2, measures that assume a unidimensional overall measure of QoL may obscure differential effects of physical health status on different domains of QoL. In addition, measures of life satisfaction do not acknowledge the multi-faceted nature of QoL. In particular, dimensions of QoL related to having a purpose in life, and fulfilling human potential, are overlooked (256,257). These dimensions are central to measures of eudaimonic wellbeing, discussed in Section 3.5.

### 3.5 Eudaimonic Wellbeing

Broader concepts of wellbeing, which attempt to incorporate dimensions related to meaning, purpose and fulfilment are often termed "eudaimonic" wellbeing, from a Greek word which can be translated as "human flourishing" (257). In contrast to unidimensional measures of life satisfaction, eudaimonic wellbeing is seen as multi-dimensional. One approach to defining eudaimonic wellbeing, which originated with Ryan & Deci, focuses on self-determination. This comprises autonomy, competence and relatedness (257,258). A measure of basic psychological needs satisfaction (BPNS) has been developed on the basis of this theory (259), though it does not appear to have been used as an outcome measure to evaluate effects of chronic conditions.

Carol Ryff has also developed a measure of eudaimonic wellbeing, referred to as psychological wellbeing (PWB). This measure comprises self-acceptance, positive relations with others, personal growth, purpose in life, environmental mastery and autonomy (256,260). Much of the recent research using this measure has focussed on how PWB predicts physical health, rather than how it is shaped by it (261). However, one study with midlife adults found that number of chronic conditions was significantly correlated with life satisfaction and negative affect, but not with purpose in life and positive relations with
others (262). This suggests that at least some dimensions of eudaimonic wellbeing may be relatively unaffected by chronic disease burden.

More recently, the CASP-19 measure of QoL, which was developed from the perspective of needs satisfaction theory, has attempted to capture eudaimonic dimensions of QoL (263). This measure is discussed in Section 3.6 below.

3.6 The CASP-19 Measure of QoL

The CASP-19 was developed in response to a need for a broader measure of QoL for use among older people, as an alternative to widely-used HRQoL measures. It was intended that it would avoid conflating constituents and determinants of QoL (43,44). Similar to measures of eudaimonic wellbeing, it takes as its starting-point a theory of what constitutes QoL, based on Maslow's theory of human needs (45). It is assumed that humans share a common set of needs, and that QoL is best thought of in terms of satisfaction of those needs. For older people in the developed world, basic needs such as shelter, food and clothing are generally met, and the model therefore focuses on four key higher needs: control, autonomy, self-realisation and pleasure. The measure aims to capture an individual’s appraisal of the extent to which these human needs are satisfied – in other words, the extent to which they are living their life in a way that they want to (control), free from outside restrictions (autonomy), and in a way that provides both enjoyment (pleasure) and active fulfilment of human potential (self-realisation). The item content (displayed in Table 3-1) was developed specifically to be appropriate for older people. For example, it asks the participant to "look back on my life", and asks how satisfied they are with "the way my life has turned out".

<table>
<thead>
<tr>
<th>Item</th>
<th>CONTROL</th>
</tr>
</thead>
<tbody>
<tr>
<td>c1</td>
<td>My age prevents me from doing the things I would like to do</td>
</tr>
<tr>
<td>c2</td>
<td>I feel that what happens to me is out of my control</td>
</tr>
<tr>
<td>c3</td>
<td>I feel free to plan for the future</td>
</tr>
<tr>
<td>c4</td>
<td>I feel left out of things</td>
</tr>
<tr>
<td>AUTONOMY</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>c5</td>
<td>I can do the things that I want to do</td>
</tr>
<tr>
<td>c6</td>
<td>Family responsibilities prevent me from doing what I want to do</td>
</tr>
<tr>
<td>c7</td>
<td>I feel that I can please myself what I do</td>
</tr>
<tr>
<td>c8</td>
<td>My health stops me from doing the things I want to do</td>
</tr>
<tr>
<td>c9</td>
<td>Shortage of money stops me from doing the things I want to do</td>
</tr>
</tbody>
</table>

| PLEASURE | 
|---|---|
| c10 | I look forward to each day |
| c11 | I feel that my life has meaning |
| c12 | I enjoy the things I do |
| c13 | I enjoy being in the company of others |
| c14 | On balance, I look back on my life with a sense of happiness |

| SELF-REALISATION | 
|---|---|
| c15 | I feel full of energy these days |
| c16 | I choose to do things that I have never done before |
| c17 | I feel satisfied with the way my life has turned out |
| c18 | I feel that life is full of opportunities |
| c19 | I feel that the future looks good for me |

This conceptual model of QoL has a number of parallels with the concept of eudaimonic wellbeing outlined above, as well as other strands of the theoretical and empirical literature on QoL in older people. Control and autonomy are included as key elements in Ryff’s concept of eudaimonic wellbeing (256), while Ryan & Deci place autonomy at the centre of their self-determination theory of wellbeing (257,258). Doyal & Gough’s (264) elaboration of needs satisfaction theory posits personal autonomy as a critical need and important pre-condition for meeting other higher needs, including purpose in life, and full participation in society. Personal autonomy was also identified as an essential component of QoL for older people in the development of both the WHOQOL-OLD supplementary module (243) and the OPQOL (265).

Self-realisation is also a key aspect of eudaimonic wellbeing. It relates to the pursuit of a purposeful and fulfilling life, in a way that is consistent with identity and self-concept. It draws on Giddens’ (266) articulation of self-realisation as reflexive construction of the self.
This is seen as a necessary response to a modernity disembedded from tradition, and the consequent need to define our own purpose and meaning in life in a way that is authentic and consistent with our own sense of self. This need also relates to a number of key concepts in Ryff’s framework (256), including purpose in life, growth and self-acceptance. Meaning and purpose have been found to mediate the effects of a wide range of life circumstances, including health, disability, and financial resources, on single-item QoL ratings (267).

The fourth need, pleasure, aims to capture the extent to which a person views their life as enjoyable and pleasurable. This need appears to align more closely with hedonic dimensions of wellbeing (268). However, current evidence suggests that it is not more strongly associated with other measures of hedonic wellbeing, such as life satisfaction or positive affect, relative to the other dimensions of CASP-19 (263).

The pursuit of both self-realisation and pleasure can be viewed as key characteristics of the "Third Age" as described by Laslett: a period of life focused on personal development once the challenges of career development and child-rearing have been met (53). The concept of the Third Age challenges traditional stereotypes of ageing as a period of general decline in health and wellbeing. The CASP-19 approach to QoL measurement is thus based on positive concepts of psychology and ageing, with an emphasis on the potential for continuing development and improved wellbeing through older age. This approach contrasts with the more problem-focused HRQoL measures discussed above, which focus on measuring deficits in physical and mental health, rather than capturing the potential for positive functioning.

Measures of wellbeing can be categorised as evaluative, eudaimonic or experience-based (which relates to feelings or affective wellbeing) (269). The control, autonomy and self-realisation CASP-19 dimensions align with eudaimonic conceptions of wellbeing, and the pleasure dimension includes cognate items: for example, "I feel my life has meaning". Evaluation relates to global measures of life satisfaction: this is captured by the CASP item "I feel satisfied with the way my life has turned out", which tends to be highly correlated with generic measures of life satisfaction (268). CASP thus captures both evaluative and eudaimonic dimensions of wellbeing.
The CASP-19 measure attempts to capture a middle-ground in defining what QoL is. It specifies the content of QoL based on theory, assuming an objective set of needs shared by all individuals, but allows for diverse satisfiers of these needs. As a measure, it therefore involves a more complex and theoretically based definition of QoL, relative to more simplistic life satisfaction measures (43), but avoids specifying a series of life domains. It is intended to allow factors such as physical health or social relationships to have differential associations with QoL across individuals and allows us to measure these associations. As noted above (Section 3.2), older people value things like health, wealth and relationships to the extent that they facilitate more fundamental needs which are essential to QoL: attachment, social roles, enjoyment, security and control (238). The CASP-19 measure aims to capture these more fundamental needs and is therefore a more appropriate end-point for measuring QoL, in contrast to measuring a series of life domains which actually contribute to, rather than constitute, QoL.

As a theoretically based QoL measure, conceptually distinct from health and function and designed specifically for older people, the CASP-19 measure has filled a gap in the market of QoL measures. It has been rapidly adopted by large-scale surveys of ageing, including the English Longitudinal Study of Ageing (ELSA), Survey of Health, Ageing and Retirement in Europe (SHARE) and the Irish Longitudinal Study of Ageing (TILDA). The initial psychometric validation study with the small Boyd-Orr cohort was promising, supporting the validity of the scale as an overall measure of QoL with four dimensions covering control, autonomy, self-realisation and pleasure (43).

However, extensive psychometric validation of the measure was not completed prior to widespread adoption. More recent studies have failed to establish the psychometric validity of the originally proposed measurement model, comprising four factors relating to the four needs, each loading on to an overall second-order QoL factor (46,47). In particular, research suggests that the control and autonomy sub-scales are not sufficiently distinct, empirically or conceptually (46,47). However, even combining the items of these sub-scales into a single control/autonomy factor does not result in a well-fitting factor structure. A key aim of this thesis is to evaluate the fit of established measurement models of CASP-19 in data collected as part of TILDA, and identify a revised structure and item composition if necessary. Care will be taken to ensure that any revised version remains consistent with
the original conceptual model for the measure, as set out by Hyde et al. (43) and Higgs et al. (44). The procedure for this analysis will be outlined in Chapter 5, with findings reported in Chapter 6.

3.7 Measures of QoL: Conclusions

It is clear that there are multiple and diverse approaches to measuring QoL. It is challenging to balance the need to accommodate diverse concepts of QoL, while also retaining comparability across individuals. Conceptual precision and delineation must be balanced with the need to capture and acknowledge multiple dimensions of QoL. CASP-19 is a multi-dimensional measure of QoL, which is broader than HRQoL and distinct from physical health and function. It thus facilitates the capture of good QoL in a context of poor health, and defines QoL as more than just an absence of physical or mental problems.

It is difficult to establish conclusively that any measure is a ‘true’ or comprehensive reflection of QoL. While conceptual analysis is helpful in disentangling some of the complexities of the area, it must not take the focus away from useful empirical research employing the concept – research carried out for the purpose of “description ... explanation ... and ultimately prediction” (34) (p. 990). The characteristics of the CASP-19 measure outlined above made it particularly useful for the current research purposes, especially in its aim to distinguish the concept of QoL and its determinants. This made it possible to study the relationships between QoL and health in a clear and coherent manner, and was thus an appropriate measure for this thesis. The next step was to identify a conceptual framework and theoretical causal model for the relationship between chronic conditions and QoL. This will be the focus of Chapter 4.
Chapter 4  Models of the Relationship between Chronic Conditions and QoL

4.1 Introduction

The central aim of this thesis was to empirically evaluate an explanatory model of the relationship between chronic disease and QoL among older adults. Chapter 3 focussed on the theory of QoL measurement, and a measure of QoL (the CASP-19) was identified for use in this thesis. Chapter 2 included a review of current evidence concerning the relationship between chronic disease and QoL in general-population samples of older adults. The findings reported were mixed, and it was concluded that it is likely that effects of chronic conditions on QoL are dependent on a variety of factors, including the severity of the condition, functional impacts, and the characteristics of the person themselves and the context in which they live. In this chapter, existing theory and evidence relevant to this complex set of relationships will be reviewed. This review will inform a conceptual framework and a hypothetical causal model for this thesis.

In Section 4.2, available conceptual frameworks and theoretical models which seek to describe and explain causal pathways between chronic conditions and QoL will be evaluated. Section 4.3 will draw on resilience theory, to identify potential protective factors in the pathway between chronic conditions and QoL. The chapter will conclude by setting out the conceptual framework for the thesis, and a hypothetical causal model of the relationship between chronic disease and QoL (Section 4.4).

4.2 Models of the Pathway between Chronic Conditions and QoL

Section 4.2 will examine available theoretical models relevant to the relationship between chronic disease and QoL. Each theoretical approach comprises a causal model which describes and explains the relationship between chronic disease and QoL, and a conceptual framework which describes and defines the different components in the causal pathway. The emphasis in this section is on identifying potential mediating factors, for example disability, that form a pathway between chronic conditions and QoL. Moderating factors will be discussed in Section 4.3.
Three potential models will be examined in Sections 4.2.1 to 4.2.3: the Wilson-Cleary model (WCM) (270), the Disablement Process model (DPM) (271) and the World Health Organisation’s International Classification of Disability, Health and Function (ICF) (272). In a recent review, Bakas et al. (273) noted that a relatively small number of studies in the QoL literature have explicitly invoked a model of QoL. Of the 100 studies identified that did, the most commonly used were the WCM and the ICF. The DPM is more often used to explain the pathway between disease and disability, but is nevertheless highly relevant to understanding how health affects QoL.

The differences and similarities across the models are discussed in Section 4.2.4, including some conceptual difficulties with how different stages of the pathway tend to be operationalised. Section 4.2.5 includes a summary and evaluation of the available empirical evidence for each proposed stage in the pathway. Some of the studies reviewed in this section were also identified in the systematic review reported in Chapter 2 (79,182). However, evidence from a broader range of studies is examined here, for example, studies which examined either chronic disease or QoL but not both together, or did not include a general-population sample of older people. Also included is one study which was outside the time-range of the systematic review (274). Section 4.2 will conclude with a discussion of the role of affective wellbeing in the pathway between chronic conditions and QoL (Section 4.2.6).

4.2.1 Wilson-Cleary Model (WCM)

The Wilson-Cleary model (WCM) was initially developed as a taxonomy of health outcomes and the causal relationships between them (270). Biological factors, measured by medical diagnoses or other indicators of pathology, initially affect symptoms (defined as individual perceptions of bodily impairments). These in turn affect the ability to perform activities in physical, cognitive and social domains (functional limitations). This leads to more negative perceptions of overall health, which in turn leads to more negative subjective appraisals of overall QoL. The model was later developed to explicitly include characteristics of the individual and environment as influences on these domains (275). This modified model is displayed in Figure 4-1.
Figure 4-1: Wilson-Cleary model of QoL (270), modified by Ferrans et al. (275)

The WCM is the most widely used model of health and QoL, with 20 studies identified in the review by Bakas et al. (273). The original paper has been cited 2,197 times [www.google.com/scholar, last accessed 03/01/2015]. However, it has rarely been empirically tested in its entirety (273). The type of analysis required to test complex direct and indirect relationships involves advanced statistical techniques, large samples and data on a wide range of variables. Six studies were identified, however, which empirically tested the direct and indirect effects hypothesised in the model. These are displayed in Table 4-1 on p. 120.

Evidence from three studies with disease-specific samples: AIDS (276) and heart disease (277,278); found broad support for symptoms, function and general health perceptions as mediators of the relationship between disease severity and QoL. Three further studies included general-population samples of older people (79,274,279). Sullivan et al. evaluated the most comprehensive version of the model, reporting that chronic conditions affected QoL via the following pathway: symptoms, physical function, activity, social function and general health perceptions (274). Orfila et al., already referred to in Section 2.3.12, tested a more limited version of the model. It was demonstrated that objective functional capacity mediated the effect of chronic conditions on HRQoL (79). Halvorsrud et al. (279) examined the effect of depressive symptoms, rather than physical health, on overall QoL and identified physical function as a mediator of this relationship.
Overall, studies that have empirically tested the main WCM pathways broadly support the model. It would appear that underlying pathology affects QoL via symptom status, functional limitations and general health perceptions. It should be noted that there is not necessarily complete mediation along the pathway - evidence was found for a direct effect of symptom status on QoL (274,276,278,279) and for function on QoL (274,277–279). However, there are a number of conceptual issues with the way that the model has been operationalised, and these will be discussed in Section 4.2.4.

4.2.2 Disablement Process Model (DPM)

The Disablement Process model (DPM) (271), similarly to the WCM, sets out a dominant pathway proceeding from underlying pathology, to bodily impairments, to functional limitations and ultimately to disability, with individual and environmental characteristics also incorporated into the model (see Figure 4-2). The model was informed by an earlier model proposed by Nagi and described in Pope & Tarlov (1991) (280). QoL is not a core focus of this model, which may explain why Bakas et al. (273) did not identify any studies using this model to examine the relationship between physical health and QoL. However, Verbrugge et al. (271) explicitly extended the model to include global QoL outcomes, conceived as a range of outcomes from wellbeing to institutionalisation.

Figure 4-2: The Disablement Process, Verbrugge et al. (271)
The key difference between the DPM and the WCM is the distinction between basic activities and disability, which are both defined as functional limitations in the WCM. In the DPM, activity limitations are defined as limitations in *basic* activities, such as walking or reaching. Restrictions in more *complex* and purposeful activities, such as instrumental activities of daily living, or paid work, are defined as disability. This acknowledges that a basic limitation may not result in a disability, especially if features of the environment are modified to accommodate it. It thus extends the WCM by suggesting that participation in more meaningful activities is a further step in the causal chain, mediating the relationship between more basic limitations and QoL. In addition, the bodily impairments concept has a more objective orientation than symptom status in the WCM, emphasising impairments in bodily systems and functions, rather than patient perceptions. There is likely to be some overlap between symptoms and bodily impairments, however, as some deficits in body function, such as pain, can only be measured by self-report.

Most studies that have empirically tested the DPM examined disability as the end-point (see Table 4-1). These studies support bodily impairment and activity limitation as predictors of disability trajectory over a four year period (281), and as mediators of the cross-sectional relationship between chronic conditions and disability (282). Femia et al. further reported that depression and subjective health mediated the relationship between function and disability (283).

Two studies were identified which assessed QoL as an outcome of the disablement process, both using samples of older people. Peek et al. (284) found that bodily impairment affects HRQoL via function and disability, providing support for the DPM. Schilling et al. (285) found that having more chronic conditions and increased disability were associated with lower life satisfaction. However, no evidence was found for an indirect effect, as chronic conditions had a weak association with disability. Overall, available empirical evidence supports the core DPM, although the evidence for the extension of the model to include QoL is limited.
4.2.3 WHO ICF Model

The WHO ICF was endorsed by the WHO in 2001 as a basis for a standard classification of health, functioning and disability (272). It was initially intended as a classification scheme rather than a model of a causal pathway (286). Nevertheless, researchers have used the ICF to examine empirical relationships across health conditions, function and disability, often drawing on the stages of the disablement process pathway (287–289). The ICF includes three distinct, positively framed domains of functioning: body function, activity and participation. Disability is defined as a deficit in any of these three domains, with these deficits usually referred to as bodily impairments, activity limitations and participation restrictions (290). As is reflected in Figure 4-3, the model is rarely presented as a linear process, with direct effects across domains at each stage of the model.

![Figure 4-3: The WHO ICF Framework of Functioning, Disability and Health (ICF), WHO (272)](image)

The bodily impairment domain is broadly equivalent to the domain of the same name in the DPM. The ICF also shares the emphasis in the DPM on the distinction between basic functional limitations and the ability to carry out more purposeful activities. Compared with the DPM, however, the activity category is broader in this framework. Activities such as self-care and dressing are included, sometimes under a sub-classification of complex
activities (289). The *participation* domain focuses on activities and roles which are important for full participation in society. *Participation* restrictions are defined broadly, as "problems an individual may experience in involvement in life situations" (291). It has been suggested that the boundaries between *participation* and *activity* are not defined clearly enough (286). Eyssen et al. suggest that participation can be distinguished by invoking social context: participation requires other people, and must involve performing a role – e.g., friend, worker, volunteer (292). Within participation, Klumb and Maier (293) distinguish between consumptive and productive activities – consumptive activities are done for their own sake (e.g., socialising, going to the pub) whereas productive activities have a further end-goal in mind (e.g., volunteering, caring for somebody). In empirical studies of the ICF, a range of activities have been included as *participation*: paid job hours (287,288,291), volunteering and socialising (287,288,291,294), and domestic tasks such as cooking (287,291,294) (see Table 4-1).

The ICF model is widely cited, with a recent review identifying 670 articles using the ICF model published between 2001 and 2009 (295). However, empirical investigation of the model is rare in the current literature. Most of the 670 articles reviewed consisted of conceptual discussion or instrument development, with only 25% applying the model in clinical or theoretical contexts. Bakas et al. (273) identified 5 studies using the ICF as a model of QoL, none of which used the framework for correlational or descriptive studies examining relationships between illness, disability and QoL. Again, the framework was used as a basis for instrument development or conceptual analysis. This is not unexpected, given that the model was primarily proposed as a common classification scheme for function and disability.

A number of studies, however, have examined empirical relationships between the ICF domains. These studies found that physical and psychological indicators of *body function* and *activity* predict *participation* frequency (294), and mediate the effect of chronic conditions on *participation* (182,287,288), on HRQoL (182,288) and on happiness (182). However, contrary to the model as outlined in Figure 4-3, evidence has not supported the role of *participation* as a mediator of the effects of chronic conditions, *body function* or *activity* on QoL (182,288). Overall, existing findings regarding the role of *participation* in the
model are mixed. For example, physical body function and activity variables may not affect participation once psychological body function and activity variables are adjusted for (294).

In sum, the ICF parallels the DPM by identifying three domains of consequences of disease: body function, activity and participation. The definition generally used of participation in the ICF model is narrower than that of disability in the DPM, comprising meaningful activities beyond those necessary for daily life. As noted above, the ICF was not necessarily intended to be used as a causal model. However, there is considerable value in using the conceptual schema put forward by the ICF in empirical studies of causal pathways between chronic conditions and QoL, precisely because it has been put forward as a common framework or language to describe disability (290). Dale et al. (289) have suggested that the ICF has become “the dominant model for exploring the consequences of a health condition on disability” (p. 170).
Table 4-1: Studies testing causal models of chronic disease, function, disability and QoL

<table>
<thead>
<tr>
<th>Reference Setting N</th>
<th>Study Design</th>
<th>Condition / Pathology</th>
<th>Body Function/ Symptoms</th>
<th>Activity / Function</th>
<th>Disability</th>
<th>Participation</th>
<th>Health Perception</th>
<th>QoL outcomes</th>
<th>Pathways Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilson Cleary Model (WCM)</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Sousa 2006 (276) AIDS patients, California n = 395</td>
<td>Cross-sectional cohort</td>
<td>HIV severity (CD4 count)</td>
<td>Fatigue, confusion, fever, gastro discomfort, shortness of breath, vomiting</td>
<td>Activities, reach, grip, eating, dressing, hygiene, walking, arising</td>
<td>Not measured</td>
<td>Not measured</td>
<td>General Health Perception (GHP)</td>
<td>QoL (Mental Health, Disease Worry)</td>
<td>CD4 → Symptoms → QoL CD4 → Symptoms → GHP → QoL CD4 → Symptoms → Function → GHP → QoL</td>
</tr>
<tr>
<td>Krethong 2008 (278) Heart failure patients, Thailand n = 422</td>
<td>Cross-sectional cohort</td>
<td>Cardiac Function (LVEF)</td>
<td>Cardiac Symptom Survey</td>
<td>NYHA functional classification</td>
<td>Not measured</td>
<td>Not measured</td>
<td>GHP</td>
<td>Minnesota Living with Heart Failure Questionnaire</td>
<td>Function → HRQoL Symptoms → HRQoL Symptoms → Function → GHP → HRQoL Disease Severity → Function → GHP → HRQoL</td>
</tr>
<tr>
<td>Höfer 2005 (277) Heart disease patients, Austria n = 432</td>
<td>Cross-sectional cohort</td>
<td>No. of diseased arteries, risk factors</td>
<td>Angina symptoms</td>
<td>SF-36 Physical function</td>
<td>Not measured</td>
<td>Not measured</td>
<td>GHP</td>
<td>MacNew Heart Disease QoL Questionnaire</td>
<td>Function → HRQoL Disease Severity → Symptom → Function → HRQoL</td>
</tr>
<tr>
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<td>Study Design</td>
<td>Condition / Pathology</td>
<td>Body Function / Symptoms</td>
<td>Activity / Function</td>
<td>Disability</td>
<td>Participation</td>
<td>Health Perception</td>
<td>QoL outcomes</td>
<td>Pathways Identified</td>
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<tr>
<td>Wilson-Cleary Model (WCM)</td>
<td>Cross-sectional cohort</td>
<td>No. of conditions</td>
<td>Pain, somatic symptoms</td>
<td>SF-20 Physical Function score</td>
<td>ADL/ IADL score</td>
<td>SF-20 Social function</td>
<td>GHP</td>
<td>Cantril's Ladder</td>
<td>Conditions → Physical function Conditions → GHP Symptoms → Social function Symptoms → GHP Physical function → Social function Physical function → GHP Conditions → Symptoms → Physical function → Activity → Social function → GHP → QoL</td>
</tr>
<tr>
<td>Sullivan 2000 (274) General pop., aged 57+, Netherlands n = 5279</td>
<td>Cross-sectional cohort</td>
<td>Geriatric Depression Score</td>
<td>SF-12 Physical function</td>
<td>Not measured</td>
<td>Not measured</td>
<td>Not measured</td>
<td>Health satisfaction, WHOQOL-Old total score</td>
<td>Symptoms → Function → Health satisfaction → HRQoL</td>
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<tr>
<td>Halvorsrud 2010 (279) General pop., aged 60+, Norway n = 89</td>
<td>Cross-sectional cohort</td>
<td>No. of chronic conditions</td>
<td>Objective functional capacity</td>
<td>Not measured</td>
<td>Not measured</td>
<td>Not measured</td>
<td>Nottingham Health Profile</td>
<td>Conditions → HRQoL Conditions → Function → HRQoL</td>
<td></td>
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<tr>
<td>Orfila 2006 (79) General pop., aged 60+, Spain n = 544</td>
<td>Cross-sectional cohort</td>
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<td>Body Function / Symptoms</td>
<td>Activity / Function</td>
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<tr>
<td><strong>Wilson-Cleary Model (WCM)</strong></td>
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| Bentley 2013 (296) | Longitudinal cohort | Not measured | Not measured | ADLs | Life-space mobility* | Not measured | Not measured | SF-12 | Functional Status → Life-space mobility → HRQoL  
| General pop., aged 65+, Alabama | | | | | | | | | Functional Status → HRQoL |
| | | | | | | | | | |
| **Disablement Process Model (DPM)** | | | | | | | | | |
| Van Gool 2005 (282) | Longitudinal cohort | No. of chronic conditions | Disease-specific symptom lists (e.g., pain, shortness of breath, stiffness) | Hearing, vision, MMSE, self-reported mobility, objective performance tests | ADLs, limiting daily activities | Not measured | Not measured | Not measured | Pathology → Impairment → Activity → Disability |
| General pop., aged 55+, Netherlands | | | | | | | | | |
| | n = 1,110 | | | | | | | | |
| | | | | | | | | | |
| Fauth 2007 (281) | Longitudinal cohort | Not measured | Vision, hearing, lung function, grip strength, blood oxygen and pulse | Physical limitations, MMSE, recall | ADL trajectory | Not measured | Not measured | Not measured | Impairment → Disability  
<p>| General pop., aged 86+, Sweden | | | | | | | | | Function → Disability |
| | n = 300 | | | | | | | | |</p>
<table>
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<th>Setting</th>
<th>Study Design</th>
<th>Condition / Pathology</th>
<th>Body Function / Symptoms</th>
<th>Activity / Function</th>
<th>Disability</th>
<th>Participation</th>
<th>Health Perception</th>
<th>QoL outcomes</th>
<th>Pathways Identified</th>
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<tr>
<td>Femia 2001 (283)</td>
<td>Cross-sectional cohort</td>
<td>Grip strength, vision</td>
<td>Upper and lower body limitations; MMSE</td>
<td>ADLs, IADLS</td>
<td>Social integration</td>
<td>Subjective health</td>
<td>Depression</td>
<td>Impairment → Disability</td>
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<td></td>
<td>Same-sex twins, aged 79+, Sweden n = 203</td>
<td>Not measured</td>
<td>Not measured</td>
<td>Not measured</td>
<td>Not measured</td>
<td></td>
<td></td>
<td>Impairment → Depression</td>
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<td>Impairment → Subjective health</td>
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<td>Depression → Disability</td>
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<td>Impairment → Function → Participation → Disability</td>
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<td>Impairment → Function → Depression → Subjective health → Disability</td>
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<tr>
<td>Schilling 2011 (285)</td>
<td>Longitudinal cohort</td>
<td>No. of chronic conditions</td>
<td>Not measured</td>
<td>ADLs, IADLS</td>
<td>Not measured</td>
<td>Not measured</td>
<td>Life satisfaction</td>
<td>Chronic conditions → Life satisfaction</td>
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<td></td>
<td>Living alone, aged 80+, Germany n = 300</td>
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<tr>
<td>Peek 2005 (284)</td>
<td>Cross-sectional cohort</td>
<td>Objective muscle strength</td>
<td>Objective performance tests</td>
<td>ADLs, IADLS</td>
<td>Not measured</td>
<td>Not measured</td>
<td>SF-36</td>
<td>Impairment → Function → Disability → HRQoL</td>
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<td></td>
<td>Hispanic-American, aged 71+, US n = 622</td>
<td>Not measured</td>
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<td>Reference Setting, N</td>
<td>Study Design</td>
<td>Condition / Pathology</td>
<td>Body Function / Symptoms</td>
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<td><strong>WHO ICF Model (ICF)</strong></td>
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<tr>
<td>Perenboom 2012 (287) Chronic disease patients, Netherlands n = 2,941</td>
<td>Cross-sectional cohort</td>
<td>No. of chronic conditions</td>
<td>Perceived problems with body functions / structures</td>
<td>Perceived problems with activities</td>
<td>Not measured</td>
<td>Perceived problems with participation</td>
<td>Not measured</td>
<td>Not measured</td>
<td>Condition → Impairment → Activity → Participation&lt;br&gt;Impairment → Participation&lt;br&gt;Condition → Participation</td>
<td></td>
</tr>
<tr>
<td>Tannenbaum 2007 (182) Women aged 55+, Canada n=2,311</td>
<td>Cross-sectional cohort</td>
<td>No. of chronic conditions and meds</td>
<td>Perceived physical capacity and performance</td>
<td>Not measured</td>
<td>Mobility, self-care, leisure, social relationships, meaningful activity</td>
<td>Not measured</td>
<td>Mental health, HRQoL (health perceptions, vitality)</td>
<td>Conditions → HRQoL&lt;br&gt;Physical health → HRQoL&lt;br&gt;Mental health → HRQoL&lt;br&gt;Conditions → Physical Health → HRQoL&lt;br&gt;Conditions → Mental Health → HRQoL</td>
<td></td>
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<tr>
<td>Van Campen 2007 (288) General pop., aged 12+, Netherlands n = 5,826</td>
<td>Cross-sectional cohort</td>
<td>Duration of illness: none / long / short</td>
<td>Mobility, vision, hearing</td>
<td>Not measured</td>
<td>Participation frequency</td>
<td>Not measured</td>
<td>SF-12; happiness (single item)</td>
<td>Conditions → Activity → Participation&lt;br&gt;Activity → SF-12&lt;br&gt;Chronic conditions → SF-12&lt;br&gt;Activity → Happiness&lt;br&gt;Impairment → Happiness</td>
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GHP = General Health Perceptions, QoL = Quality of Life; HRQoL = Health-Related QoL; SF-36 = Short Form 36; SF-12 = Short Form 12; NYHA = New York Heart Association; ADLs = Activities of Daily Living; IADLs = Instrumental Activities in Daily Living; LVEF = Left Ventricular Ejection Fraction; Pop. = Population; MMSE = Mini Mental State Examination; na = not applicable; meds = medications.

Life-space mobility is defined as extent and frequency of mobility across different levels, including home, neighbourhood, town and out of town.
4.2.4 Causal Models of Chronic Disease and QoL: Conceptual Summary

Each of the three models reviewed in this section are based on the idea that severity of disease, along with the limits placed on what the person can do as a result, are the key pathway by which illness affects QoL. They are rooted in the bio-psychosocial model of illness, considering “the individual not only as a biological but also as a social entity” (297) (p. 169).

Table 4-1 displays the concepts used in each of the studies which empirically examined the three models. It is clear that there is considerable variation in the terminology and concepts used to study relationships across health conditions, disability, and QoL. However, Bakas et al. note (273) that there are considerable conceptual parallels across models of health and QoL: in their review, they found that even studies which used an ad hoc model “used the same concepts as the three global HRQoL models but labelled them differently” (p. 10). Essentially; the WCM, DPM and ICF models all frame the pathway between disease and QoL in a similar way, but carve it up differently. Studies explicitly testing one model often operationalised model components in a way that was similar to another framework. For example, Sullivan et al., in testing the WCM, distinguished basic function from instrumental and basic activities of daily living (IADLS/ADLs) (similar to the DPM), and distinguished a separate domain of social function, similar to the ICF model's concept of participation (274).

Despite the parallels across these models, there are unique distinctions made in each framework. This is illustrated by the differing classification of difficulties in activities of daily living (ADLs) across the models: functional limitations in WCM, disability in the DPM and activity limitations in ICF. These differences illustrate that the boundaries of stages in the pathway may be blurred and difficult to identify. In particular, there appeared to be inconsistencies over whether specific deficits were defined as a symptom/bodily impairment, or as an activity limitation. One study using the ICF, for example, defined cognitive function as a body function (294), while another using the DPM defined it as an activity limitation (283). Conversely, vision and hearing were defined as activity limitations by van Campen & Iedema under the ICF (288), but bodily impairments by Fauth et al. (281) & Femia et al. (283), under the DPM framework. This conceptual ambiguity is, in some
ways, not surprising: if an aspect of impairment is measured by some aspect of function, such as ability to walk a certain distance or grip an object, it could be defined as an activity limitation.

Consistent with findings from the systematic review reported in Chapter 2, measures of HRQoL were commonly used when testing the three models, including versions of the SF-36 (182, 284, 288), disease-specific measures (277, 278) and the Nottingham Health Profile (NHP) (79). However, versions of the SF-36 were also used as measures of activity limitations (274, 277, 279). This illustrates the difficulty in using HRQoL as an outcome of a pathway that already includes evaluations of functional limitations, due to the overlap between these two concepts. As noted in Section 2.4.4 in Chapter 2, three types of health measures can be distinguished: performance, perception and evaluation (210). Evaluation measures, which include QoL assessments, are the most susceptible to response styles, which can confound associations across different measures based on subjective evaluation (214). There is better conceptual separation when a measure based on perception or performance is used to predict HRQoL outcomes. For example, Peek et al. (284) and Orfila et al. (79) use measures of objective functional capacity to predict HRQoL. Nevertheless, this type of analysis is still limited, as it merely tells us about how objective performance is related to subjective evaluations of health, rather than how important objective physical health is to overall QoL appraisals.

There are also similarities and differences in how the issue of bi-directional relationships is handled by each model. While the WCM and DPM models acknowledge reciprocal relationships, with feedback loops, they posit that the overall direction of the model as specified is dominant. While descriptions of the ICF model tend to be much less explicit about the directionality of the relationship, a dominant pathway, from disease through impairment in body function, activity limitation and participation restriction, is implied in how the ICF is described (272) and used (288, 289).

In adopting a specific model and terminology for the purposes of this thesis, it was decided to use the terminology of the ICF. This has been widely accepted as a standard classification for health and functioning. The ICF is also explicit in the distinction made between the three disability domains and QoL. Each of the domains are intended to represent the reality
of a person's circumstances, as measured either by perception or performance, rather than their evaluation of it (298). A hypothetical causal model (Hypothetical Model 1) of the relationship between chronic conditions and QoL, based on the ICF framework and the causal relationships outlined in the WCM and DPM, is displayed in Figure 4-4. Current empirical evidence for each stage of this model is summarised in the next section.

Figure 4-4: Relationship between chronic conditions and QoL: Hypothetical Model 1

4.2.5 Causal Models of Chronic Disease and QoL: Empirical Summary

In this section, the available evidence for each stage of the model outlined in Figure 4-4 is summarised, drawing on studies which specifically test the three models, and the broader available literature. Parallels with other theories in the overall health, disability and QoL literature will also be noted.

4.2.5.1 Impairment in body function

There is considerable evidence from the studies included in Table 4-1 that impairments in body function (or symptoms) directly affect activity limitations (274,276,278,279,283,284), HRQoL (278), mental health (276) and life satisfaction (285). Three studies reported that
impairments in body function mediate the effect of underlying pathology on activity limitations (274,276,277) and mental health (276). Only one study found that symptoms did not mediate the effect of disease severity on activity (277).

### 4.2.5.2 Activity limitations

There is considerable evidence that activity limitations mediate the effects of underlying conditions and/or impairments in body function on participation (274,283,288), HRQoL (79,182,274,277–279,284,288,296), mental health (276,283) and happiness (288) (see Table 4-1). Only one study reported contrary evidence, finding that activity limitations did not mediate the effect of chronic conditions on life satisfaction among older adults aged 80+ and living alone (285). This was due to a weak association between chronic disease and disability. It is possible that chronic conditions have a weaker effect on disability in the oldest-old, as disability is more reflective of general deterioration in physiological and physical functioning rather than underlying disease.

Activity limitations also appear to mediate the effects of physical health on CASP-19. While not a formal analysis of mediation, Netuveli et al. (190) found that the effect of longstanding illness accompanied by activity limitations on CASP-19 score was four times the effect of longstanding illness alone. Similarly, Blane et al. (299) found that functional limitation completely mediated the effect of physiological status (measured by lung function and obesity) on CASP-19 QoL.

### 4.2.5.3 Participation

There is extensive evidence that chronic diseases and poorer physical health are associated with reduced social engagement and participation (291,300–303). Current evidence also indicates that such activities are beneficial for QoL among older people in general (76,252,304) and those with chronic conditions (302,305,306). There is a growing literature on the positive effect on QoL of productive social activities such as volunteering and providing support to others, particularly when the activities are characterised by a high degree of control or engagement (38,307–310).
Restriction in productive activities may be particularly harmful among people with poor health, as they are unable to reciprocate care received from others (311). Qualitative research has highlighted the value of maintaining or developing new social roles in the context of illness (312). A recent study found that cardiovascular patients who provided help in the community reported fewer depressive symptoms and were less likely to experience a new event or die in the subsequent two years (313). However, while there is considerable evidence that social participation is associated with both chronic disease status, and with QoL, there is less evidence that it mediates or explains this relationship. Overall, this is the least well-supported stage of the hypothesised model displayed in Figure 4. Of the three studies which examined the role of participation included in Table 4-1 (182,288), only one found that participation mediated the effect of activity on QoL. However, none of these studies examined eudaimonic dimensions of wellbeing. Participation may mediate effects of chronic conditions on dimensions of QoL related to purpose in life, rather than HRQoL or happiness.

Social participation may also function as a protective factor for the effect of chronic conditions on QoL. In other words, engaging in leisure and productive activities may reduce or buffer the negative effect of physical health on QoL outcomes. This potential role of social participation is discussed in Section 4.3.4.

4.2.5.4 Direct effects of chronic conditions

A number of studies identified a direct effect of chronic conditions on activity limitation (79,182,274,288) and QoL (79,182,187,285), in addition to mediating effects via body function, activity and participation. This highlights that the pathway set out in Figure 4-4 may not fully explain the relationship between chronic conditions and QoL, with chronic conditions retaining a direct, independent effect on QoL even when the other factors along the pathway are taken into account. This is confirmed by the systematic review of the evidence outlined in Chapter 2: studies which examined mediators tended to find partial rather than full mediation (79,158,182,187).
4.2.5.5 Summary

Current theories of how chronic conditions affect QoL suggest a pathway via impairments in body function, activity limitations and participation restrictions. Available empirical evidence supports the mediating role of body function and activity limitation, but the evidence is more tentative for the role of participation. Only a small number of studies have empirically examined the pathways between chronic conditions and QoL in general-population samples of older people (79,274,285). Of these, one uses a HRQoL measure (79), while two use single-item evaluative measures: life satisfaction (285) and Cantril's Ladder (274).

The CASP-19 measure of QoL has been examined as an outcome of functional limitations and bodily impairment (190,299), but not as an outcome of a structural pathway comprising both chronic conditions and measures of disability. This research will thus expand and go beyond previous studies which have examined HRQoL (79), life satisfaction (285) and affective wellbeing (283) as outcomes of a pathway between chronic conditions and QoL.

CASP-19 can be aligned with evaluative and eudaimonic concepts of wellbeing or QoL, which rest on cognitive appraisals of QoL (see Section 3.6). It can therefore be considered distinct from affective wellbeing, which has been identified as the third component of SWB (269). However, it is likely that affective wellbeing plays an important role in relation to both chronic conditions and disability, and it is important that its role is examined and accounted for. This role will be discussed in Section 4.2.6.

4.2.6 Affective Wellbeing

As mentioned in Section 3.4, affective or emotional wellbeing has been identified as an important constituent of overall wellbeing. At the same time, there is strong evidence for high levels of comorbidity of physical illness and affective disorders, such as anxiety and depression (314,315). This co-occurrence potentially confounds the relationship between chronic conditions and QoL. One way to handle this is to exclude individuals with depressive or other psychological disorders from the study, at least as a sensitivity analysis (190).
However, apart from individuals with clinical levels of depression, it is important to examine the role of depressive symptoms, or affective wellbeing. The association between affective wellbeing and physical health among older adults is well established globally (315–318) and in Ireland (319). This includes evidence for the effects of chronic conditions on depressive symptoms (320). Depressive symptoms have also been identified as one of the strongest predictors of QoL (321), including the CASP-19 (36,76). These relationships, however, are likely to be complex. In the WCM, depression was originally omitted as it was argued that psychological factors play a role throughout the model (270).

It is important to include a measure of affective wellbeing not only because it may have a theoretically important role, but also to allow us to test the extent to which QoL judgements are shaped by mood. The relationship between mood or affect and cognitive appraisals of QoL is a subject of some debate. Busseri & Sadava suggest a number of possibilities: cognitive appraisals of QoL and affective wellbeing are 1) entirely distinct entities; 2) part of the same underlying latent construct; 3) distinct parts of an overall composite construct; or 4) affective wellbeing is a determinant of cognitive appraisals (322). However, they conclude that current empirical evidence does not appear to favour any one of these models. This highlights the need to examine and incorporate the role of affective wellbeing in a theoretical model for this thesis.

Affective wellbeing or depressive symptoms could be included at various stages of Hypothetical Model 1 (Figure 4-4) (p. 127). Affective wellbeing could be included as the final outcome of the pathway, either as an indicator of QoL or alongside another QoL measure (271). Alternatively, affective wellbeing may function as a modifier (281,323) or covariate (277) of the pathways in the model. Affective wellbeing, measured by depressive symptoms, has also been included as a mediator of chronic conditions and QoL, generally mediating the effect of disability or function on QoL (276,283). The ICF model includes depressive symptoms and anxiety as body impairments (294), and some of the studies based on the WCM included depressive symptoms, particularly somatic ones, at the symptom stage (276,279).

This diversity in how affective wellbeing is handled perhaps reflects the empirical realities of depressive symptoms as both a determinant and consequence of ill-health and disability.
Ormel et al. (324) summarise the potential causal pathways between depression and physical health. Depression may increase disability via poor health behaviours, or via symptoms such as fatigue or pain. Conversely, disability produced by physical illness may lead to depression. Alternatively, both depression and disability may have a common cause, such as poverty, or a traumatic life event.

In recent years, a number of studies have examined the relationship between disability and depression trajectories (324–327). The consensus appears to be that disability is more predictive of onset of depressive symptoms than vice versa (324,327), suggesting that it makes sense to view affective wellbeing as a mediator of the relationship between disability and QoL. Supporting this, a number of studies of general-population samples of older people, including some of those cited in Table 4-1, have found evidence for level of depressive symptoms as a mediator of the relationship between functional limitations and QoL (274,283,299). In addition, studies in small clinical samples have found that depressive symptoms mediate the relationship between heart disease severity and QoL (328,329).

It is worth noting that evidence has also been reported for depressive symptoms as a moderator of the relationship between chronic disease, disability, and QoL. Depressive symptoms have been found to exacerbate the relationship between poor function and QoL (330,331), and between chronic disease and disability (282). Borsbo et al. (332) found that the effect of pain on QoL may depend on the presence of depressive symptoms. However, the potentially important causal relationship between physical health and affective wellbeing suggests that it should be included in the model as a mediator of the effect of disability on QoL. It is important that it is distinguished from body function, acknowledging that it can be affected by physiological problems, but also that it is a separate entity, affected by illness and disability but also potentially maintained as part of a process of adaptation. Hypothetical Model 2 includes affective wellbeing, and is displayed in Figure 4-5.
4.2.7 Chronic Disease-QoL Pathway: Conclusions

Section 4.2 examined available conceptual frameworks and theoretical causal models for examining the relationship between chronic conditions and QoL, and discussed how affective wellbeing might best be included in such a model. On the basis of this theory and evidence, a hypothetical model of the pathway between chronic conditions and QoL was proposed. Section 4.3 will discuss how characteristics of the person and their environment may function as protective factors along this pathway between chronic conditions and QoL, fostering resilience in a context of poor or declining physical health. The chapter will conclude with a detailed hypothesis statement (Section 4.4). An explanatory model of the relationship between chronic conditions and QoL will be proposed based on the theory and evidence discussed in this chapter. Empirical testing of this model will then be described in the chapters that follow.
4.3 Protective Factors in the Pathway between Chronic Conditions and QoL

The context in which disablement occurs is an important influence on the pathway between chronic conditions and QoL. Characteristics of the person themselves and their environment directly affect levels of disability and QoL. Accordingly, the studies reviewed in Section 4.2 include a range of person and contextual factors as covariates in their models – age (79,277,279,281,282,288,333), sex (79,277,282,288,333), education (281,282,288,333), locus of control (277), mastery (281), spirituality (281), loneliness (281), alcohol consumption (79), body mass index (BMI) (281), income (288) social class (79), financial strain (284), household size (284) and social support (277,278,281,333).

However, as well as affecting each stage of the pathway directly, personal and environmental factors can also modify the pathway between chronic conditions and QoL. The ability of older people to actively adapt to the effects of illness and disability has long been recognised. One perspective, proposed by Baltes et al., emphasised the importance of how older people respond, behaviourally and cognitively, to ill health and disability. They describe a process of adaptation whereby older people select attainable goals (selection), optimise available resources (e.g., material or social supports) (optimisation) and substitute alternative goals or activity where one is no longer possible (compensation) (334,335). The stress-buffering hypothesis, on the other hand, emphasised the importance of available resources (336). It suggests that environmental supports, particularly social relationships, improve wellbeing both directly and by reducing the harmful effects of stressors through the provision of psychological and material resources.

Resilience theory integrates these two approaches, by conceptualising both individual attributes (including cognitive and behavioural responses to poor health), and environmental conditions (including social and material supports), as protective factors, which modify the effect of adversity on outcomes (337–345). Resilience is sometimes characterised as a property of an individual person. In the approach used here, resilience is viewed as a process, whereby outcomes of adverse circumstances are determined by the interplay of multiple factors relating to both the person themselves and their environment (344,345). Protective factors interact with risk or adverse circumstances, such as declining
health, to produce good, or better than expected, outcomes (344,346,347). The integration of both personal attributes and environmental conditions in resilience theory allows us to both acknowledge older people as “active agents in their own quality of life” (41) (p. 62), and to recognise the social factors and societal structures that facilitate and limit that agency.

In Sections 4.3.1 to 4.3.5 protective factors along the pathway between chronic conditions and QoL will be discussed. Evidence related to six potentially important factors will be reviewed: personality, religiosity, socioeconomic position (SEP), social relationships, age and sex. These factors were selected on the basis of the existing body of evidence, and the availability of measures in TILDA. Based on Hypothetical Model 2 (Figure 4-5), it was assumed that protective factors can intervene in the chronic conditions-QoL pathway in two ways: by reducing the disabling effect of chronic disease, or by reducing the effect of disease and disability on affective wellbeing and QoL. Each factor was thus examined as a moderator or "buffer" of 1) effects of chronic conditions on disability, affective wellbeing and QoL; and 2) effects of disability on affective wellbeing and QoL.

Throughout Section 4.3, the focus will be on evidence of protective or buffer effects based on studies which report interaction effects. These indicate the extent to which the negative effect of chronic conditions or disability is significantly smaller in the presence of the protective effect. This differs from straightforward stratified analyses, where the significance of the difference in effects may or may not be evaluated.

The role of protective factors also depends on the broader social and economic context. For example, the protective role of socio-economic position may depend on social welfare policies which shape the distribution of income across the population. For this reason, Section 4.3.6 will discuss relevant aspects of the Irish health and social policy context. Section 4.3 will conclude with a summary, and a discussion of some of the methodological challenges inherent in examining resilience.

4.3.1 Personality

Individual differences – or why some people do better than others in a context of adversity, are a key focus of research into resilience. Personality is a major driver of individual
differences. The dominant paradigm in the study of personality is the five factor model (FFM) (348,349). This model includes five personality traits: neuroticism, extraversion, openness to experience, conscientiousness and agreeableness (348,350). These traits are considered distinct from each other and broadly stable over time. It is recognised, however, that traits may change gradually over time, as part of development over the life-course (351), and in response to contextual changes (352,353). Evidence has been identified for maturation processes in personality, with increases in agreeableness and conscientiousness, and decreases in neuroticism, with age (354). Stability of traits is thought to increase over time, reaching a plateau of stability between the ages of 50 and 70 (354).

Evidence for the effects of personality on physical health and QoL is strongest for two of the Big Five traits: extraversion and neuroticism (355–357). Higher extraversion and lower neuroticism have been associated with several health outcomes, including lower morbidity (358,359), lower mortality (355,359–361) and higher HRQoL (362–364). Higher extraversion and lower neuroticism have also been shown to be strongly related to QoL outcomes, including higher affective wellbeing, life satisfaction and higher scores on the WHOQoL measure (101,356,357,362,365,366).

Individuals who are high on the extraversion trait tend to have larger social networks, more intense relationships, more energy and higher levels of positive affect (348,367). Increased access to social support may therefore explain some of the association between extraversion and better physical health and QoL. Positive emotions also play a role in improving QoL and decreasing the likelihood of illness, particularly those illnesses influenced by stress, such as cardiovascular conditions (368). Extraversion is also associated with better coping strategies in the face of stress (348), which may improve both physical health and QoL.

Neuroticism is primarily associated with negative emotions, more negative appraisals of adverse circumstances and a greater tendency towards emotional expressiveness (348). Individuals who score highly on the neuroticism trait are thus more likely to report lower levels of affective wellbeing and QoL. They experience and/or report increased distress in response to illness (348,357), are more likely to recall and report symptoms (369–372), and
engage in less effective disengagement coping strategies in response to stress (348). In addition, neuroticism may be associated with poorer physiological reactions to stress, leading to greater risk of disease (358,373). However, the effect of neuroticism on health is complex – in particular, greater attention to, and pre-occupation with, symptoms may lead to good adherence and more treatment-seeking behaviours (374). There is some evidence that neuroticism is more closely associated with lower mental HRQoL rather than lower physical HRQoL (375).

The ways in which personality affects how people respond to adversity (cognitively, affectively and behaviourally), appear to be an important component in its overall effect on health and QoL. A small number of studies have evaluated how personality interacts with effects across chronic conditions, disability and QoL among population samples of older people (displayed in Table 4-2). Three studies examined the moderating effects of neuroticism, with mixed findings (220,375,376). Neuroticism did not interact with the effects of chronic conditions on life satisfaction (220), or on the SF-36 measure of HRQoL (375). The only exception was that neuroticism increased the negative effect of chronic conditions on the general health (GH) domain of the SF-36 among men (375). Neuroticism was also associated with an increased negative effect of self-rated health on life satisfaction (220). One study examined neuroticism as a moderator of effects of variables similar to body function (e.g., motor limitations, sensory deficits) on variables similar to activity (e.g., IADLs/ADLs) (376). No interaction effects were identified. Only one study examined extraversion and no significant interaction effects were detected (220). Findings were also mixed in relation to personality traits other than those in the Big Five, including mastery, self-efficacy and locus of control (see Table 4-2).

In conclusion, there is limited evidence for the buffering effects of neuroticism and extraversion on relationships between health, disability and QoL in older populations. However, the number of studies is small, and the effects across the chronic disease-QoL pathway have not been comprehensively examined. Only one study was identified that examined the effects of chronic conditions on a general measure of QoL (life satisfaction) (220). This study had a small sample, and the effects of disability on QoL were not evaluated. Thus, as the current evidence for the protective effects of personality is not convincing, further investigation is required.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Study Pop. Setting N</th>
<th>Study Design</th>
<th>Measure of Health or Disability</th>
<th>Personality Measure</th>
<th>Outcome Measure</th>
<th>Significant Interaction Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kempen 1997 (375)</td>
<td>General pop., aged 57+, Netherlands n = 5,279</td>
<td>Cross-sectional cohort</td>
<td>No. of chronic conditions</td>
<td>Neuroticism Mastery Self-efficacy</td>
<td>HRQoL: SF-36 domains – PF, SF, GH, BP, MH, RF</td>
<td>No. of conditions x Neuroticism on GH, only in men No. of conditions x Mastery on SF Self-efficacy had no moderating effect</td>
</tr>
<tr>
<td>Kempen 1999 (376)</td>
<td>General pop., aged 57+, Netherlands n = 624a</td>
<td>Cross-sectional cohort</td>
<td>Motor limitations, cognitive function, memory, vision, hearing</td>
<td>Neuroticism Mastery Self-efficacy</td>
<td>Disability: IADLs, ADLs, SF, RF</td>
<td>No interaction effects identified</td>
</tr>
<tr>
<td>Berg 2011 (220)</td>
<td>Twins aged 80+, Sweden n = 370</td>
<td>Longitudinal cohort</td>
<td>No. of chronic conditions; self-rated health (SRH)</td>
<td>Neuroticism Extraversion Locus of control</td>
<td>Change in Life Satisfaction (LSI-Z)</td>
<td>Neuroticism moderated effect of SRH, but not no. of conditions. Locus of control moderated effect of no. of conditions, but not SRH. No interaction effects detected for extraversion.</td>
</tr>
</tbody>
</table>

PF = Physical Function, SF = Social Function, GH = General Health, BP = Bodily Pain, MH = Mental Health, RF = Role Function, IADLs = Instrumental Activities of Daily Living, ADLs = Activities of Daily Living, SRH = self-rated health

aRandom sub-sample of the same population used in Kempen et al. (1997)(375)
4.3.2 Religion and Spirituality

Religion or spirituality is a multi-faceted concept, comprising beliefs, feelings, behaviours and networks of relationships. A recent comprehensive and in-depth review of the available literature concluded that religious or spiritual beliefs and behaviour are associated with reduced mortality, better physical health and function, and improved QoL and affective wellbeing (377).

Consistent with its multi-faceted nature, it is thought that religion/spirituality can affect positive outcomes via multiple pathways: cognitive, affective, relational and behavioural (378–380). With regards to cognitive and affective pathways, qualitative evidence suggests that religious beliefs support hope, optimism and the construction of meaningful narratives in a context of adversity (379,381,382). The importance of religious or spiritual beliefs in older age is also suggested by the theory of gerotranscendence (383,384). According to this theory, as people age they become less attached to material and physical comforts, and re-set their priorities towards broader meanings and purpose in life, including spiritual dimensions of existence and connectedness with others. This process is similar to the phenomenon of response shift, referenced in Section 3.2, which involves a change in standards (re-calibration), priorities (re-prioritisation) or meanings (re-conceptualisation) in relation to QoL (211,212).

Evidence of associations between religion/spirituality and health and wellbeing may also be explained by other factors which are associated with both. Religious people may be healthier and have higher QoL partly due to their maintenance of healthier lifestyles (385). In addition, religiosity may be associated with better access to social support (386,387). This is consistent with evidence that attendance at religious services attenuates functional decline, while private religious activity does not (388). There is evidence that social support received via religious institutions and activities may be of higher quality than other sources of social support (389).

There is some evidence that the beneficial effect of religion/spirituality is stronger among individuals experiencing adversity – that is, religion buffers the effect of adverse circumstances on wellbeing. Studies with patient samples have indicated positive effects of
religion and spirituality on coping with illness (390). In addition, a meta-analysis of studies of the relationship between religiosity and depressive symptoms found that the effect was stronger in samples including individuals undergoing stressful life events, including poor physical health (391).

Three studies were identified which directly examined the buffering effects of religion on the relationship between physical health and affective wellbeing or QoL among older people (displayed in Table 4-3). Religion was found to modify the longitudinal effects of chronic disease and disability on depression (392), while religious or spiritual beliefs were found to modify the effect of frailty on eudaimonic wellbeing (393). Conversely, Fry did not detect a significant buffering effect of religion/spirituality on the effect of physical health problems on depression, anxiety or happiness (378).

It is worth noting that religiosity can also be associated with negative effects on QoL outcomes (380,394). Negative religious coping involves feeling punished or abandoned by God in a context of illness. This can result in lower optimism and more negative appraisals of the situation, and has been found to be associated with increased risk of depression and higher mortality (386,394).

In sum, it appears that evidence for the protective effect of religious belief in the pathway between chronic conditions and QoL is not extensive. Some studies have found evidence for a protective effect, though overall the evidence is inconsistent. Studies to-date have included small sample sizes, which may make it difficult to detect interaction effects (395). A protective effect of religion has been found for eudaimonic wellbeing (393), which includes measures of meaning and purpose and may therefore be more sensitive to the positive effects of religion. Analysis with larger, general-population samples is likely to shed more light on the potential protective effects of religion.
Table 4-3: Studies examining the moderating role of religion: characteristics and findings

<table>
<thead>
<tr>
<th>Name, Year Study Pop. Setting</th>
<th>Study Design</th>
<th>Measure of Health/Disability</th>
<th>Religion Measure</th>
<th>Outcome Measure</th>
<th>Significant Interaction Effects</th>
</tr>
</thead>
</table>
| Wink 2005 (392) California-born older adults, aged 65-75 n = 184 | Longitudinal cohort | Chronic disease and associated level of disability | Religious beliefs and practices; non-religious spiritual beliefs and practices (in middle and late adulthood) | Depression (CES-D) in late adulthood | Religion x physical health, both cross-sectional and longitudinal
| | | | | | No significant interaction effect for spirituality |
| Fry 2000 (378) Community and institutional pop., aged 60-90, Canada n = 340 | Cross-sectional cohort | No. of physical health problems | Religious involvement; spirituality; access to religious supports | Depression, anxiety, happiness, self-esteem (composite score) | None |
| Kirby 2004 (393) Institutional setting, aged 65-95, Britain n = 233 | Cross-sectional cohort | Frailty | Spiritual Beliefs | Ryff's Psychological Wellbeing scale (eudaimonic wellbeing) | Frailty x Spiritual Beliefs |

Pop. = population; CES-D = Centre for Epidemiological Studies – Depression

4.3.3 Socioeconomic Position

Socioeconomic position (SEP) operates as both a confounder and a potential moderator of the relationship between chronic disease and QoL. This section briefly covers how SEP influences both health and QoL, and then discusses in more detail current evidence for SEP as a protective or modifying factor in the pathway between chronic conditions and QoL.

The relationship between SEP and health is one of the most studied in the social sciences, and the literature will not be reviewed comprehensively here. Instead, the focus will be on

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1 Krieger et al. (624) and Galobardes et al. (625) advocate the use of the term socioeconomic position (SEP) to cover both access to material resources, and other resources such as knowledge or status, which arise through a person’s position in society based on their occupational or educational status. The term SEP is used throughout this thesis.
how the SEP-health relationship functions specifically at older ages. There is evidence that health inequalities reduce in later life, as the protective effect of SEP diminishes and the health of richer and poorer adults converge (e.g., 404–406). There is some debate about whether this reflects a genuine narrowing of inequality, or methodological artefacts, such as selective mortality (see Benzeval et al., 2011 for a review) (399,400).

There is ample evidence, however, that even if there is some convergence, a socioeconomic gradient nevertheless persists for diverse aspects of SEP and of health in later life (81,401–403). For example, older people with lower SEP are more likely to have multiple chronic conditions (82) and functional impairment (400), and are more likely to experience worse disability or health related QoL at the same level of comorbidity (404–406). Lower occupational grade is also associated with more rapid decline in HRQoL in middle-age (84,407). Socioeconomic gradients in health have been observed in both TILDA (6) and ELSA (408). Life-course effects – SEP in childhood and adulthood – may also be an important determinant of patterns of HRQoL and multi-morbidity at older ages (397,409,410). It is also important to acknowledge the reciprocal relationship between health and SEP (411), although evidence suggests that SEP has a stronger effect on health than vice versa (398).

There are diverse pathways by which SEP affects health in later life. Population evidence from the United States suggests that education prevents or delays the onset of disability, while greater financial resources slow the accumulation of disability after onset (398,412). Health behaviours and psychological variables such as mastery appear to mediate the effect of education, while financial resources mediate the effect of income and education (398,412). This illustrates that health inequalities cannot be reduced to differences in lifestyle or health behaviours; public policy and existing social structures also play a role via inequalities in the distribution of material resources (413–415).

Whereas SEP appears to have an effect on physical health at all ages, some authors suggest that SEP may not have a strong influence on wellbeing, referring to the "wealth-happiness" paradox (38,215). However, a meta-analysis of studies testing effects of income and education on SWB among older people indicated strong evidence for an association between SEP and SWB in later life (223). In addition, a number of studies report strong
socioeconomic gradients in the CASP-19 QoL measure (86,87,416). It is possible, however, that the negative effects of SEP on QoL are mediated by other factors. For example, social deprivation and loneliness were found to mediate the negative effects of income on life satisfaction among older chronic disease patients (417). Recent research with TILDA found that socio-economic indicators (social class, assets and income) had no effect on CASP-19 total score, independent of the effects of physical health, social relationships and mental health (76).

One way in which higher SEP may reduce the effects of chronic conditions on QoL or wellbeing is through reducing the financial stress associated with having a chronic disease. There is evidence to suggest that having a chronic condition, particularly multiple conditions, can be a considerable financial burden, depleting wealth and placing pressure on income in later life (418–422). Financial strain has been found to be associated with increased psychological distress among older people (423), and lower QoL among lower income women with cancer (424).

A number of studies have examined SEP as a moderator of the relationship between chronic disease and QoL, mostly with the working age population (see Table 4.4). A range of chronic conditions (low back pain, hypertension, diabetes, heart disease and musculoskeletal disorders) have stronger negative effects on HRQoL for people with lower education and income (425,426), and lower occupational class or grade (427–429). However, no interaction effects were identified for asthma, stroke and emphysema (426), with mixed findings across studies for heart disease (427,428) and diabetes (426,428).

Delpierre et al. reported the converse effect for self-rated health outcomes: higher SEP individuals had a stronger association between chronic low back pain and poorer self-rated health (425). It is possible that older people with higher SEP may have higher expectations for their own health, and higher normative standards for good health, leading to poor objective health status having a greater negative effect on self-rated health.

Few studies have examined the extent to which SEP modifies the effect of poor health on affective wellbeing or general measures of QoL. Musculoskeletal disorders had a stronger effect on depressive symptoms among French working-age individuals with a lower
occupational grade. Hildon et al. (338) examined the effects of SEP on the relationship between adverse circumstances and CASP-19 score in an older-age sample. Rather than examining interaction effects, this study investigated the probability of having a high CASP-19 score in a context of adversity, which included chronic disease. There was no statistically significant difference in having sufficient income among resilient (high adversity, high QoL) versus non-resilient older people (high adversity, low QoL). In addition, having enough, or more than enough, income was associated with reduced QoL in those exposed to high adversity. The sample size was small, however, and the authors recommended further research with larger sample sizes and more diverse elderly populations to validate their findings.

Overall, the effects of SEP on the relationship between health and QoL are complex. People of higher SEP may experience a steeper decline in health with age, as factors other than SEP become more important and the socioeconomic gradient decreases. However, while they decrease somewhat with age, socioeconomic differences nevertheless persist into later life. Higher SEP may also buffer the disabling impact of illness, through greater access to psychological and material resources. On the other hand, higher SEP may worsen the impact of chronic conditions on subjective assessments of QoL, as respondents have higher expectations and standards for their own QoL and perceive the illness as more detrimental to their lives. Few studies have examined the buffering effect of SEP in older populations. The extent to which socio-economic resources protect older adults from the detrimental effects of chronic conditions on disability and QoL, however, is important for understanding variation in QoL outcomes across older people.
<table>
<thead>
<tr>
<th>Name, Year Study Pop. Setting N</th>
<th>Study Design</th>
<th>Measure of Health/ Disability</th>
<th>SEP Measure</th>
<th>Outcome Measure</th>
<th>Significant Interaction Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delpierre 2012 (425) General adult pop., France n = 21,785</td>
<td>Cross-sectional cohort</td>
<td>Chronic low back pain, functional limitations</td>
<td>Education and income</td>
<td>HRQoL, Self-rated health (SRH)</td>
<td>SEP protective for effect of functional limitations and back pain on HRQoL; low SEP protective for effect of back pain on SRH</td>
</tr>
<tr>
<td>Lubetkin 2005 (426) General adult pop., US n = 13,646</td>
<td>Cross-sectional cohort</td>
<td>Diabetes, asthma, hypertension, heart disease, stroke, emphysema</td>
<td>Education and income</td>
<td>EQ-5D</td>
<td>Higher SEP protective for effect of hypertension on EQ-5D; however, the difference in effect size was small</td>
</tr>
<tr>
<td>Sacker 2008 (427) British civil servants, aged 35-55 at baseline n = 8,292</td>
<td>Longitudinal cohort</td>
<td>Coronary heart disease (CHD)</td>
<td>Employment Grade</td>
<td>HRQoL (SF-36)</td>
<td>Lower occupational grades associated with an increased negative effect of CHD on mental &amp; physical domains of the SF-36</td>
</tr>
<tr>
<td>Stafford 2012 (428) General adult pop., England n = 26,104</td>
<td>Cross-sectional cohort</td>
<td>Heart attack, angina, stroke, hypertension, diabetes</td>
<td>Social Class</td>
<td>EQ-5D</td>
<td>Higher social class protective for effect of hypertension and diabetes on EQ-5D. No effects for heart attack, angina, stroke.</td>
</tr>
<tr>
<td>Khlat 2010 (429) General pop., aged 18-64, France n = 3,368</td>
<td>Cross-sectional cohort</td>
<td>Musculoskeletal disorders</td>
<td>Employment Grade</td>
<td>Cognitive disability, fatigue, depression</td>
<td>Musculoskeletal disorders associated with increased negative effect on all outcomes among lower occupational grades</td>
</tr>
<tr>
<td>Hildon 2010 (338) General pop., aged 50+, England n = 294</td>
<td>Cross-sectional cohort</td>
<td>Multiple measures of adversity, inc. chronic disease</td>
<td>Sufficient income</td>
<td>CASP-19 (&gt; median)</td>
<td>Interactions not examined. However, sufficient income not associated with probability of high QoL in adversity.</td>
</tr>
</tbody>
</table>

Pop. = population; SEP = socioeconomic position; SRH = self-rated health; CHD = coronary heart disease
4.3.4 Social Relationships and Participation

As discussed in Section 4.2.5.3, restrictions in social participation may be a key stage in the pathway between chronic disease and QoL. However, it is also important to explore the extent to which social relationships modify this pathway by functioning as a moderating factor. It has been suggested that social relationships may be the key factor which allows people to maintain positive outcomes in adverse circumstances throughout the life-course (345, 347). For example, Luthar & Zelazo suggest that “resilience rests, fundamentally, on relationships” (347) (p. 780).

Social relationships comprise a broad category of contact and engagement with other individuals, including family, friends, and others in the community and society, and can be of good or poor quality. Within social relationships, it is useful to distinguish social participation, social support and social networks. Social participation, as discussed in Section 4.2.3, implies an engagement with broader community or society. Social support, on the other hand, involves direct provision of resources from others. It can include emotional, informational and instrumental support (336). The term social network refers to the "web" or structure of relationships around the individual, and can be characterised in terms of size, quality, density and type of relationships (367).

There is extensive evidence for a "main effect" of social relationships, networks and participation on a range of psychological outcomes, including affective wellbeing (223, 430–432), life satisfaction (221, 223) and QoL (432), including the CASP-19 (36, 76, 202). A number of studies suggest that it is not the presence or quantity of relationships that improves wellbeing, but their quality (221, 223, 433). Socio-emotional selectivity theory suggests that as people get older they may choose to reduce the size of their social networks and focus on a smaller number of high quality relationships (434). The importance of relationship quality is also reflected in the negative effect that poor quality relationships can have on QoL outcomes (76).

Positive social relationships are thought to improve QoL and wellbeing by improving self-esteem, sense of mastery and control, and sense of belonging or companionship – all of which are associated with improved mental health (435). Good quality relationships with
others can also improve our sense of purpose or "mattering" (435), which is an important constituent of eudaimonic wellbeing.

There is also evidence that good quality relationships, social participation and social networks can "get under the skin", and have a positive effect on self-rated health (436), disability (437) and mortality (438) (see Bath & Deeg, 2005 (439) for a review). Meta-analysis of relevant cohort studies indicates that marriage is associated with a reduced risk of mortality of 9 to 15%, among both men and women (440). Similarly, poor quality relationships are associated with poorer physical health (441).

Social relationships may improve physical health via beneficial effects on mental wellbeing, as outlined above. However, beneficial effects may also operate via behavioural pathways (435). Social relationships can affect health behaviours via social norms about appropriate behaviours and via social control (e.g., persuasion, reminding one another to carry out certain behaviours). Individuals may also engage in healthier behaviours if they believe that they have an important role or purpose for other people.

The evidence for the beneficial effects of social support is more complex than the effect of social relationships more generally. A number of studies have found that received social support is not associated with better physical health (442) and may be associated with higher levels of disability (437,443), and increased depressive symptoms (444). It is possible that received support reduces affective wellbeing because it is perceived negatively by the person receiving it, for example, if it reduces their sense of autonomy and control, or if they feel that they are unable to reciprocate the support (311,445). Evidence from one study, however, suggests that the negative effect of received support is not mediated by reduced control beliefs (311).

The "mobilisation hypothesis" suggests an alternative explanation for the association between received support and poorer outcomes: worse health and QoL lead to the mobilisation of higher levels of social support, thus making it seem as though social support is associated with poorer outcomes (446). This hypothesis is consistent with evidence that perceived availability of support has positive effects on measures of wellbeing, while received support has a negative effect (311,447). It is possible to disentangle the effects of
the mobilisation hypothesis by using longitudinal analysis, which takes into account the
temporal order of increased physical decline and support.

Social support may only be beneficial if it is matched with a need, such as declining health
or disability. Every-day support may be most helpful when it is perceived as invisible and is
based on reciprocity (435). However, in a time of difficulty such as declining health,
deliberate "enacted support" becomes more beneficial (435) (p.150). Support can improve
appraisals of stressful events, as individuals anticipate support from others and interpret
the situation as less threatening (336). Instrumental and material supports can lessen the
direct, tangible demands of the stressor (435). For example, family may provide financial
assistance, or help with every-day tasks such as household chores or attending medical
appointments.

There is evidence that social relationships protect against the negative effects of poor
health on depression (197,431,443,444,448–450), and CASP-19 (338) (see Table 4-5). As
well as being protective for psychological outcomes, social relationships can reduce the
effect of underlying pathology on disability or functional limitation (443,450–452) and
mortality (453). However, there are mixed findings regarding which types of social
relationship and support are protective.

Evidence from studies included in Table 4-5 appears to support the mobilisation
hypothesis, as there is conflicting evidence from studies of received social support,
compared with perceived availability of support. For example, receipt of instrumental
support (i.e., presence of supportive behaviours) does not decrease the negative effect of
disability or chronic conditions on depressive symptoms (431,448). In one study, supportive
spouse behaviours were associated with a greater association between poor visual ability
and functional limitations (443). Received emotional support (compared with instrumental)
may be an exception to this pattern: emotional supportive behaviours have been found to
reduce the effect of chronic conditions on depressive symptoms (448).

Availability of support can be perceived as high even in the absence of poor health, and is
thus less susceptible to mobilisation effects. Satisfaction with support, which reflects the
availability of support when needed, was protective for the negative effects of disability on
depression (431). In another study, availability of instrumental support was protective for the effect of health conditions on declining activity (450). Availability of emotional supportiveness was also found to be protective for the effect of health conditions on increase in depressive symptoms (450). A further indicator of availability of social support is subjective social isolation, or loneliness. An absence of loneliness has been identified as a protective factor for the effect of several chronic conditions on depression (444).

There are also inconsistencies in the evidence regarding protective roles for different types of relationships. Penninx et al. found that size of friendship network, but not family network, was protective for the effect of lung conditions on disability (448), while Fukukawa et al. reported that supportive family relationships were more important than supportive friends (450). It was possible that the focus on network size in the Penninx et al. study did not capture the quality of family relationships. There is also evidence to suggest that support from formal sources alone does not buffer the effect of disability on depressive symptoms, while informal support from family and friends does (449). Informal family support may be the most effective for what Chan et al. refer to as "diffuse and unstructured daily activities needs" (449) (p. 187) and therefore better matches the needs of older adults with poor health and disability.

A number of studies have focussed on the potential protective effects of marriage, or having a partner. Having a partner (without measuring quality) modified the effects of diabetes, heart disease, lung disease, and arthritis (but not cancer or stroke) on depressive symptoms (444), and reduced the negative effect of number of chronic conditions on physical decline (452). Haley et al. found that stroke patients who lived alone had a much greater increase in depression relative to stroke patients who lived with others and stroke free-controls (197). The same study, however, found that living alone did not modify the effect of stroke on either mental or physical HRQoL.

The protective effects of marriage quality, within groups of married people, have also been explored. A protective effect was identified for marital satisfaction on the effect of poor vision on functional limitations and depression (443), while another study found that marital quality and time spent with partner did not buffer the effect of disability on
depression (454). This parallels the findings above that availability of, or satisfaction with, support tends be associated with positive outcomes more than receipt of support.

It is worth acknowledging the negative dimension of social relationships. Poor quality marital relationships may increase the effect of poor health on depressive symptoms (454). Conversely, negative interactions have been found to be associated with a reduced effect of poor health on disability (450). The authors speculated that social control behaviours from family members, such as criticism, might be experienced as negative but induce better health behaviours, thus reducing disability.

The buffering effects of social participation have not been studied as extensively as the buffering effects of social support. Cohen suggests that this dimension of social relationships has a direct effect, rather than a modifying effect, on health and wellbeing (336). However, Hildon et al. found that better integration in the community was associated with a high total CASP-19 score in adverse circumstances (which included chronic illness) (338). Social participation may increase the network of social support available to the person, as well as compensate for the loss of purpose associated with illness by allowing the person to maintain an active role in the community (312,313). It may therefore play a role in buffering negative effects of illness on eudaimonic dimensions of wellbeing.
Table 4-5: Studies examining the moderating role of social support: characteristics and findings

<table>
<thead>
<tr>
<th>Name, Year Study Pop. Setting</th>
<th>Study Design</th>
<th>Measure of Health/Disability</th>
<th>Social Measure</th>
<th>Outcome Measure</th>
<th>Significant Interaction Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bisschop 2004 (444)</td>
<td>Longitudinal cohort</td>
<td>Cancer, chronic lung disease, stroke, diabetes, cardiac disease, arthritis, peripheral atherosclerosis</td>
<td>Partner, network size, instrumental and emotional support, loneliness</td>
<td>Depression (CES-D)</td>
<td>Loneliness associated with increased negative effect of all conditions except diabetes. Partner protective for negative effects of all conditions except cancer and stroke.</td>
</tr>
<tr>
<td>Jang 2002 (431)</td>
<td>Cross-sectional cohort</td>
<td>Disability: IADLS, ADLS, functional capacity</td>
<td>Social network, received support, satisfaction with support</td>
<td>Depression (GDS)</td>
<td>Satisfaction with support protective for effect of disability on depression, not received support or social network</td>
</tr>
<tr>
<td>Bookwala 2005 (454)</td>
<td>Cross-sectional cohort</td>
<td>Physical disability</td>
<td>Marital Quality</td>
<td>Depression (CES-D)</td>
<td>Poor marital quality exacerbated effect of physical disability on depression</td>
</tr>
<tr>
<td>Penninx 1998 (448)</td>
<td>Cross-sectional cohort</td>
<td>Diabetes, chronic obstructive lung disease, cardiac disease, arthritis, cancer</td>
<td>Partner status, family and friend relationships. Receipt of emotional, instrumental support</td>
<td>Depression (CES-D)</td>
<td>Received emotional support protective in cardiac disease and arthritis. Friend relationships protective in lung disease</td>
</tr>
<tr>
<td>Chan 2011 (449)</td>
<td>Cross-sectional cohort</td>
<td>Functional limitations</td>
<td>Instrumental support from formal and informal sources</td>
<td>Depression (CES-D)</td>
<td>Informal support protective, formal support alone not protective</td>
</tr>
<tr>
<td>Name, Year</td>
<td>Study Pop. Setting</td>
<td>N</td>
<td>Study Design</td>
<td>Measure of Health/ Disability</td>
<td>Social Measure</td>
</tr>
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</tr>
<tr>
<td>Bookwala 2011 (443)</td>
<td>Married people aged 57-85, United States</td>
<td>n = 927</td>
<td>Cross-sectional cohort</td>
<td>Poor vision</td>
<td>Marital satisfaction, supportive behaviours, free time spent with spouse</td>
</tr>
<tr>
<td>Fukukawa 2004 (450)</td>
<td>General pop., aged 40-79, Japan</td>
<td>n = 1,802</td>
<td>Longitudinal cohort</td>
<td>Health problems (disease/injury)</td>
<td>Emotional/instrumental supportive family and friend relationships; negative interactions</td>
</tr>
<tr>
<td>Haley 2011 (197)</td>
<td>General pop.; aged 45+, United States</td>
<td>n = 272</td>
<td>Longitudinal case-control</td>
<td>Stroke</td>
<td>Living alone</td>
</tr>
<tr>
<td>Bisschop 2003 (452)</td>
<td>General pop., aged 55-85, Netherlands</td>
<td>n = 2,357</td>
<td>Longitudinal cohort</td>
<td>Chronic conditions (0, 1, 2+) at baseline</td>
<td>Partner, social network (size and quality); instrumental and emotional support; perceived support</td>
</tr>
</tbody>
</table>

Pop. = population; CES-D = Centre for Epidemiological Studies measure of Depression; GDS = Geriatric Depression Scale; IADLS = Instrumental Activities of Daily Living; ADLs = Activities of Daily Living; SF-12 = Short-Form 12-item
In sum, there is considerable evidence available for the main effects of social relationships and support on health and wellbeing, and for the buffering effects on the relationships between health, disability and wellbeing. However, the studies reviewed here suggest that buffering effects may be quite specific. Benefits may depend on the quality, type of support and type of relationship; and different types of support may be specific to different outcomes. For example, emotional dimensions of support may be protective for depression, while instrumental support reduces negative effects on functional outcomes (450).

Furthermore, many studies found protective effects for some dimensions of social relationships, but not others; or for some specific conditions, but not others. Failure to detect interaction effects could be due to low power: studies of interaction effects are often under-powered, due to low cell sizes which result from comparing effects across groups (395). In addition, interaction effects tend to have a small effect size which makes them "notoriously" statistically unstable (455) which may explain inconsistent findings across studies. Difficulties associated with power and detecting small effect sizes can be at least partially alleviated with large samples, and previous studies have called for larger and more general, representative population samples in studying the buffering effects of social support (338,456).

In addition, there are gaps in the existing evidence. Only a small number of studies have examined longitudinal effects, which allow us to disentangle reverse causation effects and identify potential mobilisation effects. In addition, depression has been studied as an outcome much more frequently than QoL. In addition, the buffering effects of social participation do not appear to have been examined much in an older general population.

4.3.5 Age and Sex Differences

Age and sex have complex associations with both health and wellbeing. This thesis assumes from the outset that there are differences in how chronic conditions affect QoL in older people as part of the rationale for focussing on adults at midlife and older ages. However, this age group is not homogenous and it is also likely that there are age-related differences within the study population. It is also important to assess the extent to which sex
moderates the effect of chronic conditions and disability on QoL, as men and women differ both biologically, and in the social context in which illness occurs. This section will briefly discuss the current evidence concerning how age and sex shape our health and QoL, and also how they modify the effects of chronic conditions on overall health status and QoL.

Studies consistently find that QoL and SWB tend to increase with age, declining or staying constant from approximately age 70 (36–39). This supports the idea of a third and fourth age in later life (53). In the third age, people maintain good health and function, but have reduced family and work responsibilities, leaving them free to pursue fulfilling and enjoyable activities, resulting in high levels of wellbeing. In the fourth age, however, health and function begins to decline more steeply, and QoL can remain static or begin to decline. The timing of these stages are more dependent on trajectories of health rather than age in years, highlighting the fact that chronological age may matter less for outcomes than biological age, as measured by level of disability and functioning (457).

There is mixed evidence with regard to the extent to which age modifies the effects of chronic conditions, health status/disability on QoL, within the population of middle-aged and older people. Meta-analysis of studies of the effect of disability on life satisfaction and happiness did not find that the size of the effect was dependent on average age of study sample (223). However, nine studies were identified in Chapter 2 (Section 2.3.13), which examined how age moderates the effect of chronic conditions on QoL (129,147,150,152,162,184,186,197). Five reported that chronic conditions were associated with less of an impact on QoL among older people (150,152,162,184,186).

There is evidence among general, older population samples that chronic conditions have a more negative effect on physical HRQoL or disability as age increases, but less of a negative effect on depressive symptoms and mental HRQoL (162,450). Similarly, in a sample of patients with heart failure, among patients who experienced a decline in physical HRQoL, older age was associated with a steeper decline (458). Diseases may be more disabling among older people, due to higher severity of chronic conditions, the cumulative effect of multiple chronic conditions on function, and the effect of age-related decline in physiological "reserve capacity" which accompanies general deterioration of organ systems (459).
Disability itself, however, may have less of a negative effect on subjective outcomes, including depression and QoL. Older people may also be less likely to experience social role strain as a result of illness, as they feel fewer demands related to work and family. Another explanation is that older people tend to have relatively worse health at baseline, so that worsening health is associated with less of a decline in wellbeing (450). Alternatively, as discussed in Section 3.2, older people may experience a shift in their internal standards and expectations in relation to health as they age, and place less of a priority on the maintenance of function. However, a recent study in the TILDA sample did not find that mental health was less susceptible to the negative effects of illness in older ages. The number of chronic conditions had a greater effect on depressive symptoms in adults aged 65+, compared with those aged 50-64 (319). This highlights that the evidence regarding the role of age is far from clear-cut.

Sex also has complex relationships across chronic conditions, disability, and QoL. While women have a higher life expectancy than men, they are more likely to have multiple chronic conditions (9), tend to be more disabled than men at similar ages and disease severity (15,77,78) and report worse symptom experience in chronic conditions (460). Similarly, women tend to report worse HRQoL at older ages (461). Orfila et al. reported that worse HRQoL among women can be explained by greater number of chronic conditions and worse objectively measured functional capacity (79), implying that the differences reflect worse underlying health, rather than a greater tendency to report symptoms or limitations.

In relation to overall QoL and SWB measures, a meta-analysis of 300 studies found that women tend to be less happy and satisfied at all ages, with a larger difference after middle-age (80). Women are also more likely to report depressive symptoms (462,463), including in older age (464). However, studies with the CASP-19 measure have reported that women have slightly higher QoL scores when a variety of health, psychological and social variables are adjusted for (36,76).

Five studies identified in the systematic review reported in Chapter 2 examined moderating effects of sex in the relationship between chronic conditions and HRQoL (see Section 2.3.13). Three studies found that sex did not modify the effects of myocardial infarction (150) and stroke (129,197), while two found that women experienced increased negative
effects of chronic conditions on HRQoL (137,184). A recent study among older Irish people, however, reported that pain and incontinence had a greater effect on depressive symptoms among men, relative to women (319). The evidence related to the protective effects of sex is thus far from clear and worth further investigation.

The role of age and sex in shaping the relationship between chronic conditions and QoL is complex. Both age and sex appear to influence how illness affects the body physiologically. Older people may experience illness as more severe and disabling. Women may experience greater levels of disability at a similar level of disease burden relative to men. At the same time, age and sex may also shape the extent to which the illness and/or disability is detrimental to their overall subjective QoL, through differences in expectations (their own and others), and available financial and social resources. However, the evidence in relation to this is not clear. In particular, it is not clear whether age and female sex are associated with reduced or increased effects of illness on QoL. It is hoped that the current thesis will shed some light on these complex associations.

4.3.6 Irish Social and Economic Context

The macro social and economic context in which people develop over the life course, and live in now, is likely to shape the role of different protective factors, including SEP, religion, age and sex. The TILDA cohort, who are the focus of this thesis, were born between the mid-1920s and the end of the 1950s. Approximately 40% were born in the 1950s. This section will briefly describe relevant aspects of the historical and contemporary Irish social and economic context for this cohort.

Ireland was a religious, culturally homogeneous and predominantly rural country throughout most of the 20th century. In 1946, 60% of the population lived in small towns and villages with populations of less than 1,500 people, 97% of the population had been born in Ireland, and 94% were Roman Catholic (465). By 2011 (the most recent census) 38% lived in non-urban areas, 84% described themselves as Roman Catholic and only 83% of the population were born in Ireland (466).
4.3.6.1 Economic Context

In 2007, Ireland had a gross national income (GNI) per capita that placed it in the top 15 richest countries in the world. However, between 2008 and 2011, GNI in Ireland declined by 16%. The extent of the recent economic crisis in Ireland has been well documented (e.g., Lane 2011 (467)) and the impact on the population of the crisis is only now being assessed. The population overall experienced steep reductions in income and the value of assets over a relatively short period of time. Initial analysis suggests, however, that while older people experienced a decline in assets (468,469), they had less of a steep decline in income relative to younger people (469). Median income was largely preserved among older adult households (468).

Poverty rates among older adults increased slightly: between 2008 and 2013 the poverty rate among adults aged 65+ increased by 2.5 percentage points (470). Only 8% of pensioners in Ireland are income-poor, compared with an OECD average of 12.8%. (471). Despite extensive cuts to public spending in Ireland, State pension benefits were not reduced. While pensioners on average earn a lower proportion of average salary than in other OECD countries, the basic Irish State pension is generous relative to other countries, at 35% of average income (471).

4.3.6.2 Education

Access to second and third level education over the life-course varies widely for TILDA participants. Secondary education became free of charge in 1967, although increased provision of scholarships, and greater investment in vocational schools meant that second-level expansion had already begun from the beginning of the 1960s (472). Only those aged approximately 56 or younger in the TILDA cohort were able to avail of free second-level education.

The majority of TILDA participants reached adulthood at a time where third-level participation was rare. In 1950 there were only 7,900 students in third-level education in Ireland. In 1971 there were still only 25,000 third-level students (465). While second-level participation grew rapidly after 1967, the number of places at third-level was not increased and participation rates at university remained static at approximately 11% at least until
1975, when the youngest members of our cohort were 16 (473). Participation rates did rise for those born after 1955 (age <= 54 in TILDA) (474).

4.3.6.3 Healthcare

Healthcare in Ireland was historically seen as the responsibility of church and family, with the State involved in provision of care to only the poorest citizens (475). This has changed in recent decades, with growing State involvement and current plans to extend universal healthcare through a universal health insurance system (476). However, the current system of entitlements is fragmented and complex, reflecting the traditional rejection of NHS-style universal care.

There are four categories of patients under the Irish health system. Patients with a full medical card are entitled to free GP and public hospital care, with a small co-payment for drugs (€1.50 per item, up to a maximum of €19.50 a month). Patients with a GP visit card are entitled to free GP care. They must pay for drugs (up to a maximum of €144 month per family) and a co-payment of €75 per night for public hospital treatment (up to a maximum of €750). Public out-patient treatment is free of charge. Eligibility for both types of medical card is assessed on the basis of income thresholds, which will be outlined in detail in Section 5.2.5.4. In 2013, approximately 40% of the population had a full medical card (477). The income threshold is considerably higher for adults aged 70+, and over 90% of this age group have a medical card.

Public patients who do not have a medical card have the same entitlements as those with a GP visit card scheme, except that they must also pay a fee per GP visit, usually between €40 and €60. A fourth category of patients, those with private health insurance, comprises approximately 40% of the population. Most insurance policies cover inpatient and outpatient specialist treatment in public and private hospitals, with only some policies providing partial cover for GP care and drug costs. Hospital consultants often operate both public and private patient lists, so that private patients tend to have a shorter waiting time to see the same consultant, relative to patients in the public system.

This complex set of entitlements shapes the distribution of healthcare utilisation in the Irish population. Use of primary care services have tended to be "pro-poor" with individuals on
lower incomes using relatively higher amounts of care given the same level of need (478,479). The equity of distribution of inpatient and out-patient specialist care is less clear, with evidence for pro-rich, pro-poor and horizontal distributions reported (478–480).

4.3.7 Protective Factors: Summary

This section described how characteristics of the individual (personality, religion, age and sex) and their environment (SEP, social relationships), modify effects along the pathway identified in Section 4.2. Evidence for these "buffer" effects is complex and not very consistent across studies. Many studies identified protective effects for only one dimension of physical health, or QoL, or only one aspect of the protective factor itself. This may reflect difficulties in detecting interaction effects, particularly when power is low due to small sample size (395). Luthar et al. highlight that interaction effects are statistically unstable and difficult to detect, which may explain the low robustness of some of the findings discussed here (455).

However, the complexity and inconsistency across findings may also reflect the fact that protective effects can be quite specific and that resilience is not an "all or nothing" phenomenon (346,347). A protective effect may operate only for a specific aspect of the protective factor, a specific aspect of adversity, or a specific outcome. For example, higher SEP may reduce the effect of chronic conditions on disability, but be associated with an increased effect on perceived health (425). Older age may be associated with more disabling chronic illness, but less of an effect on wellbeing as a result of the disability (162).

Despite the challenges inherent in investigating interaction effects along the pathway between chronic conditions and QoL, doing so is an essential part of building a picture of how older people adapt to declining health. Main effects of chronic conditions and disability on QoL may obscure variation in effects across the population of older people. For example, we may conclude that older people maintain their QoL in a context of declining health, while that may only be true for those who enjoy specific protective factors. Identifying these protective factors will provide crucial information on how and why older people can achieve good outcomes in chronic disease.
4.4 Hypothetical Model of the Relationship between Chronic Conditions and QoL

This chapter has provided an overview of relevant theoretical literature and evidence to inform a conceptual framework and hypothetical causal model for this thesis. The relationship between chronic conditions and QoL is complex and it has been necessary to draw on multiple theoretical perspectives and disciplines in order to build a hypothetical model which can potentially explain the relationship. On the basis of the theoretical literature, the aims and objectives outlined in Chapter 1 have been refined and re-specified.

Four research questions were specified. The first question relates to the psychometric validity of the CASP-19 measure of QoL in the Irish population aged 50+. The second focuses on identifying a cross-sectional pathway between chronic conditions and QoL. The third question then examines how effects along this pathway operate longitudinally. In investigating longitudinal effects, each step along the pathway was evaluated separately, as it was not possible to examine longitudinal mediation due to availability of only two waves of data. The fourth research question focuses on identifying factors which interact with or modify each of these longitudinal effects.

Effect modification was examined for longitudinal rather than cross-sectional effects so that it was possible to establish the temporal priority of each moderating factor. For example, in cross-sectional analysis a reduced effect of chronic conditions on QoL may be associated with more frequent social activity. However, in cross-sectional analysis it is not possible to identify whether higher QoL was caused by more frequent social activity or vice versa. If higher frequency of social activity is observed prior to a reduced negative effect of chronic conditions on QoL, it is possible to be more confident that social activity has a protective effect, rather than the effect being completely in the other direction.
4.4.1 Research Questions

1. Is the CASP-19 a psychometrically valid measure of QoL in the Irish population aged 50+?
   
   1.1. Do established measurement models for the CASP-19 display good fit in a general-population sample of Irish adults aged 50+?
   
   1.2. If established measurement models do not fit the data well, how can the item composition and factor structure be revised to achieve good fit while also remaining consistent with the underlying conceptual model for the scale?

2. How is the relationship between chronic conditions and QoL mediated?
   
   2.1. Do chronic conditions indirectly affect affective wellbeing and QoL via the ICF domains (body function, activity and participation restrictions)?
   
   2.2. Do the ICF domains indirectly affect QoL via affective wellbeing?
   
   2.3. Are these relationships characterised by full or partial mediation?
   
   2.4. What is the size of the effect at each stage of the pathway?
   
   2.5. Do effects along the pathway vary according to sex and age group?
   
   2.6. If the CASP-19 measure of QoL can be measured as more than one dimension, what are the differential effects of chronic conditions and disability on each dimension?

3. How do relationships along the pathway between chronic conditions and QoL operate longitudinally?
   
   3.1. Do incident chronic conditions affect change in each of the ICF domains, affective wellbeing and QoL?
   
   3.2. Is change in each of the ICF domains associated with change in affective-wellbeing and QoL?
4. How do personal and environmental factors modify longitudinal effects along the pathway between chronic conditions and QoL?

How do the following factors:

4.1. Neuroticism
4.2. Extraversion
4.3. Socio-economic position
4.4. Social support
4.5. Social participation
4.6. Religiosity
4.7. Age
4.8. Sex

Modify the following effects:

i. Effects of chronic conditions on ICF disability domains, affective wellbeing and QoL
ii. Effects of ICF disability domains on affective wellbeing and QoL?

4.4.2 Hypothetical Model

Combining the working model of the pathway (Hypothetical Model 2, Figure 4-5, p. 133), with the role of environmental and personal factors, results in the model displayed in Figure 4-6 (Hypothetical Model 3). According to this model, chronic conditions are associated with impairments in body function, activity limitations and participation restrictions. These in turn reduce affective wellbeing and QoL. There are also direct effects across these factors, as body functions affect activity and participation, and activity affects participation. In addition, affective wellbeing directly affects QoL.

However, it is also recognised that this causal pathway takes place within a complex context. Personal and environmental factors directly affect disability, affective wellbeing and QoL. However, certain protective factors also modify effects along this pathway. These function by reducing the disabling effect of chronic conditions, or by reducing the negative effects of chronic conditions and disability on subjective outcomes (affective wellbeing and
QoL). The model thus integrates the WHO ICF framework with affective wellbeing and QoL as outcomes, and with resilience theory.

A strength of this hypothetical model is the clear conceptual separation across different components of the model. Chronic conditions relate to underlying disease or pathology. *Body function, activity and participation* are based on objectively measured performance, or self-reported perceptions of performance. These types of measures are less prone to response style than evaluation-type measures and therefore have less conceptual overlap with evaluation-based subjective outcomes in the model (affective wellbeing and QoL).

Hypothetical Model 3 thus provides a clear and coherent explanatory model for the relationship between chronic conditions and QoL. In the next chapter, the precise operationalisation of the model will be discussed in detail, taking into account the theoretical and conceptual issues raised in this chapter. For example, relatively concrete measures of disability will be identified, based on performance or perception where possible. For some items, the distinction between perception and evaluation is less clear-cut than others. For example, measures of pain, which is an important aspect of *body function*, necessarily involve a subjective assessment by the individual.
Figure 4-6: Relationship between chronic conditions and QoL: Hypothetical Model 3
Specific but tentative hypotheses based on Hypothetical Model 3 are outlined in Tables 4-6 to 4-8. The exact hypotheses tested will depend, in an iterative manner, on the results of the preceding phase of analysis. Evaluation of path or mediation effects on QoL will depend on the dimensions of CASP-19 identified through psychometric analysis. The examination of longitudinal effects and how they are modified will depend on the cross-sectional mediation effects identified. Table 4-6 displays hypotheses relating to mediating effects along the pathway between chronic conditions and QoL. Table 4-7 displays hypotheses concerning longitudinal direct effects along this pathway.

**Table 4-6: Hypothesised mediation effects**

<table>
<thead>
<tr>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Body function mediates the effect of chronic conditions on activity</td>
</tr>
<tr>
<td>1.2 Body function and activity mediate the effect of chronic conditions on participation</td>
</tr>
<tr>
<td>1.3 Body function, activity and participation mediate the effect of chronic conditions on affective wellbeing</td>
</tr>
<tr>
<td>1.4 Body function, activity, participation and affective wellbeing mediate the effect of chronic conditions on QoL</td>
</tr>
<tr>
<td>1.5 Activity mediates the effect of body function on participation</td>
</tr>
<tr>
<td>1.6 Activity and participation mediate the effect of body function on affective wellbeing</td>
</tr>
<tr>
<td>1.7 Activity, participation and affective wellbeing mediate the effect of body function on QoL</td>
</tr>
<tr>
<td>1.8 Participation mediates the effect of activity on affective wellbeing</td>
</tr>
<tr>
<td>1.9 Participation and affective wellbeing mediate the effect of activity on QoL</td>
</tr>
<tr>
<td>1.10 Affective wellbeing mediates the effect of participation on QoL</td>
</tr>
</tbody>
</table>

**Table 4-7: Hypothesised longitudinal effects**

<table>
<thead>
<tr>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Incident chronic conditions are associated with decline in body function, activity, participation, affective wellbeing and QoL</td>
</tr>
<tr>
<td>2.2 Worsening body function is associated with decline in activity, participation, affective wellbeing and QoL</td>
</tr>
<tr>
<td>2.3 Worsening activity is associated with decline in participation, affective wellbeing and QoL</td>
</tr>
<tr>
<td>2.4 Worsening participation is associated with decline in affective wellbeing and QoL</td>
</tr>
</tbody>
</table>
Table 4-8 displays hypotheses concerning the moderating effects of key protective factors on effects along the pathway between chronic conditions and QoL. It was hypothesised that each protective factor moderated each stage along the pathway, as there was insufficient existing evidence to specify in advance which stage each protective factor was mostly likely to have an effect on. The direction of effect was specified for each moderating factor, with two exceptions: age and sex. The evidence was not sufficiently clear to make hypotheses regarding the direction of these effects, for example, older age could have been associated with a reduced effect of disability on QoL, or an increased effect.

Table 4-8: Hypothesised moderation effects

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Description</th>
</tr>
</thead>
</table>
| Higher extraversion (3.1), lower neuroticism (3.2), higher socioeconomic position (3.3), higher quality social support (3.4), higher social participation (3.6), and higher religiosity (3.7): | a. reduce the effect of incident chronic conditions on worsening body function, activity, participation, affective wellbeing and CASP QoL  
 b. reduce the effect of worsening body function on activity, participation, affective wellbeing and CASP QoL  
 c. reduce the effect of worsening activity on participation, affective wellbeing and CASP QoL  
 d. reduce the effect of worsening participation on affective wellbeing and CASP QoL |
| Age (3.8) and sex (3.9)                                                                 | a. modify the effect of incident chronic conditions on worsening body function, activity, participation, affective wellbeing and CASP QoL  
 b. modify the effect of worsening body function on activity, participation, affective wellbeing and CASP QoL  
 c. modify the effect of worsening activity on participation, affective wellbeing and CASP QoL  
 d. modify the effect of worsening participation on affective wellbeing and CASP QoL |

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4.4.3 Summary

Chapters 2 and 4 highlighted the lack of a clear and coherent conceptual model in existing research on the effect of chronic conditions on QoL in later life. Current theoretical literature and empirical evidence indicates that this is a complex and nuanced set of relationships. If subjective outcomes are to become an increasingly important focus of health policy and policy more generally, then we need detailed information about how precisely they are affected by physical health. A potential explanatory model has been put forward here, based on existing theory and evidence, in particular the WHO ICF model and resilience theory. The following chapter (Chapter 5) will describe how this model was operationalised and empirically evaluated in a population sample of older people, with subsequent chapters (Chapters 6-8) reporting the findings of that analysis.
Chapter 5  Methods

The purpose of this chapter is to describe the data source, measures and statistical methods for this thesis. Section 5.1 will describe sampling and data collection for the Irish Longitudinal Study of Ageing (TILDA). Section 5.2 will outline the measures used in this thesis. Sections 5.3-5.5 will outline three phases of statistical analysis, the results for which will be set out in Chapters 6, 7 and 8. The aim of Analysis Phase 1 was to validate the CASP-19 measure of QoL for the Irish population aged 50+. This involved a psychometric evaluation of CASP-19, using a combination of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) (Section 5.3). The aim of Analysis Phase 2 was to test a structural model of the cross-sectional relationship between chronic conditions and QoL, using a structural equation modelling approach (Section 5.4). The aim of Analysis Phase 3 was to investigate the effect of incident chronic conditions on change in QoL over a two year period and examine how these effects were modified by personal and environmental factors (Section 5.5). Section 5.6 will briefly deal with relevant ethical issues, such as ethical approval and informed consent.

5.1 Data

The study design for this thesis is a cross-sectional and longitudinal cohort study, with secondary data obtained from The Irish Longitudinal Study of Ageing (TILDA). TILDA is a large, prospective cohort study of the community-dwelling population aged 50+ who are residents of the Republic of Ireland (ROI). This section will outline the sampling and data collection procedure for TILDA, along with the characteristics of the sample and how these characteristics compare with the overall Irish population aged 50+. The sample included at different phases of analysis is displayed in flow charts in Figure 5-1 (p. 170) and Figure 5-2 (p. 175).

5.1.1 Sampling Strategy

The RANSAM sampling procedure (481), a computerised procedure developed by the Economic and Social Research Institute in Ireland (ESRI), was used to compile a probability sample of residential addresses in Ireland, using a multi-stage probability approach. The approach is described in more detail by Barrett et al. (6) and Kearney et al. (482).
sampling frame was obtained from the Geo-directory, a directory of all residential addresses in Ireland, compiled by the Irish Postal Service and the Ordnance Survey of Ireland (OSI). These addresses were assigned to 3,155 geographic clusters. Of these, 640 clusters were randomly selected, stratified by socioeconomic position and geographical location. The probability of selection of a cluster was proportionate to the estimated number of addresses of individuals aged 50+ within the cluster. Within each of these 640 clusters, 40 addresses were selected, each with an equal probability of selection, for a total of 25,600 addresses. Each of these addresses received an invitation letter, followed up one week later by a visit in person, to determine whether there was a person aged 50+ living in the household. All household members aged 50+ were eligible to participate.

As the sampling frame was confined to private households, older adults living in institutional settings were not included. In addition, individuals with severe cognitive impairment who were unable to consent to inclusion in the study were excluded. Ability to consent was determined on the basis of interviewer judgement.

An estimated 10,128 selected households included an eligible participant (482). Respondents participated from 6,282 households, yielding an estimated response rate of 62%. The total number of respondents aged ≥50 was 8,175.

5.1.2 Data Collection: Wave 1

There were three components in the survey at Wave 1 (W1). A home interview was carried out by a trained field worker using computer assisted personal interviewing (CAPI) to complete the survey. The interview included modules on demographics, health, social relationships and participation, living standards, income and wealth. Interviews were carried out between October 2009 and February 2011. After completion of the in-home interview, respondents were given a pen and paper self-completion questionnaire (SCQ) to complete, which was returned by post. A number of the measures used in this thesis were included in the SCQ, including the CASP-19 measure of QoL, and measures of social support, social leisure activity and volunteering. An SCQ was completed by approximately 85% (n = 6,912) of respondents. Each respondent was invited to a nurse-led health assessment (HA), and approximately 72% (n = 5,886) of the total sample participated (6). The HA collected data on a range of health variables – neuropsychological, cardiovascular,
gait, balance and sensory variables, strength and bone density, and macular degeneration (483). Approximately 86% of the HA sample attended a centre, with 14% receiving a shorter HA in their home (6). The health assessments were completed by July 2011.

**5.1.3 Sample Characteristics: Wave 1**

Of the 8,175 adults who participated in TILDA, 6,912 (84.6%) completed the SCQ booklet, which contained the CASP-19 QoL questionnaire. These participants were included in Analysis Phase 1. Of this group who completed the SCQ, 5,382 (77.9%) also participated in the HA, and were included in Analysis Phase 2. Seven participants in this group had missing data on age and were excluded, leaving 5,376 participants for inclusion in Analysis Phase 2 (see Figure 5-2).

![Figure 5-1: Participant flow chart, wave 1](image-url)
Table 5-1 displays the basic socio-demographic characteristics of the TILDA study sample, the SCQ sample and the combined HA and SCQ sample. These three samples are compared with ROI Census 2011 data for the population aged 50+.

TILDA included a higher proportion of women compared to the Census population in the same age group. It also included a smaller proportion of older adults aged 80+. This was at least partly due to the exclusion of nursing home residents and adults with severe cognitive impairment from TILDA. Within TILDA, the age and sex profiles were similar across the three samples. However, the SCQ and combined SCQ/HA samples were slightly younger and included a higher proportion of women.

The proportion of TILDA participants who completed only primary school in TILDA is similar to the census (approximately 30%). The proportions completing degree-level education or higher were similar across TILDA (14.1%) and the Census (15.3%). However, the proportions completing second level and third level non-degree differ. Only 3.3% of participants in the Census reported a third-level non-degree qualification, compared with 15.2% of the TILDA sample. It appeared as if some individuals categorised as third level non-degree in TILDA may have been categorised as second level in the Census, and vice versa. However, the difference may also have been due to sampling error. Within TILDA, the SCQ and combined SCQ/HA samples were better educated on average than TILDA as a whole.

Self-rated health was measured slightly differently across the Census and TILDA; with varying response categories (see Table 5-1). However, it is possible to compare those reporting good health; and fair, poor or bad health. These proportions were similar in the full TILDA sample and the Census. Within TILDA, the SCQ sample and the combined HA/SCQ sample tended to report better health relative to the TILDA sample as a whole.

Overall, though there was some variation in the demographic profiles, the TILDA sample was broadly similar to the general Irish population aged 50+ in 2011. This similarity diverged somewhat for the SCQ and HA samples, but was still broadly in line with the overall population.
Table 5-1: Characteristics of the Full TILDA, SCQ and HA samples compared with Irish Census 2011

<table>
<thead>
<tr>
<th></th>
<th>TILDA Sample (%)</th>
<th>SCQ Sample (%)</th>
<th>HA and SCQ Sample (%)</th>
<th>Census 2011 Age 50+ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 8,175</td>
<td>n = 6,903</td>
<td>n = 5,375</td>
<td>n = 1,164,113</td>
</tr>
<tr>
<td>Men</td>
<td>45.8</td>
<td>45.5</td>
<td>45.6</td>
<td>48.1</td>
</tr>
<tr>
<td>Women</td>
<td>54.2</td>
<td>54.5</td>
<td>54.4</td>
<td>51.9</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-59</td>
<td>40.1</td>
<td>40.1</td>
<td>41.2</td>
<td>40.8</td>
</tr>
<tr>
<td>60-70</td>
<td>31.7</td>
<td>32.4</td>
<td>33.7</td>
<td>30.8</td>
</tr>
<tr>
<td>70-80</td>
<td>19</td>
<td>18.9</td>
<td>17.7</td>
<td>18.3</td>
</tr>
<tr>
<td>80+</td>
<td>7.7</td>
<td>7.1</td>
<td>5.9</td>
<td>10.1</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>30.7</td>
<td>28.1</td>
<td>25</td>
<td>31.8</td>
</tr>
<tr>
<td>Secondary</td>
<td>40</td>
<td>40.8</td>
<td>41.4</td>
<td>49.6</td>
</tr>
<tr>
<td>Third Level Non-Degree</td>
<td>15.2</td>
<td>16.0</td>
<td>17.2</td>
<td>3.3</td>
</tr>
<tr>
<td>Third Level Degree</td>
<td>14.1</td>
<td>15.0</td>
<td>16.4</td>
<td>15.3</td>
</tr>
<tr>
<td><strong>Self-Rated Health</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>15.6</td>
<td>16.4</td>
<td>16.9</td>
<td>N/A³</td>
</tr>
<tr>
<td>Very Good</td>
<td>28.6</td>
<td>29.0</td>
<td>29.7</td>
<td>Very Good</td>
</tr>
<tr>
<td>Good</td>
<td>32.6</td>
<td>32.2</td>
<td>31.9</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Total Good</strong></td>
<td><strong>76.8</strong></td>
<td><strong>77.6</strong></td>
<td><strong>78.5</strong></td>
<td><strong>76</strong></td>
</tr>
<tr>
<td>Fair</td>
<td>18.0</td>
<td>17.8</td>
<td>17.2</td>
<td>Fair</td>
</tr>
<tr>
<td>Poor</td>
<td>5.0</td>
<td>4.7</td>
<td>4.2</td>
<td>Bad</td>
</tr>
<tr>
<td>N/A³</td>
<td></td>
<td></td>
<td></td>
<td>Very Bad</td>
</tr>
<tr>
<td><strong>Total Fair/ Poor/Bad</strong></td>
<td><strong>23</strong></td>
<td><strong>22.5</strong></td>
<td><strong>21.4</strong></td>
<td><strong>23.9</strong></td>
</tr>
</tbody>
</table>

SCQ = Self-completion questionnaire; HA = Health assessment

³The Census did not include a category for excellent health, while TILDA did not include a category for very bad health

Census 2011 data obtained from www.cso.ie
5.1.4 Data Collection: Wave 2

A second wave of data collection was carried out over the period 2012 to 2013. Again, data collection comprised a computer-assisted personal interview (CAPI), a self-completion questionnaire (SCQ) and an objective health assessment (HA). However, in place of a nurse-led, clinic-based HA, the trained interviewers carried out a shorter HA in participants’ homes. The SCQ in Wave 2 (W2) included a measure of personality (NEO-FFI), which was not included in the SCQ in W1.

In W2, a detailed protocol was put in place to handle participants who may have developed cognitive impairment. If the interviewer suspected cognitive impairment, the 10-item Abbreviated Mental Test was carried out before beginning the interview (484). A proxy interview was used for participants scoring <7. The Mini-Mental State Examination (MMSE) (485) was also carried out during the course of the interview. If the participant scored <15, then the interview moved to proxy assessment.

5.1.5 Sample Characteristics: Wave 2

Of the 8,175 participants in W1, 6,995 completed an interview at W2, equating to a response rate of 86%. Of the 1,180 participants who did not respond, 205 had died, 166 were lost to follow-up while the remainder (n = 809) refused to participate. W1 participants were more likely to respond to W2 if they were younger, and if they completed both the SCQ and HA at W1. Among W2 participants, 84% completed an SCQ at W2.

Of the 5,376 participants who completed the HA and the SCQ at TILDA W1, 396 (7.3%) did not participate in W2 while a further 433 (8.1%) did not return the self-completion booklet in W2 (see Figure 5-2). This left a sample of 4,547 participants for inclusion in longitudinal analysis in Analysis Phase 3. The characteristics of the included and excluded participants are compared in Table 5-2. The included sample was younger, more likely to be female and more likely to have completed third level education. Further participants were excluded from analysis at Phase 3 due to item-level non-response, which will be described in Section 5.5 and in Chapter 8.
Table 5-2: Wave 2 included sample, compared with those lost to follow-up and excluded due to non-response

<table>
<thead>
<tr>
<th></th>
<th>W2 Included Sample n = 4,547</th>
<th>Did not participate in W2 n = 395</th>
<th>Did not complete SCQ in W2 n = 433</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>44.7</td>
<td>47.8</td>
<td>52.9</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>55.3</td>
<td>52.1</td>
<td>47.1</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>42.2</td>
<td>36.2</td>
<td>44.1</td>
</tr>
<tr>
<td>60-70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35.0</td>
<td>30.4</td>
<td>25.2</td>
</tr>
<tr>
<td>70-80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>17.0</td>
<td>22.0</td>
<td>18.5</td>
</tr>
<tr>
<td>80+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.8</td>
<td>11.4</td>
<td>12.2</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>23.4</td>
<td>37.0</td>
<td>31.2</td>
</tr>
<tr>
<td>Secondary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>41.5</td>
<td>41.8</td>
<td>39.3</td>
</tr>
<tr>
<td>Third Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35.0</td>
<td>21.3</td>
<td>29.6</td>
</tr>
</tbody>
</table>

W1 = Wave 1; W2 = Wave 2; SCQ = self-completion questionnaire
Eligible Households
n = 10,128

Non-responding households
n = 3,846

TILDA Participants aged 50+
n = 8,175

Did not complete or return SCQ
n = 1,263

Completed SCQ W1
n = 6,912

Did not complete health assessment
n = 1,527
Age missing = 9

Included in Analysis Phase 1

Completed HA W1
n = 5,376

Refused / unable to contact W2
n = 396

Included in Analysis Phase 2

Participated W2
n = 4,980

Did not complete SCQ W2
n = 433

Included in Analysis Phase 3

Completed SCQ W2
n = 4,547

Figure 5-2: Participant flow chart, waves 1 and 2
5.2 Measures

This section describes in detail the measures used in the thesis. A summary table of measures is displayed on p. 193 (Table 5-5). Many of the measures used in TILDA are based on those used in similar epidemiological studies of populations aged 50+ (ELSA (48), SHARE (51,52), HRS (49)). This helped to ensure that measures were appropriate for the population and could be compared and harmonised across studies.

5.2.1 Chronic Disease Status

In this section, the approach used to record chronic disease status in TILDA will be discussed, including some associated limitations. In addition, approaches to measuring chronic disease status – as separate conditions, as a number of conditions or as a weighted index – will be evaluated.

Chronic diseases were recorded in TILDA using a standard approach utilised by other large-scale epidemiological studies of ageing including HRS (71), ELSA (48) and SHARE (51,52). Respondents were given a checklist of conditions and asked "Has a doctor ever told you that you have any of the conditions on this card?" Self-reported doctor-diagnoses have been found to have reasonable validity relative to medical records (486–488). There is some evidence that musculoskeletal disorders do not appear to have good concordance, with both under- and over-reporting relative to medical records (486–488). Nevertheless, self-reported doctor-diagnosis is routinely used in studies examining QoL in chronic disease and was the typical approach used in studies reviewed in Chapter 2 (e.g., 83,101,102,120,138,155,162,192). In addition, evidence suggests that number of conditions based on self-report and chart review display a similar association with HRQoL (489). While information from medical records would have been useful to enhance the validity of the information, it was not possible to link respondents to their medical records due to the lack of a unique patient identifier in the Irish healthcare context.

The use of both self-reported doctor diagnoses and medical records to measure chronic disease status may lead to mis-classification of participants who have un-diagnosed chronic conditions. A review of studies comparing diagnostic information with clinical assessment from 1998-2005 identified extensive under-diagnosis for myocardial infarction (MI), chronic...
obstructive pulmonary disease (COPD), osteoarthritis, diabetes, asthma, cirrhosis, osteoporosis, atrial fibrillation, hypertension and transient ischaemic attacks (490). In general, it appeared that undiagnosed cases were of less severe forms, for example, silent myocardial infarction, silent atrial fibrillation or asymptomatic osteoarthritis. A recent study among Finnish men, however, found levels of under-diagnosis only for osteoporosis and erectile dysfunction (491). It is possible that under-diagnosis in the population for specific conditions is declining – for example, levels of under-diagnosis for diabetes have declined in the UK in recent years (492). Overall, while it should be acknowledged that there are levels of under-diagnosis of chronic conditions in the population; under-diagnosed conditions are likely to be less severe, so that number of diagnosed conditions remains a reasonable measure of overall chronic disease burden.

The second consideration when measuring chronic disease status is how to define different levels of chronic disease burden. Examining chronic disease as a simple binary variable (i.e., no conditions versus one or more conditions) is unlikely to fully capture the illness experience. Distinct conditions vary in severity and may have differential effects on both disability and QoL outcomes (493). For example, stroke may have a much more detrimental effect on QoL relative to hypertension, as reflected in the systematic review reported in Chapter 2.

However, examining the effects of conditions separately does not allow us to capture the effects of having multiple chronic conditions, or multi-morbidity (9). Many older people have more than one condition and examining a series of conditions separately ignores the overall, cumulative burden of conditions. Additional chronic conditions have been found to have an additive deleterious impact on HRQoL (494). Qualitative research similarly suggests that additional chronic conditions compound the initial illness experience (312).

Considerable attention has been paid in recent years to measuring multiple chronic conditions. Diederichs et al. (209) recently reviewed summary measures of chronic disease status, which attempt to "aggregate the complex reality into single indicators". The most common approach identified consisted of a simple list of conditions. However, there were also several approaches identified which took account of the severity of various conditions, to produce a severity-adjusted index.
The most commonly used index identified in the review (209) was the Charlson Index, originally developed in an acute patient population, with the aim of controlling for the effect of comorbidity on mortality (208). It was not originally developed for use with the general older adult population, or for use with QoL outcomes. Bayliss et al. found that the Charlson Index score and number of conditions were similarly related to HRQoL outcomes (489). This is not surprising, as most of the conditions in the Charlson Index that are highly prevalent in a general population are assigned a weighting of one – e.g., diabetes, heart disease, and COPD. Conditions with a higher weight – metastatic cancer, AIDS, cirrhosis – are likely to be rarer at the population level.

Fortin et al. compared the Charlson Index as a predictor of HRQoL to two alternative severity-adjusted indices – the Functional Comorbidity Index (FCI) and the Cumulative Illness Rating Scale (CIRS) (495). The FCI performed better than the Charlson Index. This index is a straightforward count of conditions selected on the basis of their impact on physical function (496). It includes conditions not generally defined as diseases, such as obesity and visual impairment, and excludes conditions that do not affect physical function such as hypertension, high cholesterol and heart arrhythmia. The CIRS, however, explained the greatest proportion of variance in QoL scores out of the three indices. The CIRS includes detailed severity ratings for each patient, generally obtained from chart review undertaken by clinicians (497) and is therefore not feasible to apply to a large-scale survey such as TILDA.

A further alternative index was proposed by Bayliss et al. (489). This combined the number of conditions with subjective assessments of the impact of each condition on usual activities. They found this index to be a better predictor of QoL outcomes (health status and physical function) than a simple count of conditions. This is not surprising, however, as capturing evaluations of the impact of a condition on usual activities is very close to measuring subjective assessments of physical function, thus conflating comorbidity with its consequences.

This issue reflects a broader conceptual dilemma. It is important to acknowledge that not all chronic conditions are of equal severity, but it is also important not to pre-suppose what comprises those differences in severity. One of the objectives of this thesis is to disentangle
how overall chronic disease status is related to subjective outcomes via measures of disability. It is therefore important that these outcomes are not already included in the measure of chronic disease status. For example, if we include only conditions that are likely to have an effect on physical function and exclude conditions such as hypertension, this pre-supposes that chronic conditions affect QoL only via physical function.

In sum, while there are arguments for using some kind of severity-adjusted measure, a simple measure of chronic disease burden based on a broad number of conditions is preferable, as it does not involve any *a priori* assumptions regarding the impact of chronic conditions. Therefore, the measure of chronic disease status used in this thesis was a simple count of chronic conditions, based on an inclusive list (displayed in Table 5-3). The conditions are the same as those included in the systematic literature review, and the rationale for this list was described in Section 2.2.1.2. Briefly, all physical chronic conditions that were captured in TILDA were included. Psychological disorders were excluded. Health problems that are sometimes included in expanded definitions of multi-morbidity, such as symptoms or physical functional deficits, were excluded. This ensured clear conceptual separation between chronic disease and disability.

**Table 5-3: Included chronic conditions**

<table>
<thead>
<tr>
<th>Abnormal heart rhythm</th>
<th>Congestive Heart Failure</th>
<th>High Cholesterol*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angina</td>
<td>Diabetes</td>
<td>Mini-stroke or TIA</td>
</tr>
<tr>
<td>Arthritis</td>
<td>Emphysema</td>
<td>Osteoporosis</td>
</tr>
<tr>
<td>Asthma</td>
<td>Hypertension*</td>
<td>Parkinson's disease</td>
</tr>
<tr>
<td>Cancer</td>
<td>Heart Arrhythmia*</td>
<td>Stomach Ulcer</td>
</tr>
<tr>
<td>Chronic bronchitis /</td>
<td>Heart Attack</td>
<td>Stroke</td>
</tr>
<tr>
<td>lung disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cirrhosis</td>
<td>Heart Murmur*</td>
<td>Varicose ulcer*</td>
</tr>
</tbody>
</table>

*Not included in the Functional Comorbidity Index

To test the sensitivity of the thesis findings to this inclusive definition of chronic disease status, the analysis was repeated using a narrower definition of chronic disease. This involved selection of conditions that are associated with at least some disability or functional limitations, based on their inclusion in the Functional Comorbidity Index (FCI)
This definition excluded hypertension, high cholesterol, heart arrhythmia, heart murmur and varicose ulcer.

5.2.1.1 Incident Chronic Conditions

An incident chronic condition was defined as a self-reported doctor diagnosed condition which was present at W2 but not at W1. As multiple incident conditions were relatively rare in the sample, a binary indicator for any incident condition was examined, rather than the number of incident conditions. In addition, binary indicators for an incident chronic condition with an increase in physical disability (defined as body function or activity deficits - see Section 4.2.5); and for an incident chronic condition with an increase in the number of medications, were examined. Medications were captured both by self-report and by the interviewers in the home who asked to see and recorded the medications that the participant was taking at the time of interview.

The effects of incident conditions on outcomes such as disability and QoL were also expected to vary depending on baseline chronic disease status. Baseline disease status was therefore used as a basis for stratified analyses. Categories comprised no condition, single condition and multi-morbidity (2+ conditions).

5.2.2 Quality of Life

QoL was measured using the CASP-19, a measure based on the theory of needs satisfaction (45). QoL is viewed as the fulfilment of four key higher needs - Control, Autonomy, Self-Realisation and Pleasure. The conceptual model and theoretical underpinnings of this measure were discussed in Chapter 3, Section 3.6. It consists of 19 four-point response Likert scale items. The response options include Often, Sometimes, Rarely and Never. Item content is displayed in Table 3-1. Sample items include "I feel left out of things" and "I feel satisfied with the way my life has turned out". Thirteen positively-worded items are reverse-coded so that a higher score indicates higher QoL.

The original factor structure for the scale comprises four factors relating to each of the four needs, which in turn load on to, or are part of, an overall second-order QoL factor. The scale can thus be examined as four sub-scales, or as an overall summary measure of QoL.
However, as noted in Section 3.6, psychometric evaluation of the scale to date has not supported this four-factor, second-order structure. Further validation with general-population samples has been recommended (47). Accordingly, the factor structure of the scale will be evaluated as Analysis Phase 1. The analytic strategy will be described in Section 5.3, with results reported in Chapter 6. The findings of this analysis, in terms of both item composition and dimensionality of the scale, will be used to inform the use of the CASP-19 measure in Analysis Phase 2 and Phase 3.

There are a number of versions of the CASP-19 measure with varying item compositions (e.g. CASP-12 (46)). When referring to the scale in a general sense, the term CASP measure will be used rather than CASP-19.

5.2.3 The ICF Domains

The ICF framework and its three key domains – body function, activity and participation - were described in detail in Chapter 4, Section 4.2.3. Considerable guidance is available on the operationalisation of the ICF domains, given its purpose as a classification system. The ICF categories are set out in detail in an online browser tool [www.who.int/classifications/icfbrowser]. Guidance is also available on how to link study variables to the ICF classification (298) and this was broadly followed. Essentially, this involves identifying the meaningful health-related concepts captured in an item and mapping these concepts to the most appropriate and most specific category of the ICF. The process requires a certain amount of subjective interpretation on the part of the researcher in terms of matching the concepts, particularly when the language used varies.

Initially, a list of variables related to disability or physical function available in TILDA W1 was compiled and considered for harmonisation with the ICF domains. As the focus of the thesis was on disentangling the effects of physical health on subjective outcomes, relatively concrete variables were chosen for harmonisation with the ICF indicators. Variables capturing performance or perception rather than evaluation were preferred, helping to ensure conceptual separation from QoL (212). For self-report variables, items asking a person what they can do and cannot do were selected rather than subjective appraisals of the extent to which participants consider themselves limited in their activities. For
example, the extent of a person’s mobility difficulties was captured, rather than the extent to which they believed that those mobility difficulties interfered with their daily life. This was consistent with the ICF as a classification of functioning, as distinct from QoL (298).

Bivariate associations (adjusted for age, sex and education) with number of chronic conditions and QoL were examined for each variable, and any indicators that did not have a statistically significant association with both chronic disease and QoL were excluded from further analysis. In addition, variables were only included if they were measured as part of the home HA in W1. For example, while bone density measurement is an indicator of body function, it was only available for participants who attended the health centre. Including participants who had received home assessments was important as it ensured inclusion of at least some older and sicker participants who were not able to attend the health centre.

5.2.3.1 Body Function

*Body function* relates to the basic physiological, physical, mental and sensory functions of the body. Preliminary bivariate analysis indicated that global cognitive impairment (measured by the MMSE) was not associated with chronic disease status, using two alternative cut-offs for impairment: MMSE < 26 (p=0.34), and MMSE < 23 (p = 0.59) (498). This may be explained by the low prevalence of cognitive impairment in the sample in general (MMSE < 26, 6.9%; MMSE < 23, 1.7%). As noted in Section 5.1.1, individuals with severe cognitive impairment, who were unable to consent to participation, were not included in TILDA. Objectively measured hypertension was not related to either chronic disease status (p=0.72) or QoL (p=0.94). These variables were excluded from further analysis.

Table 5-4 displays each of the indicators used to measure *body function* and the corresponding category of the ICF. More detail on the measures from which the self-report items were drawn is displayed in Table S-5. All items were treated as dichotomous. Pain was measured using a single self-report item capturing pain intensity, with pain defined as moderate or severe pain most of the time. This item was similar to a measure of pain intensity in the widely-used SF-36 (68). Poor balance was measured as feeling slightly or very unsteady while walking, standing or getting up from a chair. These items have been
validated previously as a measure of steadiness in the older, community-dwelling population (499).

Poor sleep was measured with a single item capturing difficulties falling asleep, based on a similar measure used in HRS and ELSA. Urinary incontinence was measured by the item "During the last 12 months, have you lost any amount of urine beyond your control?" (10,500). Grip strength was measured objectively using a hydraulic hand dynamometer (501). Two measurements were taken for each hand. The mean of two measures of grip strength for the dominant hand was used, with weak grip defined as being in the lowest quintile of grip strength for your sex and age group (based on 10 year age groups).

As discussed in Chapter 4 (Section 4.2.6), psychological function variables which were defined as body functions in ICF – such as energy, motivation, and appetite – were not examined due to conceptual overlap with depressive symptoms. The role of affective wellbeing was dealt with separately, measured as positive affect, which is a dimension of depression that is distinct from somatic symptoms such as appetite and motivation (502).

5.2.3.2 Activity

Where body function relates to the physiological functions of the body, activity relates to the functioning of the individual. It includes tasks that are necessary or important for daily life, including basic mobility tasks such as walking or lifting objects, and more complex tasks such as shopping or cooking.

The activities included are outlined in Table 5-4, along with their corresponding ICF codes. Again, each variable was included as a dichotomous indicator. Basic mobility tasks were included – for example, sitting for a long period, climbing stairs or reaching above shoulder level. Difficulties doing basic and instrumental activities were also examined. Basic activities of daily living (ADLs) correspond to any difficulty in self-care activities such as dressing, eating, or using the toilet. Instrumental activities of daily living (IADLs) are more complex, for example cooking or doing household chores. ADLs and IADLs are widely used measures of disability, although the specific set of activities, item content and response options included varies across measures (503–505). The set of items used here is based on those included in HRS (71). Endorsement of the IADL and ADL items in this sample were low (<7%
across all items, <2% for seven out of 11 items). It was therefore decided to measure these using dichotomous variables indicating the presence of any ADL and any IADL.

An objective measure of functional mobility was also included - the Timed Up and Go (TUG) test, which measures how long it takes someone to get up from a chair and walk (501). Similar to grip strength, a slow TUG was defined as being in the highest quintile for age and sex.

5.2.3.3 Participation

While participation is distinguished from activity in the ICF framework, the classification includes activity and participation in the same overall category. As discussed in Section 4.2.3, participation can be distinguished from activity based on whether it takes place in a social context and involves performing some kind of role. This is the approach that has been taken here. Participation was taken to require a higher level of engagement with others and the broader community – for example, activities such as cooking and cleaning were included as activity rather than participation.

Following Klumb & Maier's conceptualisation of participation (293), both leisure and productive activities were examined – social leisure activity that occurs at least once a month, participating in a community group or volunteering, and paid employment.

- Social leisure activity was measured by engagement in an active, social leisure pursuit at least once a month. Social activity at least weekly was also examined in Analysis Phase 3.
- Participation in a community group was measured using a single item from Berkman's Social Network Index (SNI): "Do you participate in any groups such as a sports or social group or club, a church connected group, a self-help or charitable body or other community group or a day care centre?" (506).
- Volunteering was measured using a single item capturing whether the participant did voluntary work at least once a month.
- Paid work was measured using a single item to assess employment status, and was defined as anyone who considered themselves employed or self-employed. This
included individuals who were temporarily away from work, working in a family business or engaged in farming.

Table 5-4: TILDA study variables mapped to ICF categories

<table>
<thead>
<tr>
<th>TILDA Variable</th>
<th>Item Content</th>
<th>ICF category</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body Function</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>Moderate or severe pain most of the time in any body part</td>
<td>b280 Sensation of Pain</td>
</tr>
<tr>
<td>Urinary Incontinence</td>
<td>Loss of urine beyond control, previous 12 months</td>
<td>b6202 Urinary continence</td>
</tr>
<tr>
<td>Poor balance</td>
<td>Feeling slightly or very unsteady when standing or getting up from a chair</td>
<td>b755 Involuntary movement reaction functions</td>
</tr>
<tr>
<td>Grip Strength</td>
<td>Objectively measured using a dynamometer</td>
<td>b730 Muscle power functions</td>
</tr>
<tr>
<td>Poor Sleep</td>
<td>Trouble falling asleep some or most of the time</td>
<td>b134 Sleep Functions</td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic Mobility</td>
<td>Walking for 100m</td>
<td>d4500 Walking short distances</td>
</tr>
<tr>
<td></td>
<td>Sitting for about 2 hours</td>
<td>d4153 Maintaining a sitting position</td>
</tr>
<tr>
<td></td>
<td>Getting up from a chair after sitting for long periods</td>
<td>d410 Changing basic body position</td>
</tr>
<tr>
<td></td>
<td>Climbing one flight of stairs without resting</td>
<td>d4551 Climbing</td>
</tr>
<tr>
<td></td>
<td>Stooping, kneeling or crouching</td>
<td>d4102 Kneeling, d4101 Squatting, d4105 Bending</td>
</tr>
<tr>
<td></td>
<td>Reaching or extending your arms above shoulder level</td>
<td>d4452 Reaching (above shoulder level not defined)</td>
</tr>
<tr>
<td></td>
<td>Pulling or pushing large objects like a living room chair</td>
<td>d4450 Pulling, d4451 Pushing (large objects not defined)</td>
</tr>
<tr>
<td></td>
<td>Lifting or carrying weights over 10 pounds/5 kilos, like a heavy bag of groceries</td>
<td>d430 Lifting and carrying objects (weight not defined)</td>
</tr>
<tr>
<td>Slow Timed Up and Go = highest quintile for age and sex</td>
<td>Timed Up and Go (objective measure, seconds)</td>
<td>d410 Changing basic body position; d4500 Walking short distances</td>
</tr>
<tr>
<td><strong>TILDA Variable</strong></td>
<td><strong>Item Content</strong></td>
<td><strong>ICF category</strong></td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td><strong>Difficulties in Basic Activities of Daily Living (one or more of these)</strong></td>
<td>Dressing, including putting on shoes and socks</td>
<td>d540 Dressing</td>
</tr>
<tr>
<td></td>
<td>Walking across a room</td>
<td>d4500 Walking short distances</td>
</tr>
<tr>
<td></td>
<td>Bathing or showering</td>
<td>d510 Washing oneself</td>
</tr>
<tr>
<td></td>
<td>Eating, such as cutting up your food</td>
<td>d550 Eating</td>
</tr>
<tr>
<td></td>
<td>Getting in or out of bed</td>
<td>d410 Changing basic body position</td>
</tr>
<tr>
<td></td>
<td>Using the toilet, such as getting up or down</td>
<td>d530 Toileting</td>
</tr>
<tr>
<td><strong>Difficulties with Instrumental Activities of Daily Living (one or more of these)</strong></td>
<td>Preparing a hot meal</td>
<td>d630 Preparing meals</td>
</tr>
<tr>
<td></td>
<td>Doing household chores (laundry, cleaning)</td>
<td>d640 Doing housework</td>
</tr>
<tr>
<td></td>
<td>Shopping for groceries</td>
<td>d6200 Shopping</td>
</tr>
<tr>
<td></td>
<td>Making telephone calls</td>
<td>d360 Using communication devices</td>
</tr>
<tr>
<td></td>
<td>Taking medications</td>
<td>d5702 Maintaining one’s health</td>
</tr>
<tr>
<td></td>
<td>Managing money, such as paying bills and keeping track of expenses</td>
<td>d620 Acquisition of goods and services; d860 Basic economic transactions</td>
</tr>
<tr>
<td><strong>Participation</strong></td>
<td>Go out to films, plays and concerts.</td>
<td>d9202 Arts and culture</td>
</tr>
<tr>
<td></td>
<td>Attend classes and lectures</td>
<td>d810-d839 Education</td>
</tr>
<tr>
<td></td>
<td>Play cards, bingo, games</td>
<td>d9200 Play</td>
</tr>
<tr>
<td></td>
<td>Eat out of the house.</td>
<td>d9205 Socializing</td>
</tr>
<tr>
<td></td>
<td>Travel for pleasure.</td>
<td>d920 Recreation and leisure</td>
</tr>
<tr>
<td><strong>Community Participation (yes to at least one of these items)</strong></td>
<td>Do voluntary work at least monthly</td>
<td>d855 Non-remunerative employment</td>
</tr>
<tr>
<td></td>
<td>Do you participate in any groups such as a sports or social group or club, a church connected group, a self-help or charitable body or other community group or a day care centre?</td>
<td>d9100 Informal associations</td>
</tr>
<tr>
<td><strong>Paid Work</strong></td>
<td>Employed or Self-employed</td>
<td>d850 Remunerative employment</td>
</tr>
</tbody>
</table>

### 5.2.4 Affective Wellbeing

The ICF framework includes variables relevant to affective wellbeing, such as affect and anxiety, as mental functions in the overall category of *body function*. However, one of the aims of this thesis was to examine how impairments in *body function* and other disability...
domains influence QoL via negative effects on affective wellbeing, and therefore affect was considered separately. The Centre for Epidemiological Studies – Depression (CES-D) scale was developed for use with the general population, and thus captures the continuum of affective wellbeing, rather than the presence of a clinical depressive disorder (507). Participants rated the frequency of specific feelings in the past week, such as "hopeful about the future" and “depressed”. Response options include rarely/none of the time, some of the time, most of the time, or all of the time.

Meta-analysis of studies examining the factor structure of the CES-D indicates that there are four separate dimensions of the CES-D: positive affect, depressed or negative affect, somatic symptoms and interpersonal problems (502). This factor structure has been confirmed with older people in TILDA (508). As somatic symptoms overlap with body function, and interpersonal problems were examined elsewhere in the conceptual framework, only the dimensions of affect were considered for inclusion.

It is unclear whether positive and negative affect constitute distinct dimensions of affect, or whether differences are due to a method effect arising from the direction of wording of the items (509). An initial factor analysis indicated that latent factors for positive and negative affect were highly correlated (0.751). The positive affect sub-scale was thus used to measure affective well-being, as it is measured using fewer items (four versus seven for negative affect). However, the analysis was repeated using negative affect as a sensitivity analysis, to assess whether findings were specific to the positive dimension of affect.

5.2.5 Personal and Environmental Factors

Characteristics of the person and features of their environment are important determinants of physical health, disability, affective wellbeing and QoL, as outlined in Chapter 4, Section 4.3. They are also included in the WHO ICF, though this aspect of the classification is not as well-developed as for the disability domains (510). It was considered important to adjust for personal and environmental covariates in analysis of mediating factors, to ensure that mediation effects were not induced by one or more unmeasured third variables (511). However, as discussed in Section 4.3, personal and environmental factors also modify or interact with effects along the pathway between chronic conditions
and QoL. Personal and environmental factors were thus examined in this thesis as both covariates and as moderating factors (see Figure 4-6, p. 164).

The following personal factors were examined: age, sex, personality and religiosity. Environmental factors included social support (including marital status), socio-economic position (SEP) and social participation. Lifestyle factors (obesity, smoking and alcohol consumption) and employment status were included as covariates, but not examined as moderating factors.

5.2.5.1 Socio-demographics and lifestyle

Age and sex were adjusted for in analyses of mediation and moderation effects. Age is associated with reduced physical health and has a U-shaped relationship with QoL (36,76). Age was thus adjusted for in analysis of both mediation effects (Phase 2) and moderation effects (Phase 3). In addition, a quadratic term for age (age$^2$) was included to account for this non-linear relationship between age and QoL. Women tend to have worse physical health than men at the same age (77–79) and appear to report worse life satisfaction (80) and more depressive symptoms (462,463). However, current evidence suggests that they report higher CASP-19 scores (36,76). Sex was thus also adjusted for in analysis of both mediation effects (Phase 2) and moderation effects (Phase 3). Age and sex were also investigated as moderators of the pathway between chronic conditions and QoL (see Section 4.3.5).

The influence of lifestyle on chronic disease and disability risk is well documented, and associations with QoL have also been found (88–91). The following lifestyle factors were adjusted for in analysis of mediating and moderating effects: current smoking, alcohol consumption (>4 times per week), and obesity (objectively measured BMI ≥30). Objective BMI was measured at W1 only, while information on smoking and alcohol was available at both waves.

Employment status is also a potential confounder of the relationship between physical health and QoL. In this sample, the majority of participants were employed (38%), retired (37%), or looking after home (14% - almost all women). Retirement can have complex associations between physical and mental health (512,513), and was adjusted for in all
analyses, except for analyses where paid work was examined as an indicator of participation.

5.2.5.2 Personality

Two personality traits were examined, neuroticism and extraversion. Neuroticism and extraversion have been identified as important influences on both health and wellbeing (220,363,364) (see Section 4.3.1 in Chapter 4). These traits were examined as both covariates and moderators of effects along the pathway from chronic conditions to QoL. However, they were only examined in Analysis Phase 3 as data on personality were collected in W2 only. Personality is thought to remain relatively stable over short time periods similar to two years, particularly at older ages (354), and the absence of a measure of personality at W1 was therefore not considered problematic.

Neuroticism and extraversion form two of the Five Factor ("Big Five") model of personality traits, which is the most well-established model of personality (348,349). The other three traits are openness to experience, conscientiousness and agreeableness. The two traits were measured using two sub-scales of the NEO Five Factor Inventory (NEO-FFI). This scale is an abbreviated version of the NEO Personality Inventory-Revised (NEO-PI-R) (514) and has been shown to work well with older population samples (515). Although the psychometric validity of the NEO-FFI has been challenged (516), most of the problematic items appear to relate to the openness to experience and agreeable traits (515). In addition, a more recent evaluation of the factor structure, using an exploratory structural equation modelling approach (ESEM), found that the five-factor model had adequate fit in a general young adult sample (517).

5.2.5.3 Religiosity

The potential importance of religiosity as a modifier of relationships between physical health and QoL outcomes was outlined in Section 4.3.2. Religion and spirituality are multidimensional constructs comprising psychological dimensions, such as beliefs, and environmental or behavioural components, such as church attendance. In this study, a simple measure of self-rated religiosity was used: "How important would you say religion is
in your life?" There were three response options: very important, somewhat important and not important.

In order to separate out the environmental aspects of religious participation, regular church attendance was also captured and adjusted for. A dichotomous variable was used, for church attendance at least weekly, versus less than weekly or not at all. In addition, analyses of religiosity were also adjusted for rural location, to account for the possibility that religiosity is higher in rural areas. Three categories of geographical location were examined: Dublin (the capital city of Ireland), a town other than Dublin, and rural area.

5.2.5.4 Socioeconomic Position

Lower socio-economic position (SEP) tends to be associated with poorer physical health (81,401–403), and lower QoL (86,87,416), as outlined in Section 4.3.3. The main indicator of SEP examined was education, measured as three levels: primary, secondary and third level. The primary school category included a small proportion of participants who had not completed primary school (approximately 3%). The third level category was split broadly equally between those who had a third level degree and those who had achieved a third level non-degree qualification (i.e., diploma or certificate).

Healthcare eligibility status was used as a proxy measure of socio-economic position (SEP). As outlined in Section 4.3.6.3, adults aged <70 years are entitled to a medical card on the basis of low income. This entitles them to access public healthcare free of charge, or at a minimal cost. Granting of a medical card is decided on the basis of a detailed means assessment, based on the net income of the individual and their spouse, taking into account housing, childcare and commuting costs (518). For example, in 2014 an individual living alone had to have a net weekly income (after costs) of €184 or less for a full medical card, and €276 or less for a GP visit card (which does not provide some benefits, such as drug costs). Only 8% of medical card holders aged <70 in TILDA held a GP visit card, with the remainder holding a full medical card.

Having a medical card is therefore a useful proxy for low income. In the 70+ age group, the income thresholds are considerably higher (€500 for a single person) and medical card status does not therefore function as a useful proxy measure of low income. Medical card
status was thus only included as a covariate in sub-group analyses that included only adults aged <70. It was also examined as a moderator of effects along the chronic conditions-QoL pathway, again only among participants aged <70.

Private health insurance (PHI) was used as a proxy measure of high income in the analysis of moderating factors (Analysis Phase 3). This was on the basis that it implies sufficient disposable income to pay an insurance premium. In 2012, the average annual health insurance premium in Ireland was €1047.47, or €87.30 per month (519). Many adults aged 70+ in TILDA have a medical card and PHI, so that PHI functions as a proxy measure of income in the over 70s. However, overall coverage rates were high, with almost 65% of the combined SCQ and HA sample at W1 having PHI.

Data on income and assets were collected in TILDA; however, there was a proportion of missing data (520). As a proportion of TILDA participants were already excluded from the study sample for the thesis due to SCQ and HA non-response, it was decided that including income and/or asset data would erode this sample further. While imputation methods are available to handle missing data, typical application of these methods requires that data are MAR, or Missing at Random (521). This means that the probability of missingness is conditional on the values of other variables in the dataset, but not on the missing data themselves. However, this assumption is not tenable for missing income data, where individuals with particularly high or low income may be less likely to respond. This means that data are MNAR, or Missing Not at Random. While multiple imputation is possible under these conditions, it is significantly more complex (521). Income and assets were therefore not examined as indicators of socio-economic position.

5.2.5.5 Social Support

Supportive relationships with others are a key feature of the context which can potentially modify the negative effects of chronic conditions and disabilities on QoL (see Section 4.3.4). Three types of supportive relationship were therefore examined in the analysis of moderating factors: partner, relatives and friends. Marital status on its own was also adjusted for in all analyses, as being married is associated with both better physical health.
and may be associated with higher QoL (76). Participants who were co-habiting or living as married were defined as married.

As discussed in Chapter 4, Section 4.3.4, measuring the effects of social support can be challenging. Receipt of social support can be associated with poorer outcomes, as people who have a greater need receive more care. It is more useful to measure availability of support, which is less sensitive to need. For each type of relationship, availability of instrumental and emotional dimensions of support was captured. Three items were used, based on a social support measure adapted from HRS (522):

1. *How much does he/she really understand the way you feel about things?*

2. *How much can you rely on him/her if you have a serious problem?*

3. *How much can you open up to him/her if you need to talk about your worries?*

The relationship was defined as supportive if the participant indicated that each of these three statements were true some or all of the time. The relationship was defined as not supportive if the participant stated that any of the statements were never true, or true only a little of time. For the spousal relationship there were three levels of measurement: not married, non-supportive partner, and supportive partner.
<table>
<thead>
<tr>
<th>Measure</th>
<th>No. of Items</th>
<th>Sample Item</th>
<th>Response options</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-reported doctor diagnoses</td>
<td>20</td>
<td><em>Has a doctor ever told you that you have any of the following conditions?</em></td>
<td>yes/no for each condition</td>
<td>Adapted from HRS (71)</td>
</tr>
<tr>
<td>CASP-19a</td>
<td>19</td>
<td><em>My age prevents me from doing the things I would like to</em></td>
<td>often/sometimes/rarely/never</td>
<td>Hyde et al. (43)</td>
</tr>
<tr>
<td>Pain</td>
<td>2</td>
<td><em>Are you often troubled with pain? How bad is the pain most of the time?</em></td>
<td>yes/no; mild, moderate, severe</td>
<td>Adapted from ELSA/HRS (49,71)</td>
</tr>
<tr>
<td>Poor balance</td>
<td>3</td>
<td><em>When walking do you feel...</em></td>
<td>very steady/slightly steady/ slightly unsteady/very unsteady</td>
<td>Clark et al. (499)</td>
</tr>
<tr>
<td>Poor Sleep</td>
<td>1</td>
<td><em>How often do you have trouble falling asleep?</em></td>
<td>most of the time/sometimes/rarely or never</td>
<td>Adapted from HRS (71)</td>
</tr>
<tr>
<td>Urinary Incontinence</td>
<td>1</td>
<td><em>During the last 12 months, have you lost any amount of urine beyond your control?</em></td>
<td>yes/no</td>
<td>Adapted from ELSA/HRS (49,71)</td>
</tr>
<tr>
<td>Activities of Daily Living (ADLs)</td>
<td>6</td>
<td><em>Because of a health or memory problem, do you have difficulty doing any of the activities on this card? Sample response: Dressing, including putting on shoes and socks</em></td>
<td>yes/no</td>
<td>Adapted from HRS (523)</td>
</tr>
<tr>
<td>Instrumental Activities of Daily Living (IADLs)</td>
<td>6</td>
<td><em>Because of a health or memory problem, do you have difficulty doing any of the activities on this card? Sample response: Preparing a hot meal</em></td>
<td>yes/no</td>
<td>Adapted from HRS (523)</td>
</tr>
<tr>
<td>Measure</td>
<td>No. of Items</td>
<td>Sample Item</td>
<td>Response options</td>
<td>Source</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>--------------</td>
<td>------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Mobility, Strength and Fine Motor Skills</td>
<td>10</td>
<td><em>Because of a physical or mental health problem, do you have difficulty doing any of the activities on this card? Sample response: Walking 100m</em></td>
<td>yes/no</td>
<td>Sub-set of 12 item measure, adapted from HRS (523).</td>
</tr>
<tr>
<td>Active, Social Leisure Activities</td>
<td>5</td>
<td><em>How often do you ... go out to films, plays and concerts?</em></td>
<td>8 response options representing frequency, ranging from Daily/Almost Daily to Never</td>
<td>Sub-set of broader social activity measure, adapted from HRS (522,524)</td>
</tr>
<tr>
<td>Community Participation</td>
<td>1</td>
<td><em>Do you participate in any groups such as a sports or social group or club, a church connected group, a self-help or charitable body or other community group or a daycare centre?</em></td>
<td>yes/no</td>
<td>Item from Berkman's Social Network Index (506)</td>
</tr>
<tr>
<td>Volunteer work</td>
<td>1</td>
<td><em>How often do you ... do voluntary work?</em></td>
<td>8 response options representing frequency, ranging from Daily/Almost Daily to Never</td>
<td>Sub-set of broader social activity measure, adapted from HRS (522,524)</td>
</tr>
<tr>
<td>Employment Status</td>
<td>1</td>
<td><em>Which one of these would you say best describes your current situation?</em></td>
<td>7 response options, including Retired, Employed, Unemployed, Looking After Home, Permanently Sick/Disabled</td>
<td>Adapted from ELSA/HRS (49,71)</td>
</tr>
<tr>
<td>Centre for Epidemiological Studies – Depression scale (CES-D)</td>
<td>10 (4 positive and 6 negative)</td>
<td><em>I felt hopeful about the future (positive); I felt sad (negative</em></td>
<td>rarely or none of the time/some of the time/most of the time/all of the time</td>
<td>Radloff (1977) (507)</td>
</tr>
<tr>
<td>Measure</td>
<td>No. of Items</td>
<td>Sample Item</td>
<td>Response options</td>
<td>Source</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>--------------</td>
<td>----------------------------------------------------------------------------</td>
<td>--------------------------------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>Perceived Social Support: Partner, Friends, Relatives(^a)</td>
<td>3 for each relationship</td>
<td><em>How much does he/she really understand the way you feel about things?</em></td>
<td><em>a lot/some/a little/not at all</em></td>
<td>Adapted from HRS (522)</td>
</tr>
<tr>
<td>Personality: Neuroticism and Extraversion(^a)</td>
<td>24</td>
<td><em>I am not a worrier (Neuroticism); I usually prefer to do things alone (Extraversion)</em></td>
<td>five point Likert scale ranging from Strongly Agree to Strongly Disagree</td>
<td>Neuroticism and Extraversion subscales of the NEO-FFI (514)</td>
</tr>
<tr>
<td>Self-rated Religiosity</td>
<td>1</td>
<td><em>How important would you say religion is in your life?</em></td>
<td>very important/not important/somewhat important</td>
<td>Adapted from HRS (522)</td>
</tr>
</tbody>
</table>

ELSA = English Longitudinal Study of Ageing; HRS = Health-Retirement Survey; NEO-FFI = Neuroticism, Extraversion, Openness to Experience Five Factor Inventory

\(^a\)Included in the self-completion questionnaire
5.3 Statistical Analysis Phase 1: Psychometric Evaluation of CASP-19

5.3.1 Overview

The objective of Phase 1 of the analysis was to evaluate established measurement models for the CASP-19 in the TILDA sample and if necessary, to revise the factor structure and develop a satisfactory measurement model. As mentioned in Section 3.6 (Chapter 3), a satisfactory measurement model has been difficult to identify for the CASP-19. If revision of the scale was deemed necessary, then the aim of the revision was to identify a factor structure and item composition for the scale that was both consistent with the empirical data in TILDA (i.e., how participants responded to the items), and the conceptual model underpinning the scale. The results of this analysis are outlined in Chapter 6. This analysis has also been published (525), and a postprint version of the paper is included as in Appendix 3.

Multi-item QoL measures are based on the idea that each of the item responses are indicators of an underlying latent entity, or factor, which is not directly observable. Each item measures the underlying factor with error, and the use of multiple indicators is intended to minimise the error. In a measurement model, estimated using factor analytic techniques, this measurement error is explicitly modelled. The measurement model specifies the underlying latent factors captured by each set of items and how these factors are related to each other. It is also possible to specify correlations between item errors (residual covariances), where a single source of error may affect two or more items – for example, where items share a measurement characteristic, such as response options. In confirmatory factor analysis (CFA), the "fit" between the observed covariance matrix and expected covariance matrix produced by a measurement model is assessed.

Prior to undertaking factor analysis, descriptive statistics, including item proportions and inter-item poly-choric correlations, were examined for each of the 19 ordinal-categorical CASP items. The psychometric analysis consisted of three broad steps. In Step 1, two established measurement models (CASP-19 and CASP-12) were tested using CFA. If neither of these models fitted the data well, as anticipated from previous studies, then alternative
factor structures were explored using exploratory factor analysis (EFA) (Step 2). Models indicated by the EFA were then assessed using CFA. In Step 3, the model structure identified in Step 2 was further refined, sequentially modifying the model to improve overall fit, based on parameter estimates and model fit statistics, as will be described in Section 5.3.2. Revisions to the model were based on empirical fit statistics, but were also guided by theoretical and conceptual considerations (526,527).

Stata 11.2 was used for data management, including recoding and generation of variables, and for descriptive and bivariate statistics. MPlus version 6.0 was used for EFA and CFA. All participants who had completed the SCQ component of W1 were available for this phase of analysis (see Figure 5-2). There was missing data at the item-level among participants who returned the SCQ. The approach taken to handling this missing data is described in Section 5.3.7.

5.3.2 Estimation Methods and Fit Indices

The weighted least-squares mean and variance adjusted (WLSMV) estimator was used to estimate measurement models, consistent with the ordinal-categorical nature of the CASP-19 response items. Computer simulation studies have supported the performance of this estimator with ordinal-categorical indicators, across sample sizes and for varying model complexity (528). Traditionally, a range of fit statistics are used to assess model fit in CFA (526,529,530). Each index has advantages and limitations, and each should be taken into account when judging model fit.

5.3.2.1 Adjusted Chi-Square Test of Model Fit

The chi-square test statistic is a measure of the discrepancy between the covariances observed in the data and those predicted by the model. The larger the statistic, the greater the discrepancy and the worse the model fit. In general, a statistically significant chi-square is taken to imply a poorly fitting model. However, this essentially tests the hypothesis of exact or perfect fit – an objective which may be unrealistic or implausible in reality, and especially so when the sample size is large.
Theoretical models are expected to approximate, rather than perfectly reproduce reality (531). Furthermore, as a test of statistical significance this test is sensitive to sample size - in large samples a chi-square may be significant even where the differences between the observed and predicted covariances are small and possibly trivial. A significant chi-square is therefore not a reason by itself to reject a model, particularly in large samples. Nevertheless, it does indicate some degree of misfit, and local fit statistics or fit diagnostics (described below) should be inspected to assess whether the misfit is trivial or indicates a meaningful substantive problem with the model (526).

5.3.2.2 Approximate fit indices

Given the sensitivity of the chi-square test to sample size, a number of alternative fit statistics have been recommended. Rather than testing the exact fit of a model, these indices test whether a model has close or approximate fit to the data.

(i) Root Mean Square Error of Approximation (RMSEA)

The root mean square error of approximation (RMSEA) is a measure of how well the model approximates the population covariance matrix, rather than fits it exactly. It is scaled as a measure of bad fit, so that a smaller value indicates better fit. It includes a penalty for model complexity – however, larger models may be less sensitive to this, so that it can favour models with more variables. In general, an RMSEA value of <0.05 is taken as indicating good fit, with a value between 0.08-0.10 indicating fair fit (529). Yu, however, in a simulation study of cut-off indices with the WLSMV estimator, recommended an RMSEA cut-off of 0.045 for models with both latent factors and covariates, and large sample sizes (532).

(ii) Incremental Fit Indices – Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI)

Incremental or comparative fit indices are based on the fit of the specified model compared with a baseline null or independence model, where there are no associations among the observed variables. In other words, they compare the specified model with the worst possible model (533). Kline notes that a complete independence model is implausible, and it may not therefore tell us much to find that the model tested has
improved fit (526). In MPlus, however, a more plausible baseline model is used which allows covariances among the observed independent variables (533,534).

The most commonly reported incremental fit indices include the comparative fit index (CFI) and the Tucker-Lewis Index (TLI). Both of these indices include a penalty for additional parameters, and thus favour more parsimonious models. The penalty for the TLI is greater, and this index is thus more sensitive to model complexity. Yu recommends cut-offs of 0.95 for both the CFI and TLI when using the WLSMV estimator (532).

Summary measures of fit based on the model correlation residuals have been suggested. The weighted root-mean-square residual (WRMR) has been put forward as a version that works with WLSMV – however, this index has not been extensively evaluated (532). In addition, Kline suggests that it may be preferable to examine the matrix of correlation residuals and inspect their pattern as this is more informative than a simpler summary measure (526).

5.3.2.3 Measures of Local Fit

Measures of local fit, or fit diagnostics, were also examined, including modification indices (MI), expected parameter change (EPC) and residual correlations (529). These statistics give more detailed and refined information on precisely which items or indicators are sources of model mis-fit. In particular, high residual correlations indicate which relationships the model does not re-produce well. These statistics can be used, in conjunction with substantive considerations, to improve a poorly fitting model in ways that make theoretical sense, rather than simply rejecting a model and examining it no further.

Modification indices indicate approximately how much the addition of a specific parameter, such as a residual covariance, will reduce the chi-square test statistic, hence reducing the difference between the observed covariances and those predicted by the model. No specific cut-off was used for the MI – rather, parameters with the largest MI were considered for inclusion in a sequential manner, in conjunction with substantive considerations. It has been argued, however, that due to the focus on improving model fit, the MI may be poor at identifying non-trivial, theoretically important model mis-specifications (535). Kaplan argues for the use of the standardised EPC statistic, which takes
into account the size of the parameter to be added (535). A cut-off of 0.2 was used as a guide as to whether a parameter was worth considering for inclusion in the model, as this indicates a small to moderate effect size (536). Kline emphasises the usefulness of residual correlation statistics, which indicate the extent to which each specific correlation in the model is under- or over-estimated by the model specification (526). Following Kline, residual correlations greater than >0.1 were considered potentially problematic. While the cut-offs for EPC and residual correlations were used as a guide, the focus was on the relative size of these indicators across parameters, in conjunction with substantive considerations, to inform sequential revisions to the model.

5.3.2.4 Summary

It is useful to set out cut-offs for model fit at the beginning of a study, based on conventional criteria, to avoid post-hoc, favourable judgements of model fit. At the same time, it is important to recognise these cut-offs are guidelines rather than golden rules (537). In particular, it may be tempting to make trivial changes to a model in order to "push" a fit statistic above a cut-off for good fit. It is important to only make changes to the model where there is substantive justification, and to thoroughly examine all indicators of model fit, including global indices, and localised fit statistics such as residual correlations. Inevitably, the process of model revision involves an element of subjective judgement on the part of the researcher. It is thus important that this process is transparent and accountable, through clear and explicit reporting of the rationale for each revision made (527).

5.3.3 Step 1: Testing CASP-19 and CASP-12

The original measurement model for the 19-item CASP scale comprised four factors measuring four needs – control, autonomy, self-realisation and pleasure. These four factors were thought to each load on to an overall, second-order QoL factor (CASP-19) (43). More recently a revised three-factor 12-item scale was proposed by Wiggins et al., which combines the control and autonomy dimensions into a single dimension (CASP-12) (46). A second-order QoL factor is also included in this three-factor 12-item version. A 12-item version of CASP is also used in SHARE (51,52); however, this differs from the version proposed and evaluated by Wiggins et al., which is the version evaluated in this thesis. The
two measurement models were tested using CFA and fit was assessed using the goodness-of-fit statistics detailed above.

5.3.4 Steps 2 – 3: Model Revision

If neither of the established measurement models fit the data well, the next step was to revise the model. Descriptive statistics were first inspected for evidence of problematic items, focussing on high levels of missingness, severe floor or ceiling effects, or low inter-item correlations. A floor or ceiling effect was identified when more than 20% of participants responded at the highest (ceiling) or lowest (floor) possible response option of an item. This effect indicates that an item has poor discrimination across participants. A low inter-item correlation indicates that a specific item is not related to the other items in the scale, and thus has poor internal consistency. An inter-item correlation was deemed to be low if it was less than 0.2.

The sample was then divided into two random sub-samples comprising 40% (sub-sample A) and 60% (sub-sample B) of the participants. Sub-sample A was used for model revision and development, with sub-sample B used for confirmatory testing of models. This cross-validation approach attempts to minimise sensitivity to sample-specific variation. The larger size of sub-sample B allows for more precise estimates in the final validation models. It would be preferable to validate the revised version of the scale in a new sample, particularly if the revised version of the scale includes a different item composition. Participants may respond differently to a shorter set of items presented on their own, as items present in the longer version may influence responses to items included in a shorter version (527). However, it was not feasible to carry out the sample recruitment and data collection required to validate a revised scale in an independent sample.

5.3.4.1 Step 2: EFA followed by CFA

EFA was conducted in sub-sample A, using oblique rotation for correlated factors. Potentially well-fitting models were identified based on eigenvalues, patterns of factor loadings and overall fit indices. Eigenvalues are a measure of the amount of variance in the items explained by the factor, and each factor should have a value greater than one for a
model to be acceptable (538). If more than one meaningful model was identified by the EFA, the models were tested and compared using CFA.

5.3.4.2 Step 3: Model Modification based on Fit Diagnostics

The best fitting model developed in Step 2 was examined for evidence of model misspecification based on fit diagnostics, or measures of local fit. As outlined in Section 5.3.2.3, these measures included modification indices (MI), expected parameter change (EPC) and residual correlations. Based on these values, the model was modified by freeing the relevant parameter, or removing one or more relevant item. Any changes to the model were performed sequentially.

A chi-square difference test was used at each step to confirm that the difference in the chi-square between the two models was statistically significant. This statistic tests the hypothesis that two nested models fitted the data equally well (526). Two models are nested if the parameters of one form a sub-set of the other – that is, all the parameters estimated in the first model are also estimated in the second. If the test is significant then the model with the lower chi-square value is considered to be the model with the closest fit between the observed and expected covariance matrix. Similar to the adjusted chi-square statistic, the chi-square difference test is sensitive to sample size, with a significant difference in fit more likely to be observed in larger samples. Therefore, it is recommended that the difference in the comparative fit index (CFI) is also evaluated, with differences greater than 0.1 used as a cut-off for a difference in model fit (539).

5.3.5 Model Cross-Validation

The models developed in Steps 2 to 3 were validated in sub-sample B using CFA, and assessed using the goodness-of-fit statistics described above.

5.3.6 Testing the CASP-15

Since publication of the paper reporting this analysis, an alternative measurement model for the CASP has been proposed, comprising 3 factors: control/autonomy, self-realisation and pleasure, and 15 items (268). Items which capture the effect of health, age, family and
finances on control/autonomy are excluded. This measurement model was tested in TILDA using CFA. The empirical fit of the model was examined with reference to overall fit statistics, as well as modification indices, EPCs and residual correlations.

5.3.7 Missing Data

All participants who had completed the SCQ component of W1 were available for this phase of analysis. Participants who had responded to less than half the CASP-19 items were excluded. For the remaining missing items, procedures available in MPlus for handling missing data with the WLSMV estimator were used. As there were no covariates in the model, missing data were handled using pairwise present analysis, which is a type of available case analysis (540). In this type of analysis, every observed value was used to estimate a standard deviation, while each observed pair of values was used to estimate covariances (521).

This approach assumed that data were missing completely at random (MCAR) – i.e., the missing data were not a function of the observed variables or the missing variables (540). This is a restrictive assumption that may not be reasonable with this data. For example, participants with low overall QoL may have been more likely to miss one item or more. However, given the low levels of missingness at the item-level (<2% for most items, <4% for all items), it was unlikely that the results were influenced by how missing data were handled in the analysis.

A survey weight was applied in the analysis to account for non-response bias due to non-response to TILDA overall, and to the SCQ in particular. This weighted the analysis by age, sex and education, based on the profile of these characteristics in the overall community-dwelling Irish population in the same age group. These overall population values were estimated using the Quarterly National Household Survey (QNHS) (4,6). This weight was then divided by the probability of the participant taking part in the SCQ, on the basis of their age, wealth, level of depression and self-reported health (6).
5.4 Statistical Analysis Phase 2: Testing a Structural Model of the Pathway between Chronic Conditions and QoL

5.4.1 Overview

The aim of the second phase of analysis was to examine the ICF disability domains and affective wellbeing as mediators of the relationship between chronic disease and QoL. Structural equation modelling was used to evaluate a structural model of the pathway between chronic conditions and QoL. This approach combines the CFA procedure described in Section 5.3, with assessment of a structural model which specifies relationships across latent factors and observed variables. The total effect of chronic conditions is decomposed into a direct effect on QoL and a series of indirect effects via each of the ICF disability domains (body function, activity and participation), and affective wellbeing. The size and significance of the indirect effects, compared with the direct effects, indicate the extent to which the overall effect is mediated by factors along the pathway.

Descriptive and bivariate statistics for each study variable were examined initially. Following this, in Step 1, each indicator of the ICF domains was examined separately as a mediator of the effect of chronic conditions on QoL. In Step 2, latent factors were specified for body function, activity, positive affect and QoL. The fit of each of these factors was evaluated separately and together as an overall measurement model. In Step 3, the latent factors identified at Step 2 were included in a structural model based on the causal relationships set out in Hypothetical Model 2 (Section 4.2.7, p.133).The results of this analysis are set out in Chapter 7. This analysis has also been published (541), and a postprint version of the paper is included in Appendix 3.

Stata 11.2 was used for data management, including recoding and generation of variables; descriptive and bivariate statistics, and for multivariate regression. MPlus version 6.0 was used for CFA, and for structural equation modelling analysis.

TILDA participants who participated in the HA and completed the SCQ in W1 were included in analysis at this stage. This sample comprised 5,376 participants. For this phase of analysis, the publicly available TILDA dataset was used (available from http://www.ucd.ie/issda/data/tilda). This was due to timing and software availability.
considerations. For anonymisation purposes, age was censored for 319 participants aged >80 in this version of the TILDA dataset. It was not possible to adjust for age in these participants, and they were therefore excluded from analysis, leaving a sample of 5,057 participants. A proportion of these 5,057 participants had missing data at the item-level, and the approach used to handle this missing data will be outlined in Section 5.4.6.

5.4.2 Descriptive and Bivariate Statistics

Descriptive statistics (mean, standard deviations and proportions) were generated and examined for chronic disease status, the ICF indicators, positive affect, QoL and covariates (age, age\(^2\), sex, education, obesity, smoking, alcohol consumption, marital status and medical card status). The effect of number of chronic conditions on QoL (using a summed score) was also examined, using linear regression adjusted for age, age\(^2\), sex and education.

5.4.3 Multivariate Analysis of Indirect Effects

Analysis of indirect effects, or path analysis, involves the decomposition of a relationship between two variables into direct effects and indirect effects via other variables, usually termed mediators (542). Here, this approach allows decomposition of the total effects of chronic conditions on QoL into direct effects and indirect effects via the ICF disability domains, and positive affect. This type of analysis is described as multivariate, as effects on multiple outcomes were estimated simultaneously.

Structural equation modelling (SEM) combines this structural, path approach with the CFA approach outlined in Section 5.3. It allows analysis of direct and indirect effects across latent factors measured using multiple observed indicators. For example, body function was measured as a latent factor with multiple indicators, including pain, poor balance, grip strength, etc. The measurement model for each latent factor was included in the overall structural model, allowing measurement error to be taken into account when estimating direct and indirect effects. Specification of QoL as a latent factor (with regards to item composition and number of factors) was based on the results of Analysis Phase 1 (outlined in Section 5.3). The estimation method (WLSMV), and fit indices (chi-square, RMSEA, TLI, and CFI) used to assess model fit were the same as those described in Section 5.3.2.
The analysis consisted of three steps. In Step 1, path analysis was used to test the indirect effects of chronic conditions on QoL, via each of the observed indicators of body function, activity and participation. A separate model was specified for each specific disability indicator, examining each of these variables separately as a mediator of the chronic disease-QoL relationship. In Step 2, a measurement model was specified with latent factors for body function, activity, positive affect and QoL, and tested using CFA. This was consistent with the two-step approach to SEM recommended by Kline (526), which requires a satisfactory measurement model to be derived initially, prior to testing structural relationships across the latent factors. In Step 3, a structural model was specified to empirically test direct and indirect relationships across chronic conditions, body function, activity, participation, positive affect and QoL.

In contrast to body function and activity, participation variables were not examined as indicators of an underlying latent factor. It was considered that each of these variables reflected a different dimension of participation: social leisure activity (leisure participation), community participation (un-paid productive participation) and paid work (paid productive participation). It therefore did not make conceptual sense to include these variables of indicators of a single latent participation factor.

5.4.3.1 Step 1: Path Analysis

A series of path models were tested to examine the role of each of the ICF disability indicators as mediators of the relationship between chronic disease and QoL. A separate model was estimated for each ICF disability indicator. The indicators examined are displayed in Table 5-4 in Section 5.2.3. This provided information on the extent to which each indicator of disability mediated the effect of chronic conditions on QoL on its own. A generalised and simplified version of the model is shown in Figure 5-3.

The specification of the QoL factor was based on the results of Analysis Phase 1. Effects of the covariates (age, age², sex, education, marital status, smoker, obesity, alcohol consumption) on each of the mediators and the QoL outcome were also included, though are not shown in Figure 5-3. Model fit was assessed using the usual overall fit indices (chi-square, RMSEA, CFI and TLI), and mediation was examined by assessing the statistical significance and size of the indirect effect via each disability domain.
Effect sizes for direct and indirect effects were assessed using Cohen's d (536). According to these criteria, a standardised mean difference of 0.2 is a small effect, 0.5 equates to a medium effect and 0.8 can be interpreted as a large effect. In addition, the size of mediation effects was assessed by examining the indirect effect as a proportion of the total effect (543). For example, if complete mediation is observed, then the direct effect is zero and the indirect effect constitutes 100% of the total effect. This represents a large mediation effect.

Figure 5-3: Generalised path model of the relationship between chronic disease and QoL, via observed indicators of body function, activity and participation

Legend: ICF indicator_{1...20} denotes the 20 indicators of ICF disability, with a separate model fit for each indicator. QoL_1...QoL_k denote the k indicators of QoL, to be determined on the basis of Analysis Phase 2 (Section 5.3).

Note: The effects of covariates on the relevant ICF indicator and QoL were included (age, age^2, sex, education, marital status, obesity, smoking, alcohol), but are not displayed for ease of presentation.
5.4.3.2 Step 2: Measurement Model

In Step 2, CFA was used to evaluate single-factor measurement models for body function and activity, based on the indicators outlined in Table 5-4 (Section 5.2.3), and for positive affect. This step of the analysis ensured that each latent factor had satisfactory fit to the data, prior to incorporation into an overall measurement model. Each model was assessed by examining overall and local fit statistics (see Section 5.3.2), as well as factor loadings (>0.3). Where necessary, revisions were made sequentially, by removing indicators and/or adding residual covariances. Revisions were only made where justifiable on substantive grounds.

Following this, an overall measurement model including all three factors, and a latent factor for QoL, was tested. The specification of the QoL factor was based on the results of Analysis Phase 1. The structure of the model is displayed in Figure 5-4. This overall measurement model was assessed using the same criteria as the single-factor measurement models, and any necessary revisions were carried out according to the same procedure. Once a satisfactory measurement model had been developed, it could then be used as a basis for a structural model in Step 3.
Figure 5-4: Measurement model for body function, activity, positive affect (PA) and QoL

Legend: Variables BF$_1$ to BF$_5$ denote the body function indicators, variables A$_1$ to A$_{12}$ denote the activity indicators, while variables PA$_1$ to PA$_4$ denote the positive affect items. QoL$_1$...QoL$_{k}$ denote the $k$ indicators of QoL, to be determined on the basis of Analysis Phase 2.
5.4.3.3 **Step 3: Structural Model**

In Step 3, observed variables for chronic disease, social leisure activity, community participation, paid work and covariates were added to the measurement model derived in Step 2, to form a structural model based on Hypothetical Model 2 (Section 4.2.7, p.133). Figure 5-5 displays the model tested. For ease of presentation, *participation* is presented as a single element of the model; however, social leisure activity, paid work and community participation were each included as separate observed variables in the model. Effects of covariates on each of the dependent latent and observed variables (*body function, activity, participation, positive affect* and QoL) were adjusted for.

Following initial estimation of the hypothetical model, non statistically-significant parameters (p<0.05) were removed with the aim of producing the most parsimonious model (544). Non-significant effects along the main structural pathway were removed first, starting with the parameters with the highest p-value. Effects of covariates were removed last to ensure that each of the key structural effects in the final model was adjusted for appropriately.

Model fit was evaluated using measures of overall and localised fit (see Section 5.3.2). To account for multiple comparisons in the analysis, a Bonferroni adjusted level of significance was used based on the number of direct and indirect effects estimated in the initial model (545). The adjusted level of significance was calculated by dividing 0.05 by the number of direct and indirect effects that were tested for significance. This more conservative p-value reduced the chance of Type 1 error, or the probability of chance findings (545). Statistically significant direct and indirect effects in the model were thus identified using a Bonferroni adjusted level of significance (0.05/22 = 0.002). Effect size for direct and indirect effects was assessed using Cohen’s d, and the proportion of the indirect effect to the total effect (as outlined in Section 5.4.3.1)
Figure 5-5: Structural model of the relationship between chronic conditions, the ICF domains, positive affect and QoL

Notes: Measurement models for body function, activity, positive affect and QoL not shown, for ease of presentation. Participation variables were included separately, but are shown together for ease of presentation. Effects of covariates on each of the dependent variables were estimated. The number of factors used to measure QoL was decided on the basis of Analysis Phase 1 (Section 5.3).
5.4.4 Stratification by Age and Sex

Many of the relationships examined in the structural models outlined may vary across age and sex groups. Adjusting for age and sex in the model ensured that each of the direct effects estimated in the model were independent of effects of age and sex; however, it did not account for variation in direct effects across age and sex groups. For example, the role of paid work may vary across men and women, and across those before and after retirement age. It was therefore decided to re-test the models examined in Step 3, stratified by age and sex – women under 65, men under 65, women aged 65-80 and men aged 65-80.

The measurement model tested at Step 2 was tested across each of these age and sex groups, followed by the structural model (Step 3). Medical card status was included as a covariate, as a proxy measure of low income, in the analysis in the <65 age group. Model fit was assessed using overall and local fit statistics, as described above (Section 5.3.2). The size of direct and indirect effects of chronic conditions on QoL was compared across age and sex groups. It was also hypothesised that the role of participation might vary by age and sex. Therefore, differences in the size of direct effects of participation on QoL were also explored.

Multiple group models were used to compare the size of these effects across age and sex groups. This involved estimating the model simultaneously but separately across groups (526). The MODEL TEST command in MPlus was used to assess whether the size of direct effects were significantly different across groups, while the MODEL CONSTRAINT command was used to assess differences in size of indirect effects across groups. It was necessary to use MODEL CONSTRAINT for indirect effects as this allows testing of differences in effects that are based on combinations of parameters. These commands use a Wald chi-square test, which tests the null hypothesis that a specific parameter is equal to zero. It can be thus used to determine whether the difference in size of a parameter across two groups is significantly different from zero, with a Wald statistic with a p-value <0.05 indicating a significant difference in size.
5.4.5 Sensitivity Analysis

Analysis Phase 2 was repeated using alternative measures of chronic disease status and affective wellbeing, as a sensitivity analysis. The alternative measure of chronic disease excluded chronic conditions that were not associated with at least some functional impairment, based on their inclusion in the Functional Comorbidity Index (496). This resulted in the exclusion of heart murmur, arrhythmia, hypertension, high cholesterol and varicose ulcer from the definition of chronic disease. Step 3 was repeated using this alternative number of chronic conditions. The alternative measure of affective wellbeing was a six-item measure of negative affect, which replaced the four-item positive affect measure. Steps 2 and 3 were repeated with negative affect in the place of positive affect.

The findings of the sensitivity analyses were evaluated primarily on the basis of whether the results led to the same substantive conclusions as the main analysis: that is, did the sensitivity analysis lead to any differences in whether specific hypotheses were rejected or not?

5.4.6 Missing Data

The proportion of missing data on each study variable was examined and reported. Characteristics of participants with complete and missing data were compared by key socio-demographic and health variables. Logistic regression was used to examine the predictors of any missingness across variables.

As discussed in Section 5.3.7, there are methods available in MPlus to handle missing data when using WLSMV estimation. The approach used in this thesis was pairwise present analysis, where every observed value was used to estimate the standard deviations, while each observed pair of values was used to estimate covariances (521). Where covariates were included in the model, the covariances were conditional on the covariates. This means that the analysis was consistent with the assumption that the missing data is random (MAR) with respect to the covariates (540). Listwise deletion was used for participants that were missing on any of the covariates: age, sex, education, marital status, smoking, obesity and alcohol consumption.
Levels of missingness across the study variables were generally low (<10%), as will be presented in Chapter 7. It was therefore reasonable to assume that the approach to handling missing data would not overly influence the results of the analyses, and that a more sophisticated approach, such as the use of multiple imputation, was not necessary.

The analysis was repeated applying a survey weight to account for non-response bias due to non-response to TILDA overall, and to the HA in particular. This weighted the analysis by age, sex and education, based on the profile of these characteristics in the overall community-dwelling Irish population in the same age group. These overall population values were estimated using the QNHS (4,6). This weight was then divided by the probability of the participant taking part in the HA, on the basis of a range of characteristics identified using a multivariate logistic regression (6). The results of the weighted analysis were compared to the main analysis to ensure that the substantive conclusions were not affected by any potential non-response bias.

5.5 Statistical Analysis Phase 3: Moderation of Longitudinal Effects

5.5.1 Overview

The purpose of Phase 3 of the analysis was to identify factors which moderated effects along the pathway between chronic conditions and QoL, based on the pathways identified in Phase 2. Personal and environmental factors identified in Section 4.3 (Chapter 4) were examined as moderators. These included age, sex, personality, religiosity, social support, social participation, and SEP. The measures used were outlined in Section 5.2.5.

As outlined in Section 4.4, it was decided that the analysis of moderating effects would focus on longitudinal effects along the pathway between chronic conditions and QoL, rather than cross-sectional effects. The use of data from two time-points made it possible to identify evidence for reverse causation effects. For example, if high religiosity was observed prior to a reduced effect of chronic conditions on QoL, then it was possible to be more confident that religiosity led to a decreased negative effect of chronic conditions on QoL, rather than vice versa.
Step 1 of the analysis was to evaluate how each of the cross-sectional effects identified in Analysis Phase 2 (see Figure 5-5, p. 211) operated longitudinally. This involved examining the effect of incident chronic conditions between W1 and W2 on each of the ICF disability domains, positive affect and QoL at W2; and changes in the ICF disability domains between W1 and W2 on positive affect and QoL at W2. Only effects identified as significant cross-sectional effects in Analysis Phase 2 were examined in this phase. Each effect was examined using conditional change linear regression, while adjusting for socio-demographic factors, marital status, retirement status, lifestyle factors and personality. Step 1 is outlined in Section 5.5.3, including a brief description of the conditional change regression approach.

Step 2 involved examining how each of the personal and environmental factors modified each of the longitudinal effects along the pathway between chronic conditions and QoL. This was done by estimating interaction effects between incident chronic conditions and each moderating factor, and between change in physical impairment and each moderating factor. Interaction effects were examined for each outcome: physical impairment, positive affect and QoL. Again, conditional change regression was used. The moderating factors examined are displayed in Table 5-6 and Step 2 is outlined in detail in Section 5.5.4.

For Phase 3 of the analysis, participants who responded to W1 and W2, participated in the HA at W1, and completed the SCQ at both waves were included. This group comprised 4,547 participants (see Figure 5-2, p.175). A proportion of these participants had missing data at the item-level, and the approach used to handle this missing data will be outlined in Section 5.5.5. Stata 12.0 was used for all data management and analysis.

5.5.2 Descriptive Statistics

Detailed descriptive statistics were generated for each of the study variables at each wave, and for changes between waves. In contrast to Analysis Phase 2, body function, activity, positive affect and QoL were not examined as latent factors. This was because of the difficulties associated with modelling interactions with latent variables using WLSMV.

---

2 In Analysis Phase 1 and Analysis Phase 2, Stata 11.0 was used. In Analysis Phase 3, the multiple imputation functions available in v12.0 were required.
estimation (546). Therefore, in Steps 1 and 2 summed scores or count variables were used to measure body function, activity, participation, positive affect and QoL. Each variable was based on the items or indicators identified in the estimation of measurement models in Phase 2.

Proportions for each study variable at each wave, and for transitions between waves, were generated for categorical variables (e.g., social support, religiosity, social activity). Examination of transitions between waves meant that each dichotomous variable had four categories. For example, for the indicator of social support from friends, it was possible to identify those had 1) a supportive friend at both waves, 2) no supportive friend at both waves 3) a supportive friend at W1 but not W2 (decrease in support) and 4) a supportive friend at W2 but not W1 (increase in support).

Means and standard deviations at each wave, and for changes between waves, were generated for continuous variables (QoL and positive affect scores). The number of body function and activity deficits was also examined (summarised in Table 5-4), along with change in the number of deficits between waves.

Incidence of chronic conditions was also examined, stratified by baseline chronic disease status (none, single condition, >1 condition). Several definitions of incident conditions were used (as described in Section 5.2.1.1) to facilitate comprehensive exploration of change in chronic disease status. These included:

- Any incident condition
- Single incident condition
- Two or more incident conditions
- Any condition with increased body function or activity deficits
- Any condition with increased medications
- Specific diagnoses

5.5.3 Step 1: Estimating Longitudinal Effects

Longitudinal relationships along the pathway between chronic conditions and QoL were investigated using conditional change linear regression. This approach, also known as the
**regressor variable** approach, can be contrasted with the **difference score** approach to analysing change between two time-points (547,548). In the **difference score** approach, the effect of a predictor variable $X_1$ on the simple difference between the outcome at time 1 ($Y_{t1}$) and time 2 ($Y_{t2}$) is examined (Figure 5-6a). In the conditional change approach, $Y_{t2}$ is included as the outcome variable, while ($Y_{t1}$) is treated like any other predictor variable or covariate (Figure 5-6b). The second approach essentially examines the effect of the predictor variable ($X_1$) on change in the outcome, but this effect is conditional on the outcome at baseline. This takes into account that rates of change may be influenced by baseline levels: for example, more extreme or unusual scores at baseline may be more prone to a greater change, a phenomenon often referred to as regression to the mean.

![Figure 5-6: Linear regression analysis of change between two time-points: (a) the difference score approach, (b) the conditional change or regressor variable approach](image)

Adapted from Taris (2000) (547).

The effect of an incident chronic condition between W1 and W2 on each of the outcome variables (ICF disability domains, positive affect and QoL) was first examined. For example, the effect of an incident condition on QoL score at W2 was examined, while also adjusting for QoL score at W1. Each analysis was also adjusted for age, age$^2$, sex, education, marital status, retirement status and personality. This analysis was also stratified by baseline chronic disease status.

The effect of change in each of the ICF disability domains between W1 and W2 on positive affect and QoL at W2 was also examined. For example, the effect of change in **body function** between W1 and W2 on QoL at W2 was examined, adjusting for both **body**
function and QoL at W1. Again, the analysis was adjusted for age, age\(^2\), sex, education, marital status, retirement status and personality.

The effect of each of the study variables (covariates and moderators) on each of the outcomes at W2 (ICF disability domains, positive affect and QoL) was also explored using conditional change regression analysis. Age, sex, education, marital status, retirement status, obesity, smoking, alcohol and personality were adjusted for in each analysis. For example, the effects of spousal support (including change in support between waves) on QoL at W2 were investigated. This made it possible to investigate how each of the outcomes at W2 was determined by personal and environmental factors at W1, and by how these factors had changed between the waves.

5.5.3.1 Types of Regression Analysis

Positive affect and QoL summed scores were measured as summed continuous scores based on Likert-scale items, and were examined using ordinary least squares regression. Participation variables were binary outcomes, and could be examined using logistic regression.

Body function and activity were measured as counts of deficits, and were therefore more appropriately characterised as discrete or count data. Poisson regression and negative binomial regression can be used to model these types of count outcomes. The negative binomial approach is recommended for outcomes that are over-dispersed (that is, the mean and variance are not equal). Counts of deficits (such as IADL outcomes) tend to be over-dispersed (549). The negative binomial approach was thus used to model counts of body function and activity deficits. The significance of the dispersion parameter (the alpha coefficient) was assessed using a likelihood-ratio test, to confirm over-dispersion in the outcome variable and the appropriateness of the negative binomial approach.

Variables which measure counts of deficits tend to include large numbers of zeros, and may therefore include excess zeros (549,550). Excess zeros occur when there are two processes involved in generation of zero values. For example, a sample can be seen as comprising two groups: one which includes individuals with a high propensity to be free of any physical health deficits; and a second which includes individuals who are likely to have at least one
This type of sample requires a zero-inflated negative binomial approach. A two-step model is used to first estimate the probability of having zero deficits using a logit model, and then estimate the expected number of deficits.

The hypothesis of excess zeros can be assessed using a vuong test to compare the fit of the zero-inflated negative binomial approach with a standard negative binomial approach. However, trivial differences in fit may lead to a significant improvement for the zero-inflated approach, particularly in large samples. It has been argued that zero-inflated models are rarely necessary, and should only be used when there is a strong basis for suspecting that the outcome is censored at zero for some individuals. It was therefore decided to run both types of models (negative binomial and zero-inflated negative binomial) and evaluate the extent to which taking any potential zero-inflation into account affected substantive interpretation of results.

5.5.4 Step 2: Estimating Interaction Effects

Once the longitudinal effects along the pathway between chronic conditions and QoL had been examined in detail, the next step was to examine whether personal characteristics and contextual resources played any role in modifying these effects. Variables examined as moderating factors are displayed in Table 5-6. Continuous moderator variables, including age, neuroticism and extraversion, were centred at the mean to avoid co-linearity.

First, modification of the effect of incident chronic conditions on disability, positive affect and QoL at W2 was examined. A binary variable for incident chronic conditions was interacted with indicators of each of the moderating factors, as outlined in Table 5-6. Next, modification of the effect of change in disability on positive affect and QoL at W2 was examined. Variables for change in each of the disability variables (body function, activity and participation) were interacted with each of the moderating factors.
Each of the categorical moderators was examined in two ways. First, it was examined as a binary indicator, measured at W2, while also adjusting for measurement at W1. For example, an indicator for supportive friends at W2 was interacted with change in disability between W1 and W2, while also adjusting for having supportive friends at W1. Then, change in disability was interacted with a disaggregated categorical variable which took into account transitions between W1 and W2. For example, for social support from friends, the moderating effect of 1) a supportive friend at both waves, 2) no supportive friend at both waves, 3) decreasing support and 4) increasing support, was investigated. This allowed examination of the extent to which any interaction effect was dependent on these transitions.

Analysis of interaction effects related to specific transitions between waves was likely to be under-powered, due to the small number of participants experiencing changes in circumstances between waves. However, it was still useful to examine effects of transitions, to identify the extent to which an overall moderating effect may have been influenced by effects related to transitions.

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The analysis of supportive partner as a moderator was repeated adjusting for clustering by household, to account for the fact that the partner may have also been a TILDA participant. Models which examined interactions with medical card status were only estimated for those aged <70 at W2. Medical card status functions as a proxy measure of low income only in adults aged 50-69, due to differences in income thresholds for medical card eligibility for the over 70s (see Section 5.2.5.4).

5.5.4.1 Multiple Testing

This phase of analysis required the estimation of multiple regression models. This increased the risk of Type 1 Error, or the detection of effects that were due to chance (545). On the other hand, testing for interaction effects tends to have low power, thus increasing the risk of Type 2 errors, or failure to detect a true effect (395). It was decided to use a conservative p-value (p<0.01), although it was noted where effects trended towards this level of significance.

5.5.5 Missing Data

The proportion of missing data on each study variable was examined and reported. Characteristics of participants with complete and missing data were compared by key socio-demographic and health variables. Initially, the analysis was carried out using only data for participants who had complete data on all of the study variables. However, due to the large number of study variables at both waves, this resulted in the exclusion of a large number of participants. While missing data at the item level was low (<5%), aggregation of data in summed scales (e.g., CASP, CES-D, NEO-FFI) inevitably resulted in higher levels of missingness at the scale level.

It was thus decided to repeat the analysis of interaction effects with multiple imputed data. Multiple imputations using chained equations were implemented, using the mi impute chained procedure available in Stata 12.0 (554,555). This involved estimating an imputation model for each variable with missing data, and using the remaining study variables to predict missing values for each participant. This was done sequentially, so that imputed values were included in the imputation model for the next variable.
Uncertainty in this process was handled by carrying out the imputation multiple times, resulting in multiple imputed datasets. As a rule of thumb, the number of imputed datasets should be the same as the percentage of participants in the sample who have missing data (555). In the approach outlined below, 20.9% of participants had missing data imputed, and 20 imputed data-sets were therefore generated.

A number of factors were considered in determining which variables to impute, for example, it is preferable to impute data at the item level (556). This involves, for instance, imputing individual items in the extraversion sub-scale, rather than imputing an overall extraversion score for each participant missing any extraversion items. The imputed items are then summed to produce a score. This approach utilizes more of the available data as the summed score includes both completed responses and imputed responses to items.

It is also important to take into account any complexity in the structure of the data, such as interaction effects. It is recommended that any interaction terms that will be examined in the analysis should be included in the imputation model; otherwise, interaction effects are likely to be biased towards zero and hence difficult to detect (554,555). However, imputation of interaction terms was problematic, particularly for categorical variables. For example, it would be necessary to directly impute a variable for interaction between different levels of friendship support (including transitions) and change in disability. This interaction term includes multiple categories, many of which have small cell sizes. Imputation of these types of variables led to a highly unstable imputation model, due to the difficulties associated with predicting values for small cells.

To overcome these complications, a conservative approach to imputation was taken. Only missing item responses which were part of multi-item scales were imputed, and only where at least 50% of items had been completed by the participant. These multi-item scales included positive affect, CASP and the NEO-FFI personality measure. Of these three scale variables, only the personality measure was involved in interaction terms. This meant that the remaining interaction terms could be included in the model, without having to impute the interaction terms themselves. These terms included interactions between incident chronic conditions and age, sex, social support, social participation, religiosity and SEP, and
interactions between change in disability and age, sex, social support, social participation, religiosity and SEP. The precise imputation model used will be presented in Chapter 8.

The disadvantage of this approach was that participants who had missing data on any of the categorical or count study variables (social support, religion, social participation, body function, activity) continued to be excluded from the analysis. However, over one third of participants (38.6%) who had any missing data were only missing data on one of the multi-item scales, and had completed at least half the items in each scale. This approach thus had the advantage of allowing inclusion of a large proportion of participants with missing data, while only imputing a small amount of data. By including interaction terms in the model the complex structure of the data was also largely conserved.

As an alternative approach, data were also imputed for non-response on any item, thus including all participants who had missing data on any variable. In this approach, interaction terms were not included in the imputation model, and interaction effects may therefore have been biased towards zero. However, none of the participants who had non-response at the item level were excluded. The results of this approach will be reported in Appendix 7.

The predictive mean matching method was used to impute missing data on variables which had at least four categories (e.g., CASP items). This method ensured that the imputed value was within the range of values already present in the data-set, and was appropriate for scale items where the potential responses are bounded. Logistic regression was used to impute values of dichotomous variables, such as indicators of body function, activity or participation. Imputations were performed separately for participants aged under and over 70, to take account of the fact that the medical card status variable was likely to function differently in the two age groups, due to variation in application of income thresholds for medical card eligibility (see Section 5.2.5.4).

Estimation of regression equations was based on Rubin's rules for combining parameter estimates over imputed data-sets (557,558). The combined regression coefficients were based on an average of coefficients across the imputed data-sets, while the standard errors
were based on a combination of the within-imputation and between-imputation variances (555).

5.6 Ethics

Ethical approval for the TILDA study was obtained from the Trinity College Dublin Research Ethics Committee. Informed consent was obtained from all respondents. For the health assessment, participants were informed that they would be given selected information – height, weight, blood pressure and cholesterol – and could opt for this information to be given to their GP. In the course of the study, participants with undiagnosed atrial fibrillation were also informed and invited to a clinic for diagnosis. Ethical approval for the secondary data analysis of TILDA data conducted in this thesis was part of the overall ethical approval of TILDA.
Chapter 6     Results 1: Psychometric Evaluation of the CASP-19 in the Irish population aged 50+

6.1 Introduction

This chapter presents the results of Analysis Phase 1. This introductory section will include a description of current measurement models for CASP-19, and existing evidence for their psychometric validity. Section 6.2 will cover the characteristics of the study sample. In Section 6.3, the results of a psychometric evaluation of the established measurement models with the TILDA sample will be reported. Following this, Sections 6.4 to 6.6 will outline the results of a scale revision process. The analysis reported in Sections 6.2-6.6 has been published (525), and a postprint version of the publication is included in Appendix 3. Since publication, a further measurement model for the CASP has been proposed (CASP-15) (268). Evaluation of this version in TILDA will be described in Section 6.7. Section 6.8 will include a discussion of the extent to which the revised version of the scale is consistent with the original CASP-19 conceptual model and appropriate for use in subsequent phases of analysis in this thesis.

The theoretical basis for the CASP-19 measure of QoL was described in Section 3.6 (p. 107). Briefly, the measure is based on a definition of QoL as fulfilment of four needs: control, autonomy, self-realisation and pleasure. Initial psychometric assessment of the CASP-19 was undertaken with the Boyd-Orr cohort, a sample of 286 British people aged 65-75, followed up from a survey of childhood health in the 1930s (43). The proposed measurement model comprised four factors, aligned to the four needs, with each of the four factors loading on to a second-order QoL factor. Each of the four dimensions had good internal consistency, and the sub-scale scores were significantly correlated with each other. The observed sub-scale scores loaded on to an overall QoL factor. However, factor analysis was not done at the item level to examine the overall fit of a four-factor, second-order measurement model.

Wiggins et al. (2008) subsequently carried out an item-level evaluation with larger samples from the English Longitudinal Study of Ageing (ELSA) and the British Household Panel Survey (BHPS) (46). This evaluation found that a four-factor, second-order model did not
exhibit good fit to the data. In other words, this measurement model was not consistent with observed item responses. A 12-item, three-factor, second-order model displayed improved fit to the data. In this three-factor model, control and autonomy were combined into a single factor. It was argued that these two dimensions were not clearly delineated conceptually. Despite improved fit, the fit indices reported for this version of the scale remained outside the range commonly accepted as indicating good fit. For example, the reported RMSEA was 0.072 in ELSA and 0.103 in BHPS, where an RMSEA of ≤ 0.05 indicates good fit.

Recent evaluation of the CASP-19 scale with a smaller retirement community sample again confirmed that the 12-item, three-factor, second-order version proposed by Wiggins et al. (46) exhibited better fit to the data than the 19-item, four-factor, second-order version (47). However, a number of items were poorly correlated with the relevant domain scores, particularly negatively-worded items. The authors concluded that the scale could benefit from further psychometric evaluation with larger samples, and potentially from further revision.

The aim of Phase 1 of the statistical analysis in this thesis was to evaluate the two existing measurement models – the four-factor and the three-factor models – in the TILDA sample. Based on current evidence, it was anticipated that these models would not fit the data well. If this was the case, then the measurement model would be revised.

The analysis sought to answer the following research questions:

1. Do the two established measurement models for the CASP-19, i.e.:
   a) 19-item, four-factor, second-order model; and
   b) 12-item, three-factor, second-order model,
   exhibit good fit in a large Irish population sample aged 50+?

2. If established measurement models do not fit well the data well, how can the item composition and factor structure be revised to achieve good fit while also remaining consistent with the underlying conceptual model for the scale?
Criteria for good model fit were outlined in Section 5.3.2 in Chapter 5, and are displayed in Table 6-1. The model revision procedure was based on empirical fit statistics (overall fit and fit diagnostics), and substantive considerations. Decisions regarding the dimensionality and item composition of the scale were made with reference to the underlying conceptual model of the scale, as outlined in Hyde et al. (2003) and Higgs et al. (2003) (43,44). Following Goetz et al. (527), the rationale for each revision is clearly described, with reference to empirical and substantive considerations, to ensure transparency of the revision process.

**Table 6-1: Criteria for goodness-of-fit statistics**

<table>
<thead>
<tr>
<th>Fit Statistic</th>
<th>Fit Indices</th>
<th>Criteria for change in fit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adjusted chi-square</td>
<td>RMSEA</td>
</tr>
<tr>
<td>Acceptable</td>
<td>p&gt;0.05</td>
<td>&lt;0.08</td>
</tr>
<tr>
<td>Good</td>
<td>&lt;0.045</td>
<td>&gt;0.95</td>
</tr>
</tbody>
</table>

RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index

### 6.2 Sample Characteristics and Missing Data

There were 6,912 participants who returned the SCQ in wave 1 (W1) of TILDA. Of these, 89 participants (1.2%) had not responded to at least half of the CASP-19 items, and were excluded. This exclusion left 6,823 participants available for analysis (see flow chart in Figure 6-1). The characteristics of this sample are displayed in Table 6-2. Just over half the participants were women (54%), while the mean age was 63.6 years (SD = 9.6). Just over a third of the sample was in paid employment (36.7%), and over a third was retired (37.4%). While the number of excluded participants was small (n=89), they were older than included participants, with an average age of 70 years. They also had a lower level of education, with almost two-thirds (64.1%) reporting less than secondary education.

The majority of the 6,823 participants (86%) had complete data for all items, with 97% of participants missing two items or less. Most items had ≤2% missing data (see Table 6-3). Item 3 had the highest level of missingness at 3.6%. Participants who were missing fewer than 50% of the CASP items (<10) were included in the analysis by using a type of pairwise
present or available case analysis. This involved estimating the model on the basis of covariances between all available pairs in the data (see Chapter 5, Section 5.3.7 for more detail).

Table 6-3 displays the item content and response proportions. There was a strong positive skew towards higher QoL in most items. The proportion of responses at the highest end of the response scale varied from 15% to 85% across items, with an average of 53% endorsement for the most positive option. This was the modal response for 17 out of 19 items. A ceiling effect, based on 20% of responses at the highest option, was therefore identified for 18 out of 19 items. Conversely, the lowest end of the scale had an average endorsement of just 5%, with endorsement falling below 5% in 12 of 19 items. Items in the pleasure domain showed marked ceiling effects, with between 68% and 85% of responses at the highest level of the scale.

Figure 6-1: Participant flow chart, Analysis Phase 1
<table>
<thead>
<tr>
<th></th>
<th>Included (n = 6,823)</th>
<th>Excluded (n=89)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (Mean (SD))</strong></td>
<td>63.6 (9.6)</td>
<td>70.1 (8.9)</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>3,121</td>
<td>26</td>
</tr>
<tr>
<td>Women</td>
<td>3,702</td>
<td>63</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary or Less</td>
<td>1,886</td>
<td>57</td>
</tr>
<tr>
<td>Secondary</td>
<td>2,799</td>
<td>19</td>
</tr>
<tr>
<td>Third Level</td>
<td>2,136</td>
<td>13</td>
</tr>
<tr>
<td><strong>Employment Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed (inc. Self-Employed)</td>
<td>2,507</td>
<td>36.7</td>
</tr>
<tr>
<td>Retired</td>
<td>2,551</td>
<td>37.4</td>
</tr>
<tr>
<td>Looking after home</td>
<td>1,020</td>
<td>15.0</td>
</tr>
<tr>
<td>Unemployed/Unable to Work</td>
<td>619</td>
<td>9.1</td>
</tr>
<tr>
<td>Other</td>
<td>126</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>4,862</td>
<td>71.3</td>
</tr>
<tr>
<td>Separated/Divorced</td>
<td>422</td>
<td>6.2</td>
</tr>
<tr>
<td>Never Married</td>
<td>631</td>
<td>9.3</td>
</tr>
<tr>
<td>Widowed</td>
<td>908</td>
<td>13.3</td>
</tr>
<tr>
<td><strong>Self-rated Health</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>1,121</td>
<td>16.4</td>
</tr>
<tr>
<td>Very Good</td>
<td>1,992</td>
<td>29.2</td>
</tr>
<tr>
<td>Good</td>
<td>2,194</td>
<td>32.2</td>
</tr>
<tr>
<td>Fair</td>
<td>1,203</td>
<td>17.6</td>
</tr>
<tr>
<td>Poor</td>
<td>312</td>
<td>4.6</td>
</tr>
</tbody>
</table>
Table 6-3: Item response proportions and % of missing values for the CASP-19 scale (n = 6,823)

<table>
<thead>
<tr>
<th>Item</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>% Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CONTROL (C)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1*</td>
<td>8</td>
<td>25</td>
<td>28</td>
<td>39</td>
<td>0.8</td>
</tr>
<tr>
<td>2*</td>
<td>6</td>
<td>24</td>
<td>31</td>
<td>40</td>
<td>2.9</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>9</td>
<td>30</td>
<td>56</td>
<td>3.6</td>
</tr>
<tr>
<td>4*</td>
<td>4</td>
<td>19</td>
<td>29</td>
<td>48</td>
<td>2.6</td>
</tr>
<tr>
<td><strong>AUTONOMY (A)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5*</td>
<td>3</td>
<td>4</td>
<td>26</td>
<td>67</td>
<td>1.9</td>
</tr>
<tr>
<td>6*</td>
<td>6</td>
<td>25</td>
<td>26</td>
<td>43</td>
<td>2.0</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>4</td>
<td>28</td>
<td>66</td>
<td>1.9</td>
</tr>
<tr>
<td>8</td>
<td>11</td>
<td>23</td>
<td>22</td>
<td>45</td>
<td>1.8</td>
</tr>
<tr>
<td>9*</td>
<td>18</td>
<td>36</td>
<td>22</td>
<td>23</td>
<td>1.3</td>
</tr>
<tr>
<td><strong>PLEASURE (P)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10*</td>
<td>1</td>
<td>2</td>
<td>17</td>
<td>80</td>
<td>0.8</td>
</tr>
<tr>
<td>11*</td>
<td>2</td>
<td>3</td>
<td>19</td>
<td>77</td>
<td>1.2</td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>1</td>
<td>14</td>
<td>85</td>
<td>0.7</td>
</tr>
<tr>
<td>13</td>
<td>0</td>
<td>2</td>
<td>19</td>
<td>79</td>
<td>0.5</td>
</tr>
<tr>
<td>14*</td>
<td>1</td>
<td>4</td>
<td>27</td>
<td>68</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>SELF-REALISATION (S)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15*</td>
<td>3</td>
<td>13</td>
<td>52</td>
<td>33</td>
<td>1.1</td>
</tr>
<tr>
<td>16</td>
<td>12</td>
<td>31</td>
<td>42</td>
<td>15</td>
<td>2.0</td>
</tr>
<tr>
<td>17</td>
<td>2</td>
<td>5</td>
<td>33</td>
<td>60</td>
<td>1.2</td>
</tr>
<tr>
<td>18*</td>
<td>4</td>
<td>14</td>
<td>42</td>
<td>40</td>
<td>1.4</td>
</tr>
<tr>
<td>19*</td>
<td>3</td>
<td>9</td>
<td>41</td>
<td>47</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>All items</strong></td>
<td>5</td>
<td>13</td>
<td>29</td>
<td>53</td>
<td></td>
</tr>
</tbody>
</table>

*Items included in the 12-item version (Wiggins et al., 2008 (46))

P = positively worded items: 0 = Never, 1 = Rarely, 2 = Sometimes, 3 = Often
N = negatively worded items: 0 = Often, 1 = Sometimes, 2 = Rarely, 3 = Never
Score Range: 0-57
6.3 Step 1: Testing CASP-19 and CASP-12

The results of the confirmatory factor analysis (CFA) for the 19-item, four-factor, and second-order measurement model for CASP in TILDA are displayed in Table 6-4 (Model 1.1). The adjusted chi-square was statistically significant, while the RMSEA, the CFI and TLI all indicated poor fit. The 12-item, three-factor model displayed better fit to the data (Model 1.2). However, each of the fit indices were again outside the bounds of good model fit (e.g., RMSEA=0.072, 90% CI 0.07-0.075), suggesting that this measurement model can be improved upon.

Table 6-4: Model fit statistics for the CASP-19 and CASP-12 measurement models (n = 6,823)

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Four-factor, 19-item, second-order model (CASP-19)</td>
<td>9431.24*</td>
<td>149</td>
<td>0.10</td>
<td>0.094</td>
<td>0.097</td>
<td>0.85</td>
</tr>
<tr>
<td>1.2</td>
<td>Three-factor, 12-item, second-order model (CASP-12)</td>
<td>1912.18*</td>
<td>52</td>
<td>0.07</td>
<td>0.07</td>
<td>0.075</td>
<td>0.95</td>
</tr>
</tbody>
</table>

df = degrees of freedom, RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index
*p>0.05

Inspection of modification indices in both models indicated that model fit could be improved by adding cross-loadings across several items. For example, in Model 1.1, there was a modification index (MI) of 2471.84 for the cross-loading of item 8 on to the control factor. There was an MI of 778.34 for the cross-loading of item 17 on to the pleasure factor. In Model 1.2, there was an MI of 234.51 for the cross-loading of item 15 on to the control/autonomy factor. This suggested problems with the overall factor structure, with items not strongly related to a specific factor. It was thus decided to revise the factor structure and, if necessary, the item composition of the scale, in order to arrive at a well-fitting model. The next step was to examine alternative factor structures through exploratory factor analysis (EFA).
6.4 Step 2: EFA followed by CFA

As detailed in Chapter 5 (Section 5.3.4, p. 201), the sample was divided into two random sub-samples – a model revision sample (sub-sample A, 40% of the overall sample) and a validation sample (sub-sample B, 60%). Prior to splitting the sample, descriptive statistics were examined to initially identify problematic items. While all items displayed a ceiling effect, item 12 “I enjoy the things that I do” had the most severe ceiling effect, with 85% of participants giving the most positive response, and less than 2% choosing the two least positive options (see Table 6-3). Item 6 “Family responsibilities prevent me from doing what I want to do” had weak correlations with other items in the scale, with the majority smaller than 0.2 (the matrix of item correlations is displayed in Table A4.1, Appendix 4). Family responsibilities may not have been viewed by participants as a limit on autonomy, due to the value older adults place on caring for and supporting their family. Items 12 and 6 were excluded from further analysis.

An EFA was conducted on the remaining 17 items in the model revision sub-sample (A, n = 2,272). Four eigenvalues were greater than one, suggesting suitability of solutions with up to four factors (538). In the four-factor solution, negatively-worded control and autonomy items loaded on to the first factor, self-realisation and pleasure items loaded on to the second factor, and positively-worded control and autonomy items loaded on to the third factor. A fourth factor had low communality, with weak loadings for all but one item (item 4).

This pattern was suggestive of a method effect. A method effect occurs where responses are a function of the underlying trait, residual factors, and a measurement characteristic (559,560). In this case, it appeared that there was a method effect associated with wording direction. This type of method effect has been identified frequently in scales with reverse-worded items (561). The presence of a method effect complicates interpretation of the results of an EFA, which cannot take into account the co-varying residuals arising from method effects.

However, the pattern of factor loadings suggested the possibility of two factors – control/autonomy and self-realisation/pleasure. The combined control/autonomy factor
has been confirmed by previous studies, and is consistent with the considerable conceptual similarity between control and autonomy items - for example, "My age prevents me from doing the things I would like to" (C) and "My health stops me from doing things I want to do" (A). However, there is also poor conceptual delineation between the self-realisation and pleasure items. For example, the item "I feel that my life has meaning" is included as a pleasure item, though having meaning and purpose in life is an important part of self-realisation. There is also a high level of conceptual overlap across individual items: for example, "I feel satisfied with the way my life has turned out" (S) and "On balance, I look back on my life with a sense of happiness" (P).

Therefore, a CFA with two factors was fitted in sub-sample A. A two-factor model, with 17 items, did not display good fit to the data (Model 2.1a, Table 6-5). This made sense, given the EFA results which suggested separate factors for negatively and positively worded control/autonomy items. The next step was to fit a model which accounted for this method effect.

There are two ways of handling method effects in CFA. Method factors can be added to the model, in addition to factors for substantive latent constructs. Alternatively, residual covariances can be added across items captured by the same method (e.g., with the same wording direction). Specification of method factors leads to more easily interpretable solutions and are often seen as preferable (562). However, they are frequently associated with identification problems, leading some to recommend the use of residual covariances (563). Consistent with this, the addition of method factors to Model 2.1a led to inadmissible solutions.

Residual covariances were therefore added to the negatively-worded items. It was not possible to add covariances to the positively-worded items. Model identification requires that each factor has at least two indicators without a residual covariance (564), and all of the self-realisation/pleasure items were positively-worded. Inclusion of these residual covariances led to substantially improved model fit (Model 2.2a, Table 6-5). A chi-square difference test indicated that this improvement was statistically significant (see Table 6-6). The change in CFI was also above the cut-point for difference in fit ($\Delta$CFI > 0.01) (539).
In Model 2.2a (Table 6-5), the two factors were highly correlated (>0.8), suggesting that a single-factor solution may be sensible. CFA indicated that a single-factor model with residual covariances for negative items (Model 2.3a, Table 6-5) had similar fit to the two-factor model. However, neither Model 2.2a nor Model 2.3a displayed satisfactory fit to the data, based on the cut-off criteria set out in Table 6-1. The next step, therefore, was to examine more detailed and specific fit diagnostic information, including modification indices, expected parameter change statistics (EPCs) and residual correlations.

Table 6-5: Model fit statistics for models evaluated at Step 2, sub-sample A (n = 2,722)

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2 – EFA followed by CFA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1a</td>
<td>Two-factor, 17 items</td>
<td>2579.57*</td>
<td>118</td>
<td>0.09</td>
<td>0.085</td>
<td>0.090</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td>Items excluded: 6, 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2a</td>
<td>Two-factor, 17 items, Residual covariances for negative items</td>
<td>1561.34*</td>
<td>108</td>
<td>0.07</td>
<td>0.067</td>
<td>0.073</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>Items excluded: 6,12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3a</td>
<td>Single-factor, 17 items, Residual covariances for negative items</td>
<td>1700.01*</td>
<td>109</td>
<td>0.07</td>
<td>0.070</td>
<td>0.076</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>Items excluded: 6,12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, *p>0.05

Table 6-6: Change in model fit at Step 2, sub-sample A (n = 2,722)

<table>
<thead>
<tr>
<th>Model Comparison</th>
<th>Chi-square difference test</th>
<th>df</th>
<th>p</th>
<th>Change in CFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 2.2a V Model 2.1a (Addition of residual covariances for negative items)</td>
<td>995.87</td>
<td>10</td>
<td>&lt;0.01</td>
<td>0.05</td>
</tr>
</tbody>
</table>
6.5 Step 3: Model Modification based on Fit Diagnostics

Examination of MIs, EPCs and residual correlations in the two-factor model (Model 2.2a) indicated that a number of items in the scale were associated with poor fit. This led to the removal of a number of poorly performing items. Items were removed one at a time, with changes in model fit re-examined carefully following the removal of each item. At each stage of revision, consideration was given to the conceptual coverage and coherence of the scale. Alternative combinations of items were tested to ensure that the final version was not sensitive to the sequencing of the item removal process.

Item 15 “I feel full of energy” was the first item removed. It was associated with large MIs, EPCs and residual correlations in relation to item 8 “My health stops me from doing the things I want to do” (MI = 299.41, EPC = 0.50) and item 1 “My age prevents me from doing the things I would like to do” (MI = 163.65, EPC = 0.40). Items 1 and 8 related to the impact of age and health on control/autonomy. This suggested that while item 15 was intended as a measure of self-realisation, it was strongly influenced by age and health status.

Next, a number of items were removed due to empirical and conceptual overlap with other items in the scale. Item 16 “I choose to do things that I have never done before” was associated with several large MIs, EPCs and residual correlations. In particular, fit statistics suggested an association with item 18 “I feel that life is full of opportunities” (MI = 91.85, residual correlation = 0.12), reflecting the content overlap between these items. Fit diagnostics also suggested a strong association between item 14 “On balance, I look back on my life with a sense of happiness” and item 17 “I feel satisfied with the way my life has turned out” (MI = 110.29; residual correlation = 0.11), reflecting the high inter-item correlation (0.72). A similar association and content overlap was evident between item 5 “I can do the things that I want to do” and 7 “I feel that I can please myself what I do” (MI = 52.27; residual correlation = 0.12). It was decided to remove items 16, 14 and 5, as removal of these items resulted in the greatest improvement in model fit.

Item 19 “I feel that the future looks good for me” was also associated with large MIs, EPCs and residual correlations. It was particularly strongly associated with item 18 (MI = 54.45, EPC = 0.41). This indicated that it was a relatively non-specific item. As a future-oriented
item, it was also less essential for the conceptual coverage of the scale, which is focussed on appraisal of the individual’s current life situation.

Similar patterns of localised poor fit were observed in the single-factor Model 2.3a, and the procedure led to the removal of the same items. Removal of all five items resulted in substantial improvement in model fit, for both the two-factor and single-factor models (3.1a and 3.2a, Table 6-7). These improvements were statistically significant, based on the chi-square difference test and change in CFI >0.01 (see Table 6-8). The different models and item compositions tested, including fit statistics and changes in model fit, are displayed in Table A4.2 in Appendix 4.

Table 6-7: Model fit statistics for models evaluated at Step 3, sub-sample A (n = 2,722)

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 3 – Further Model Modification</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1a</td>
<td>Two-factor, 12 items, Residual covariances for negative items</td>
<td>184.10*</td>
<td>43</td>
<td>0.04</td>
<td>0.030</td>
<td>0.040</td>
<td>0.99</td>
</tr>
<tr>
<td></td>
<td>Items excluded: 5, 6, 12, 14, 15, 16, 19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2a</td>
<td>Single-factor 12 items, Residual covariances for negative items</td>
<td>206.74*</td>
<td>44</td>
<td>0.04</td>
<td>0.032</td>
<td>0.042</td>
<td>0.99</td>
</tr>
<tr>
<td></td>
<td>Items excluded: 5, 6, 12, 14, 15, 16, 19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

df = degrees of freedom, RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, *p>0.05

Table 6-8: Change in model fit between Step 2 and 3, sub-sample A (n = 2,722)

<table>
<thead>
<tr>
<th>Model Comparison</th>
<th>Chi-square difference test</th>
<th>df</th>
<th>p</th>
<th>Change in CFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 3.1a V Model 2.2a</td>
<td>6910.90</td>
<td>5</td>
<td>&lt;0.01</td>
<td>0.051</td>
</tr>
<tr>
<td>(Two-factor model: removal of problematic items)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 3.2a V Model 2.3a</td>
<td>6901.33</td>
<td>5</td>
<td>&lt;0.01</td>
<td>0.058</td>
</tr>
<tr>
<td>(Single-factor model: removal of problematic items)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CFI = Comparative Fit Index
6.6 Model Cross-Validation

The next step was to evaluate the models in the validation sub-sample. Table 6-9 displays the results of a CFA in sub-sample B of the models developed in Steps 2 to 3. Models tested at Step 2 had acceptable fit, while the models developed at Step 3 had excellent fit (e.g., Model 3.1b: RMSEA = 0.03, CFI = 0.99, TLI = 0.99). This final model is referred to as the CASP-12R (R=Revised).

Table 6-9: Model fit statistics in cross-validation sample (n = 4,101)

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 2 – EFA followed by CFA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1b</td>
<td>Two-factor, 17 items</td>
<td>1519.05*</td>
<td>118</td>
<td>0.05</td>
<td>0.051</td>
<td>0.056</td>
<td>0.97</td>
</tr>
<tr>
<td></td>
<td>Items excluded: 6, 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2b</td>
<td>Two-factor, 17 items, Residual covariances for negative Items</td>
<td>935.85*</td>
<td>108</td>
<td>0.04</td>
<td>0.041</td>
<td>0.046</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>Items excluded: 6, 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3b</td>
<td>Single-factor, 17 items, Residual covariances for negative Items</td>
<td>1053.19*</td>
<td>109</td>
<td>0.05</td>
<td>0.043</td>
<td>0.049</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>Items excluded: 6, 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3 – Further Model Modification</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1b</td>
<td>Two-factor, 12 items, Residual covariances for negative Items</td>
<td>150.86*</td>
<td>43</td>
<td>0.03</td>
<td>0.021</td>
<td>0.029</td>
<td>0.99</td>
</tr>
<tr>
<td></td>
<td>Items excluded: 5, 6, 12, 14, 15, 16, 19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2b</td>
<td>Single-factor, 12 items, Residual covariances for negative Items</td>
<td>161.90*</td>
<td>44</td>
<td>0.03</td>
<td>0.021</td>
<td>0.030</td>
<td>0.99</td>
</tr>
<tr>
<td></td>
<td>Items excluded: 5, 6, 12, 14, 15, 16, 19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, *p>0.05
Figure 6-2 displays the factor structure and completely standardised parameters for the two-factor model with residual covariances (Model 3.1b). In general, factor loadings are greater than or equal to 0.4. Items with lower loadings – 1, 8 and 9 – include content related to age, health and financial situation, and are thus capturing these factors in addition to control/autonomy. It was decided to retain these items, however, in order to capture how people assessed the extent to which their control/autonomy was limited by their circumstances. The items included in the CASP-12R are displayed in Table 6-10.

Figure 6-2: Structure and unstandardised parameter estimates for Model 3.1b (CASP-12R)
Table 6-10: CASP-12R item content

<table>
<thead>
<tr>
<th>Item</th>
<th>CONTROL/AUTONOMY</th>
</tr>
</thead>
<tbody>
<tr>
<td>c1</td>
<td>My age prevents me from doing the things I would like to do</td>
</tr>
<tr>
<td>c2</td>
<td>I feel that what happens to me is out of my control</td>
</tr>
<tr>
<td>c3</td>
<td>I feel free to plan for the future</td>
</tr>
<tr>
<td>c4</td>
<td>I feel left out of things</td>
</tr>
<tr>
<td>c7</td>
<td>I feel that I can please myself what I do</td>
</tr>
<tr>
<td>c8</td>
<td>My health stops me from doing the things I want to do</td>
</tr>
<tr>
<td>c9</td>
<td>Shortage of money stops me from doing the things I want to do</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SELF-REALISATION/PLEASURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>c10</td>
</tr>
<tr>
<td>c11</td>
</tr>
<tr>
<td>c13</td>
</tr>
<tr>
<td>c17</td>
</tr>
<tr>
<td>c18</td>
</tr>
</tbody>
</table>

6.7 Testing the CASP-15

Since publication of the analysis reported in this chapter, a further version of CASP has been proposed. This alternative version has 15 items and three factors (CASP-15) (268). Four items which capture the effect of life circumstances (age, health, shortage of money and family responsibilities) on control and autonomy are excluded from this version. This is intended to ensure that CASP is more clearly delineated from the factors that determine it, consistent with the initial rationale for the scale (268). Similar to the version developed in this chapter, control and autonomy are combined, and residual covariances are included for negatively-worded items. In contrast to the version proposed here, two separate factors are retained for pleasure and self-realisation. In addition, unlike the CASP-12R, items 5, 12, 14, 15, 16 and 19 are retained. Validation with ELSA found that the CASP-15 had acceptable but not good model fit (e.g., RMSEA = 0.07) (263).

Table 6-11 displays the fit statistics for the CASP-15 in the TILDA sample. The CFI and TLI are within the cut-off criteria for good fit. However, the RMSEA is just outside the bounds of good fit (RMSEA = 0.056). Inspection of modification indices, EPCs and residual correlations.
revealed that many of the items discussed as problematic in Section 6.5 were also problematic in the CASP-15. In particular, fit diagnostics suggested high overlap between items 14 and 17, items 5 and 7 and items 16 and 18. Item 15 also had poor fit, with modification indices suggesting strong overlap with control/autonomy items, e.g., item 2 (MI = 142.24, EPC = 0.233).

Table 6-11: Model fit statistics for the CASP-15 (n = 6,823)

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Three-factor, 15 items Residual covariances for negative items (CASP-15) Items excluded: 1, 6, 8, 9</td>
<td>1944.38*</td>
<td>86</td>
<td>0.056</td>
<td>0.054</td>
<td>0.058</td>
<td>0.964</td>
</tr>
</tbody>
</table>

RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, *p>0.05

In summary, the CASP-15 had acceptable fit to the TILDA data. However, this version retained a number of problematic items, and thus had poorer fit relative to the 12-item two-factor version (CASP-12R) presented in Section 6.5 and 6.6. A well-fitting model, relative to an acceptably fitting model, is more easily incorporated into a complex structural model. In structural equation modelling, specification errors in one part of a model can result in incorrect estimation of parameters elsewhere in the model, a phenomenon known as error propagation (526). In addition, as will be argued in Section 6.8.1, the combination of self-realisation and pleasure made sense on conceptual grounds. It was therefore decided to use the well-fitting, two-factor, 12-item version in subsequent phases of analysis.

6.8 Discussion

This chapter described a measurement model (CASP-12R) for the CASP-19 measure of QoL, which is psychometrically valid for use with the Irish population aged 50+. Consistent with other revised versions of CASP-19, the control and autonomy dimensions are combined (46,268) and residual covariances for negatively-worded items are included (268). The self-realisation and pleasure dimensions are also combined, on the basis of EFA and substantial
empirical and conceptual overlap across the items. Seven poorly performing items are excluded from the scale. The resultant scale can be measured using a single-factor measurement model or as a two-factor construct.

The purpose of this section is to briefly summarise the theoretical and conceptual rationale for using the CASP-12R in subsequent phases of analysis in this thesis. The combination of self-realisation and pleasure domains represents a departure from other established versions of CASP, and the extent to which this combination is consistent with the underlying conceptual model of CASP will be evaluated. In addition, the inclusion of items which involve evaluation of the effects of life circumstances on QoL will be briefly discussed.

### 6.8.1 Self-Realisation and Pleasure

The need for self-realisation relates to fulfilment of human potential, and a person's need to live in a way that is consistent with their individual self-concept. The need for pleasure relates to the need for enjoyment and pleasurable experiences (see Section 3.6). Self-realisation can thus be aligned with eudaimonic concepts of wellbeing, which relate to having a purpose in life, and pleasure can be aligned with hedonic concepts of wellbeing which emphasise happiness and satisfaction (39,48,268,565).

However, examination of the item content of the two dimensions in CASP does not support this distinction. Items in the self-realisation dimension relate to satisfaction with life – e.g., "I feel satisfied with the way my life has turned out". The pleasure dimension, on the other hand, includes items capturing meaning and purpose in life, e.g., "I feel that my life has meaning". Empirically, EFA suggests that pleasure and self-realisation items load on to the same factor. Previous analysis with ELSA data found that pleasure and self-realisation displayed similar associations with indicators of life satisfaction, a measure of hedonic wellbeing (263,268).

The following description of the theoretical underpinnings of CASP is consistent with a two-factor approach. Pleasure and self-realisation are described as two aspects of the same thing – living a fulfilling and enjoyable life. Control and autonomy are framed as facilitators of this pursuit of purpose and happiness.
"It is [the] more active side of older age that we aim to map with the other two dimensions of our model, pleasure and self-realisation. Inclusion of these domains aims to show that good quality of life is not just about freedom from undue interference, nor is it simply to have the potential to be able to intervene in one’s environment. Instead, what we argue is that once these requirements have been met then individuals need to use them to pursue the reflexive process of self-realisation through activities that make them happy."

Higgs et al. (44) (p. 245).

A number of theoretical perspectives on QoL suggest that perceived control or autonomy is a precursor or facilitator of overall QoL, or that it mediates the effect of life circumstances on overall QoL. Doyal & Gough’s theory of human need, an important influence on the development of CASP-19, identifies personal autonomy as a key precursor and facilitator of leading a fulfilling and purposeful life (264). Theories of subjective wellbeing (SWB) suggest that the ability to attain valued goals is a key determinant of SWB, and that physical health affects SWB via interference with the attainment of valued goals (215). The theory of illness intrusiveness also suggests that declining physical health primarily affects overall wellbeing via reduced perceived control (566,567).

Perceived control has been identified as a stronger predictor of life satisfaction than objective life circumstances (568). In addition, perceived control or mastery has been found to mediate the effects of social support, physical function and housing problems on depression and life satisfaction (569,570). Older adults with a high burden of chronic conditions and high locus of control appear to have comparable life satisfaction to those with a low burden of chronic conditions (222).

Conceiving of CASP as two dimensions – control/autonomy and self-realisation/pleasure – enables examination of this premise: that the ability to control one’s life mediates the effects of external life circumstances on living a meaningful and enjoyable life. In Analysis Phase 2, effects of chronic conditions and disability on control/autonomy and self-realisation/pleasure will be compared. In addition, the extent to which control/autonomy mediates effects of chronic disease and disability on self-realisation will be evaluated. This approach is consistent with the principle (noted in Chapter 2) that QoL should, where conceptually and empirically sensible, be examined as a multi-dimensional construct.
6.8.2 Disentangling life circumstances and QoL

Items 1, 8 and 9 capture evaluations of the impact that age, health and financial circumstances have on control/autonomy. It has been argued that this is inconsistent with the stated objective of CASP to measure a concept of QoL distinct from the factors which determine it, including age and health (268). In this analysis, these items displayed low item loadings. This may suggest that responses to these items are determined by factors other than latent control/autonomy.

Items 1 and 8 represent evaluations of the effects of age and health status, and can thus be considered somewhat distinct from more direct perception or performance measures of health and function (210) (see Section 2.4.4 for further discussion of this distinction). These items arguably perform an important function by providing some anchor between subjective evaluations of QoL and life circumstances. In addition, in contrast to measures of HRQoL these items form only a small part of the scale, rather than being the focus.

The associations between items 1 and 8 and indicators of health status and function will be evaluated empirically in the next phase of analysis. The two-factor measurement model for CASP developed here will be included in an overall measurement model which also includes latent factors for body function and activity, comprising both performance and perception indicators of physical health.

6.9 Conclusion

This chapter described a well-fitting two-factor measurement model for the CASP measure of QoL, the CASP-12R. This measurement model will be used to examine complex direct and indirect effects of chronic disease, disability and affective wellbeing on QoL, in accordance with the hypothetical model outlined in Section 4.4. This next phase of analysis will allow examination of how the two factors identified here are related to other key health and wellbeing constructs, thus providing further evidence for or against its utility and validity.
Chapter 7    Results 2: A Structural Model of the Pathway between Chronic Conditions and QoL

7.1 Introduction

This chapter presents the results of Analysis Phase 2. This involved a cross-sectional analysis of the indirect effects of chronic conditions on QoL, via the ICF disability domains and affective wellbeing. The analysis procedure was described in detail in Section 5.4, Chapter 5. The analysis described in this chapter has been published (541), and a postprint version of the article is included in Appendix 3.

This introductory section will describe the hypothetical model and specific hypotheses that were tested. A description of the sample will follow in Section 7.2, including a profile of missing data. Section 7.3 will describe the results of an initial path analysis, which tested individual ICF disability indicators as mediators of the chronic disease-QoL relationship. Section 7.4 will report an evaluation of measurement models for body function, activity, positive affect and QoL as a pre-cursor to their inclusion in a structural model. Estimation of this structural model, which is based on the hypothetical model outlined below, will be reported in Section 7.5. The following sections will examine how this structural model varies across age and sex (Section 7.6), when low income is adjusted for (Section 7.7), and when alternative definitions of chronic disease (Section 7.8.1) and affective wellbeing (Section 7.8.2) are used.

According to the hypothetical model outlined in Section 4.4 (p. 160), chronic disease affects the functioning of the body, which in turn affects a person's ability to carry out basic and more complex activities important for daily life. This restricts their participation in community life and society, which has a negative effect on their affective wellbeing and their appraisal of overall QoL. Earlier stages of the pathway were expected to retain influence on later stages – for example, body function, activity limitations and participation each affect QoL directly, as well as indirectly via the pathway. Specific hypotheses are detailed in Table 7-1, and the hypothetical model is displayed in Figure 7-1.
Table 7-1: Hypothesised mediation effects between chronic conditions, disability and QoL

<table>
<thead>
<tr>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Body function mediates the effect of chronic conditions on activity</td>
</tr>
<tr>
<td>1.2 Body function and activity mediate the effect of chronic conditions on participation</td>
</tr>
<tr>
<td>1.3 Body function, activity and participation mediate the effect of chronic conditions on affective wellbeing.</td>
</tr>
<tr>
<td>1.4 Body function, activity, participation and affective wellbeing mediate the effect of chronic conditions on QoL</td>
</tr>
<tr>
<td>1.5 Activity mediates the effect of body function on participation</td>
</tr>
<tr>
<td>1.6 Activity and participation mediate the effect of body function on affective wellbeing</td>
</tr>
<tr>
<td>1.7 Activity, participation and affective wellbeing mediate the effect of body function on QoL</td>
</tr>
<tr>
<td>1.8 Participation mediates the effect of activity on affective wellbeing</td>
</tr>
<tr>
<td>1.9 Participation and affective wellbeing mediate the effect of activity on QoL</td>
</tr>
<tr>
<td>1.10 Affective wellbeing mediates the effect of participation on QoL</td>
</tr>
</tbody>
</table>

Figure 7-1: Hypothetical Structural Model of the Relationship between Chronic Conditions and QoL
Chapter 6 concluded that the CASP scale could be measured using two factors, control/autonomy and self-realisation/pleasure. Current theory and evidence suggests that chronic disease and disability may affect overall wellbeing via effects on perceived control (38,215,220,566,567). This implies that effects of chronic disease, body function and activity on control/autonomy are stronger than effects on self-realisation/pleasure. This hypothesis was tested (see Table 7-2). The hypothesis that chronic conditions and disability affect self-realisation/pleasure indirectly via control/autonomy was also tested. Participation was not included in this hypothesis, as it was thought that this domain might have a stronger effect on QOL domains related to having meaning and purpose in life.

Table 7-2: Hypothesised differential effects on control/autonomy and self-realisation/pleasure

<table>
<thead>
<tr>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.11 Chronic conditions, body function, activity have a stronger effect on</td>
</tr>
<tr>
<td>control/autonomy relative to self-realisation/pleasure</td>
</tr>
<tr>
<td>1.12 Chronic conditions, body function, activity affect self-realisation/pleasure indirectly via control/autonomy</td>
</tr>
</tbody>
</table>

7.2 Sample Characteristics and Missing Data

This section presents a profile of the sample included in this phase of analysis, and also includes a description of missing data and excluded participants. It also includes a profile of chronic disease diagnoses in the sample, and a brief analysis of the effects of chronic conditions on control/autonomy and self-realisation/pleasure.

7.2.1 Missing Data Profile

Analysis Phase 2 included TILDA W1 participants who had responded to both the self-completion questionnaire (SCQ) and the health assessment (HA) (n = 5,376) (see flow chart in Figure 7-2). For this phase of analysis, the publicly available dataset was used (available from http://www.ucd.ie/issda/data/tilda). For anonymisation purposes, age was censored for 319 participants aged >80 in this version of the TILDA dataset. It was not possible to adjust for age in these participants, and they were therefore excluded from analysis.
The remaining participants (n= 5,057) had missing data on a number of variables, displayed in Table 7-3. It was possible to include participants who had missing data on endogenous (dependent) variables in the structural model, using a pairwise present approach available in MPlus. All available observed values were used to estimate standard deviations, while each observed pair of values was used to estimate covariances. These covariances were conditional on covariates in the model (see Section 5.4.6, p.213). This approach did not allow inclusion of participants with missing data on exogenous covariates. Data were missing for two covariates – alcohol consumption and obesity. Initial analysis indicated that alcohol consumption did not have a strong relationship with either chronic disease status or CASP score. It was therefore decided to exclude this variable from further analysis, rather than exclude the 66 participants who had missing data for this variable. Sixteen participants with missing data on obesity were excluded. Participants were also excluded if they did not respond to at least 50% of items used to measure control/autonomy (n=63), self-realisation/pleasure (n=50), positive affect (n=2), and negative affect (n=2). In total, 96 participants were excluded due to item-level non-response.

Remaining participants had missing data on some body function, activity and participation variables; though the proportion of missing data was generally low (see Table 7-3). Three body function and activity variables had missing data (weak grip (1.3%), slow Timed Up and Go (TUG) (0.7%) and poor balance (0.1%). Two participation variables had missing data: community participation (3.4%) and social leisure activity (9.4%).

The odds of missingness on each variable were examined in relation to age, sex, education and marital status. Participants with a lower level of education, single participants, and women were more likely to have missing data on participation variables. Single people were also more likely to have missing data on obesity. Women were more likely to have missing data on grip strength. As noted in Chapter 6, participants with missing data on CASP items tended to be older and have a lower level of education.
Figure 7-1: Participant flow chart, Analysis Phase 2

TILDA Participants aged 50+
n = 8,175

Did not complete or return SCQ
n = 1,263

Completed SCQ W1
n = 6,912

Did not complete health assessment
n = 1,527
Age missing = 9

Completed HA W1
n = 5,376

Aged > 80
n = 319

Item non-response
n = 96

Included Phase 2 Analysis
n = 4,961
### Table 7-3: Number and % of participants with missing data by variable (n = 5,057)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Missing Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td><strong>Exogenous variables (covariates)</strong></td>
<td></td>
</tr>
<tr>
<td>Obese*</td>
<td>16</td>
</tr>
<tr>
<td>Alcohol consumption</td>
<td>66</td>
</tr>
<tr>
<td><strong>Scale variables</strong></td>
<td></td>
</tr>
<tr>
<td>Control/Autonomy (7 items)</td>
<td>1-3 items</td>
</tr>
<tr>
<td>&gt;3 or 50% of items*</td>
<td>63</td>
</tr>
<tr>
<td>Self-realisation/Pleasure (5 items)</td>
<td>1-2 items</td>
</tr>
<tr>
<td>&gt;2 or 50% of items*</td>
<td>50</td>
</tr>
<tr>
<td>Positive Affect (4 items)</td>
<td>1-2 items</td>
</tr>
<tr>
<td>&gt;2 or 50% of items*</td>
<td>2</td>
</tr>
<tr>
<td>Negative Affect (7 items)</td>
<td>1-3 items</td>
</tr>
<tr>
<td>&gt;3 or 50% of items*</td>
<td>2</td>
</tr>
<tr>
<td><strong>Endogenous (dependent) variables</strong></td>
<td></td>
</tr>
<tr>
<td>Social Leisure Activity</td>
<td>474</td>
</tr>
<tr>
<td>Community Participation</td>
<td>174</td>
</tr>
<tr>
<td>Poor balance</td>
<td>5</td>
</tr>
<tr>
<td>Slow TUG</td>
<td>33</td>
</tr>
<tr>
<td>Weak Grip</td>
<td>64</td>
</tr>
</tbody>
</table>

*Participants with missing data excluded from analysis; total n = 96

Note: Only variables with missing data are displayed in this table.

TUG = Timed Up and Go
7.2.2 Sample Characteristics

Table 7-4 displays information on each of the study variables for the included sample, the 96 excluded participants, and the Republic of Ireland (ROI) Census 2011. In the included sample, there were slightly more women than men, and almost two-thirds were aged under 65. The majority (75.8%) were living as married, and over three-quarters (76.8%) had secondary education or higher. Over three-quarters reported at least one chronic condition (78%), with over a quarter reporting three or more (27.1%). The majority reported social leisure activity at least monthly (74.2%), and most were involved in some form of community participation (60.1%). Less than half of included participants were employed or self-employed (40.6%). The sample profile was similar to that of the same age group (50-80) in the Irish Census 2011. Only the educational profile differed. As explained in Section 5.1.3 (p. 170), this was partly to do with differing definitions of non-degree third level education in TILDA and the Census, but may also have been due to sampling error.

The small number of excluded participants differed from the included sample across a number of characteristics. They were older, more likely to only have a primary education, less likely to be living as married and less likely to be employed. They were also more likely to report a range of impairments in body function and activity limitations. Excluded participants also reported lower scores on both QoL domains, but no differences in affective wellbeing scores. The total proportion of excluded participants was small (<2% of the sample).
Table 7-4: Sample characteristics: socio-demographic factors, lifestyle, chronic disease and ICF disability indicators (n = 5,057)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Included (n = 4,961)</th>
<th>Excluded (n=96)</th>
<th>Census 2011 (50-80 yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td><strong>Socio-demographics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>2,283</td>
<td>46.0</td>
<td>29</td>
</tr>
<tr>
<td>Women</td>
<td>2,678</td>
<td>54.0</td>
<td>67</td>
</tr>
<tr>
<td>Aged &lt;65</td>
<td>3,149</td>
<td>63.5</td>
<td>37</td>
</tr>
<tr>
<td>Aged 65-80</td>
<td>1,812</td>
<td>36.6</td>
<td>59</td>
</tr>
<tr>
<td>Living as married</td>
<td>3,761</td>
<td>75.8</td>
<td>55</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary / none</td>
<td>1,151</td>
<td>23.2</td>
<td>45</td>
</tr>
<tr>
<td>Secondary</td>
<td>2,089</td>
<td>42.1</td>
<td>31</td>
</tr>
<tr>
<td>Third Level</td>
<td>1,721</td>
<td>34.7</td>
<td>20</td>
</tr>
<tr>
<td><strong>Lifestyle</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoker</td>
<td>772</td>
<td>15.6</td>
<td>16</td>
</tr>
<tr>
<td>Obese (BMI &gt;=30)</td>
<td>1,711</td>
<td>34.5</td>
<td>23</td>
</tr>
<tr>
<td><strong>Chronic Disease Status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1,093</td>
<td>22.0</td>
<td>16</td>
</tr>
<tr>
<td>1</td>
<td>1,387</td>
<td>28.0</td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>1,132</td>
<td>22.8</td>
<td>25</td>
</tr>
<tr>
<td>3 or more</td>
<td>1,349</td>
<td>27.1</td>
<td>32</td>
</tr>
<tr>
<td><strong>Participation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social leisure activity</td>
<td>3,373</td>
<td>74.2</td>
<td>24</td>
</tr>
<tr>
<td>Community participation</td>
<td>2,903</td>
<td>60.1</td>
<td>37</td>
</tr>
<tr>
<td>Paid work</td>
<td>2,014</td>
<td>40.6</td>
<td>17</td>
</tr>
<tr>
<td><strong>Body Function</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weak grip</td>
<td>990</td>
<td>20.2</td>
<td>21</td>
</tr>
<tr>
<td>Moderate or severe pain</td>
<td>1,239</td>
<td>25.0</td>
<td>34</td>
</tr>
<tr>
<td>Poor balance</td>
<td>1,298</td>
<td>26.2</td>
<td>45</td>
</tr>
<tr>
<td>Poor sleep</td>
<td>1,760</td>
<td>35.5</td>
<td>36</td>
</tr>
<tr>
<td>Incontinent</td>
<td>629</td>
<td>12.7</td>
<td>16</td>
</tr>
<tr>
<td>Variable</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Walking 100m</td>
<td>245</td>
<td>4.9</td>
<td>18</td>
</tr>
<tr>
<td>Sitting for 2 hours</td>
<td>513</td>
<td>10.3</td>
<td>16</td>
</tr>
<tr>
<td>Getting up from a chair</td>
<td>834</td>
<td>16.8</td>
<td>25</td>
</tr>
<tr>
<td>Climbing stairs</td>
<td>244</td>
<td>4.9</td>
<td>15</td>
</tr>
<tr>
<td>Stooping/kneeling</td>
<td>1,283</td>
<td>25.9</td>
<td>34</td>
</tr>
<tr>
<td>Reaching</td>
<td>346</td>
<td>7.0</td>
<td>13</td>
</tr>
<tr>
<td>Pulling or pushing large objects</td>
<td>509</td>
<td>10.3</td>
<td>23</td>
</tr>
<tr>
<td>Lifting or carrying weights</td>
<td>768</td>
<td>15.5</td>
<td>29</td>
</tr>
<tr>
<td>Picking up small objects</td>
<td>153</td>
<td>3.1</td>
<td>6</td>
</tr>
<tr>
<td>Any ADLs</td>
<td>354</td>
<td>7.1</td>
<td>17</td>
</tr>
<tr>
<td>Any IADLs</td>
<td>236</td>
<td>4.8</td>
<td>18</td>
</tr>
<tr>
<td>Slow Timed Up and Go (TUG)</td>
<td>959</td>
<td>19.4</td>
<td>35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Mean</th>
<th>SD</th>
<th>p-value</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>CASP-12R (12 items)</td>
<td>40.4</td>
<td>5.0</td>
<td>35.3</td>
<td>7.2</td>
<td>&lt;0.01</td>
<td>18-48</td>
</tr>
<tr>
<td>Control/autonomy (7 items)</td>
<td>22.1</td>
<td>3.6</td>
<td>19.8</td>
<td>5.6</td>
<td>0.003</td>
<td>8-28</td>
</tr>
<tr>
<td>Self-realisation/pleasure (5 items)</td>
<td>18.3</td>
<td>2.1</td>
<td>17.5</td>
<td>3.0</td>
<td>0.03</td>
<td>5-20</td>
</tr>
<tr>
<td>Positive affect (4 items)</td>
<td>14.3</td>
<td>2.4</td>
<td>14.3</td>
<td>2.4</td>
<td>0.98</td>
<td>5-16</td>
</tr>
<tr>
<td>Negative affect (7 items)</td>
<td>7.3</td>
<td>2.4</td>
<td>7.8</td>
<td>2.8</td>
<td>0.07</td>
<td>7-28</td>
</tr>
</tbody>
</table>

BMI = Body Mass Index; ADLs = Difficulties with Basic Activities of Daily Living; IADLs = Difficulties with Instrumental Activities of Daily Living; SD = Standard Deviation
7.2.3 Chronic Conditions

Table 7-5 displays the frequency of specific diagnoses among people with at least one condition. High cholesterol, hypertension and arthritis were the most common conditions reported. Among individuals who reported at least one doctor-diagnosed condition, just over 40% had high cholesterol, over a third (34.5%) had hypertension and over a quarter had arthritis (26.5%). Parkinson’s disease, stroke, transient ischaemic attack (TIA), cirrhosis and congestive heart failure were the least frequently reported.

Table 7-5: Frequency of diagnoses in participants with >=1 condition (n = 3,868)

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Cholesterol</td>
<td>1,597</td>
<td>41.3</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1,334</td>
<td>34.5</td>
</tr>
<tr>
<td>Arthritis</td>
<td>1,025</td>
<td>26.5</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>395</td>
<td>10.2</td>
</tr>
<tr>
<td>Asthma</td>
<td>367</td>
<td>9.5</td>
</tr>
<tr>
<td>Stomach Ulcer</td>
<td>278</td>
<td>7.2</td>
</tr>
<tr>
<td>Heart Arrhythmia</td>
<td>278</td>
<td>7.2</td>
</tr>
<tr>
<td>Diabetes</td>
<td>271</td>
<td>7.0</td>
</tr>
<tr>
<td>Cancer</td>
<td>244</td>
<td>6.3</td>
</tr>
<tr>
<td>Heart Murmur</td>
<td>182</td>
<td>4.7</td>
</tr>
<tr>
<td>Angina</td>
<td>170</td>
<td>4.4</td>
</tr>
<tr>
<td>Myocardial Infarction</td>
<td>155</td>
<td>4.0</td>
</tr>
<tr>
<td>Chronic Lung Disease</td>
<td>147</td>
<td>3.8</td>
</tr>
<tr>
<td>Other Heart</td>
<td>132</td>
<td>3.4</td>
</tr>
<tr>
<td>Varicose Ulcer</td>
<td>116</td>
<td>3.0</td>
</tr>
<tr>
<td>TIA</td>
<td>70</td>
<td>1.8</td>
</tr>
<tr>
<td>Stroke</td>
<td>50</td>
<td>1.3</td>
</tr>
<tr>
<td>Congestive Heart Failure</td>
<td>35</td>
<td>0.9</td>
</tr>
<tr>
<td>Cirrhosis</td>
<td>23</td>
<td>0.6</td>
</tr>
<tr>
<td>Parkinson’s Disease</td>
<td>15</td>
<td>0.4</td>
</tr>
<tr>
<td>Total &gt;=1 condition</td>
<td>3,868</td>
<td>100</td>
</tr>
</tbody>
</table>
7.2.4 Chronic Conditions and QoL

Table 7-6 displays the effect of chronic conditions on control/autonomy and self-realisation/pleasure, adjusted for age, sex and education. For control/autonomy, the effect of a single condition was significant, with increased effects for two and three or more conditions (CA Model 1). For self-realisation/pleasure, effects were only statistically significant for two and three or more conditions (SP Model 1).

The effect of chronic conditions on self-realisation/pleasure was not significant when control/autonomy score was adjusted for (SP Model 2). This suggested that for a given level of control/autonomy, chronic conditions were not associated with reduced sense of meaning and enjoyment in life. This provided preliminary support for the hypothesis that perceived control mediates the effects of physical health on overall wellbeing. The contrary hypothesis, that self-realisation/pleasure mediated the effect of chronic conditions on control/autonomy, was not supported (CA Model 2). These relationships will be explored further in multivariate analysis.

Table 7-6: Regression analysis of effects of chronic conditions on control/autonomy and self-realisation/pleasure (n = 4,522^a)

<table>
<thead>
<tr>
<th>No. of conditions</th>
<th>CA Model 1^b</th>
<th>SP Model 1^b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>95% CI</td>
</tr>
<tr>
<td>None (Ref)</td>
<td>-0.52</td>
<td>-0.80 -0.22</td>
</tr>
<tr>
<td>1</td>
<td>-0.94</td>
<td>-1.25 -0.63</td>
</tr>
<tr>
<td>2</td>
<td>-2.36</td>
<td>-2.66 -2.05</td>
</tr>
<tr>
<td>3 or more</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of conditions</th>
<th>CA Model 2^c</th>
<th>SP Model 2^d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>95% CI</td>
</tr>
<tr>
<td>None (Ref)</td>
<td>-0.41</td>
<td>-0.66 -0.16</td>
</tr>
<tr>
<td>1</td>
<td>-0.72</td>
<td>-0.99 -0.46</td>
</tr>
<tr>
<td>2</td>
<td>-1.86</td>
<td>-2.12 -1.59</td>
</tr>
</tbody>
</table>

CA = control/autonomy; SP = self-realisation/pleasure. ^aSmaller sample due to missing data on CASP items; ^bAdjusted for age, sex and education; ^cAdjusted for age, sex, education and SP; ^dAdjusted for age, sex, education and CA
7.3 Step 1: Path Analysis

A series of single mediator models were tested to separately examine each ICF disability indicator as a mediator of the effect of chronic disease on the two QoL dimensions. Each model specified a direct effect of chronic conditions on each of the QoL dimensions, and an indirect effect via the relevant ICF indicator (see Figure 7-3). Effects of age, sex, education, obesity, smoking and marital status on the relevant disability indicator, and on each QoL dimension, were adjusted for in each model. All of the fit indices were within the criteria for acceptable fit (RMSEA < 0.07, TLI > 0.90, CFI > 0.90). See Table 6-1 (p. 227) for goodness-of-fit criteria.

The estimated direct and indirect effects for each model are displayed in Table 7-7. In each of the models, both direct and indirect effects were statistically significant. This suggested that each ICF indicator partially mediated the effect of chronic conditions on QoL. The proportion of the indirect effect relative to the total effect, which is a measure of the size of the mediation effect (543), is also displayed. Based on this, the largest mediators were instrumental and basic activities of daily living, pushing or pulling large objects, lifting heavy weights, poor balance, pain, being able to climb one flight of stairs and walking 100m. For each of these variables, the size of the indirect effect was approximately 40% or more of the total effect. The weakest indicators were objective measures of body function and activity (slow TUG and weak grip), and indicators of participation restriction (approximately 10% or less of the total effect).

A single structural model evaluating all of the disability indicators as independent mediators of the effects of chronic conditions on QoL was specified and tested. However, the disability indicators were too highly correlated, and the model too poorly fitting, so that the model estimates failed to converge. In other words, the model as specified was too poorly fitting for the parameters to be estimated. The next step, therefore, was to take into account high correlations across body function and activity variables by specifying them as indicators of underlying latent factors.
Figure 7-2: Generalised path model of the relationship between chronic conditions and QoL, via observed indicators of body function, activity and participation

Legend: ICF indicator\textsubscript{1…20} denotes the 20 indicators of ICF disability, with a separate model specified and estimated for each indicator.

Note: The effects of covariates on the relevant ICF indicator and QoL were included (age, age\textsuperscript{2}, sex, education, marital status, obesity, smoking), but are not displayed for ease of presentation.
### Table 7-7: Direct and indirect effects in single mediator models for each ICF disability indicator (n = 4,961)

<table>
<thead>
<tr>
<th>Disability Indicator</th>
<th>Direct effect of chronic disease on CA</th>
<th>Indirect effect of chronic disease on CA via disability indicator</th>
<th>Indirect Effect as proportion of Total Effect</th>
<th>Direct effect of chronic disease on SP</th>
<th>Indirect effect of chronic disease on SP via disability indicator</th>
<th>Indirect Effect as proportion of Total Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Co-efficient</td>
<td>p</td>
<td>Co-efficient</td>
<td>p</td>
<td>Co-efficient</td>
<td>p</td>
</tr>
<tr>
<td><strong>Body Function</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>-0.147</td>
<td>&lt;0.001</td>
<td>-0.099</td>
<td>&lt;0.001</td>
<td>0.40</td>
<td>-0.05</td>
</tr>
<tr>
<td>Poor balance</td>
<td>-0.146</td>
<td>&lt;0.001</td>
<td>-0.099</td>
<td>&lt;0.001</td>
<td>0.40</td>
<td>-0.038</td>
</tr>
<tr>
<td>Weak grip</td>
<td>-0.216</td>
<td>&lt;0.001</td>
<td>-0.009</td>
<td>&lt;0.001</td>
<td>0.04</td>
<td>-0.084</td>
</tr>
<tr>
<td>Incontinence</td>
<td>-0.198</td>
<td>&lt;0.001</td>
<td>-0.031</td>
<td>&lt;0.001</td>
<td>0.14</td>
<td>-0.071</td>
</tr>
<tr>
<td>Poor sleep</td>
<td>-0.199</td>
<td>&lt;0.001</td>
<td>-0.033</td>
<td>&lt;0.001</td>
<td>0.14</td>
<td>-0.061</td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADL</td>
<td>-0.147</td>
<td>&lt;0.001</td>
<td>-0.108</td>
<td>&lt;0.001</td>
<td>0.42</td>
<td>-0.049</td>
</tr>
<tr>
<td>IADL</td>
<td>-0.137</td>
<td>&lt;0.001</td>
<td>-0.112</td>
<td>&lt;0.001</td>
<td>0.45</td>
<td>-0.047</td>
</tr>
<tr>
<td>Walking 100m</td>
<td>-0.159</td>
<td>&lt;0.001</td>
<td>-0.098</td>
<td>&lt;0.001</td>
<td>0.38</td>
<td>-0.051</td>
</tr>
<tr>
<td>Sitting 2 hours</td>
<td>-0.173</td>
<td>&lt;0.001</td>
<td>-0.067</td>
<td>&lt;0.001</td>
<td>0.28</td>
<td>-0.063</td>
</tr>
<tr>
<td>Getting up from a chair after sitting</td>
<td>-0.166</td>
<td>&lt;0.001</td>
<td>-0.068</td>
<td>&lt;0.001</td>
<td>0.29</td>
<td>-0.055</td>
</tr>
<tr>
<td>Climbing 1 flight of stairs</td>
<td>-0.150</td>
<td>&lt;0.001</td>
<td>-0.095</td>
<td>&lt;0.001</td>
<td>0.39</td>
<td>-0.050</td>
</tr>
<tr>
<td>Stooping, kneeling, crouching</td>
<td>-0.152</td>
<td>&lt;0.001</td>
<td>-0.085</td>
<td>&lt;0.001</td>
<td>0.36</td>
<td>-0.055</td>
</tr>
<tr>
<td>Disability Indicator</td>
<td>Direct effect of chronic disease on CA</td>
<td>Indirect effect of chronic disease on CA via disability indicator</td>
<td>Indirect Effect as proportion of Total Effect</td>
<td>Direct effect of chronic disease on SP</td>
<td>Indirect effect of chronic disease on SP via disability indicator</td>
<td>Indirect Effect as proportion of Total Effect</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------</td>
<td>---------------------------------------------------------------</td>
<td>---------------------------------------------</td>
<td>--------------------------------------</td>
<td>---------------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Co-efficient</td>
<td>p</td>
<td>Co-efficient</td>
<td>p</td>
<td>Co-efficient</td>
<td>p</td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reaching</td>
<td>-0.173</td>
<td>&lt;0.001</td>
<td>-0.059</td>
<td>&lt;0.001</td>
<td>0.25</td>
<td>-0.062</td>
</tr>
<tr>
<td>Pulling or pushing large objects</td>
<td>-0.139</td>
<td>&lt;0.001</td>
<td>-0.111</td>
<td>&lt;0.001</td>
<td>0.44</td>
<td>-0.040</td>
</tr>
<tr>
<td>Lifting or carrying large weights</td>
<td>-0.139</td>
<td>&lt;0.001</td>
<td>-0.110</td>
<td>&lt;0.001</td>
<td>0.44</td>
<td>-0.047</td>
</tr>
<tr>
<td>Picking up a small coin</td>
<td>-0.186</td>
<td>&lt;0.001</td>
<td>-0.046</td>
<td>&lt;0.001</td>
<td>0.20</td>
<td>-0.067</td>
</tr>
<tr>
<td>Slow TUG</td>
<td>-0.206</td>
<td>&lt;0.001</td>
<td>-0.024</td>
<td>&lt;0.001</td>
<td>0.10</td>
<td>-0.079</td>
</tr>
<tr>
<td><strong>Participation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community participation</td>
<td>-0.218</td>
<td>&lt;0.001</td>
<td>-0.005</td>
<td>0.111</td>
<td>0.02</td>
<td>-0.083</td>
</tr>
<tr>
<td>Social leisure activity</td>
<td>-0.215</td>
<td>&lt;0.001</td>
<td>-0.011</td>
<td>0.001</td>
<td>0.05</td>
<td>-0.081</td>
</tr>
<tr>
<td>Paid work</td>
<td>-0.201</td>
<td>&lt;0.001</td>
<td>-0.027</td>
<td>&lt;0.001</td>
<td>0.12</td>
<td>-0.077</td>
</tr>
</tbody>
</table>

CA = control/autonomy; SP = self-realisation/pleasure; ADL = Activities of Daily Living, IADL = Instrumental Activities of Daily Living, TUG = Timed Up and Go

*Total effect = Direct effect + indirect effect
7.4 Step 2: Measurement Models

Step 2 involved testing a measurement model for the latent constructs body function, activity, positive affect, control/autonomy and self-realisation/pleasure. The objective of this step was to develop a satisfactory measurement model for use in a structural model to test the relationship between chronic disease and QoL. Table 7-8 displays the fit of each of the measurement models tested at Step 2.

Single latent factors for body function (Model 2.1) and activity (Model 2.2) each fitted the data well, with all the fit indices within the criteria for good fit (see Table 6-1, p. 227). A single positive affect factor also had acceptable fit (Model 2.3). In Model 2.4, these three factors were combined with the control/autonomy and self-realisation/pleasure factors developed in Analysis Phase 2 (reported in Chapter 6). This model (2.4) fitted the data reasonably well, based on approximate fit indices (RMSEA = 0.045; CFI > 0.9; TLI > 0.9).

However, the correlation between body function and activity factors was high (0.97). High correlations between latent factors can lead to statistical instability (526) and make it difficult to identify their separate, independent relationships with other variables. This would make it difficult to compare effects of body function and activity on QoL in a structural model. Model 2.5 therefore combined body function and activity into an overall physical impairment factor. This indicated that hypotheses 1.1 and 1.5 (p. 245) were not supported, as it was not possible to examine whether body function mediated effects of chronic disease on activity, nor whether activity mediated effects of body function on participation, affective wellbeing or QoL.

The fit of Model 2.5 was acceptable rather than good. Modification indices (MIs), EPCs and residual correlations were inspected for evidence of mis-fit. Large MIs for two control/autonomy items suggested cross-loadings on to the physical impairment factor – item 8 "My health stops me from doing what I want to do" (MI = 1520.53, EPC = 0.715) and item 1 "My age prevents me from doing the things I would like to do" (MI = 428.87, EPC = -0.364). These items were excluded in Model 2.6 which displayed improved fit (RMSEA = 0.03, CFI = 0.96, TLI = 0.95).
The adjusted chi-square test was statistically significant, however. This indicated that the covariances predicted by the model were significantly different to the observed covariances. This could have been due to the large sample size, or model mis-specification. Fit diagnostics were therefore examined for evidence of mis-fit. This process suggested a number of substantively justified modifications to the measurement model. Large modification indices, EPCs and residual correlations suggested that the indicator poor sleep (BF6) was closely related to control/autonomy (MI=404.73), self-realisation/pleasure (MI = 418.20) and positive affect (MI = 448.25). This shared variance may have been associated with levels of depression, as poor sleep is a symptom of depression. This item was removed.

Fit diagnostics indicated that addition of residual covariances between three pairs of items would improve model fit. This included two pairs of activity indicators: "lifting and carrying weights" and "pushing and pulling large objects" (MI = 219.86, EPC = 0.86, residual correlation = 0.16); and "getting up from a chair" and "stooping/crouching" (MI = 73.53, EPC = 0.419, residual correlation = 0.12). Two self-realisation/pleasure items (item 11) "I feel my life has meaning" and (item 10) "I look forward to each day" also had a large MI (102.3) and EPC (0.491) associated with their residual covariance. Residual covariances were added for each item pair.

This final model, Model 2.7, displayed good fit to the data (RMSEA = 0.03, CFI = 0.97, TLI = 0.97). The chi-square statistic remained significant, but as noted in Section 5.3.2.1 (p. 197), this test is sensitive to sample size. Few residual correlations were greater than 0.1 (25 out of 650 correlations). None of these were >0.2 and they did not form a meaningful pattern that would suggest the need for further model re-specification. The structure of the model and parameter estimates, are displayed in Figure 7-4.

A survey weight was added to Model 2.7 to adjust for non-response to TILDA overall, and to the self-completion component in particular. This model fitted the data equally well, and differences in fit indices and parameter estimates were of no substantive significance.

As the item composition of CASP-12R had been altered in Model 2.6 with the removal of item 1 and 8, the measurement model for CASP was re-tested with items 1 and 8 excluded,
as both a two-factor (Model 2.8) and a single-factor (Model 2.9) model. Both models had acceptable and comparable fit. As neither version was preferable on the basis of model fit, it was decided to use the two-factor version on conceptual grounds, to allow the assessment of differential effects on the two domains.

Table 7-8: Model fit statistics for measurement models tested at Step 2 (n = 4,961)

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Single-factor Body Function</td>
<td>19.7*</td>
<td>5</td>
<td>0.02</td>
<td>0.014</td>
<td>0.036</td>
<td>0.99</td>
</tr>
<tr>
<td>2.2</td>
<td>Single-factor Activity</td>
<td>669.95*</td>
<td>54</td>
<td>0.05</td>
<td>0.045</td>
<td>0.051</td>
<td>0.96</td>
</tr>
<tr>
<td>2.3</td>
<td>Single-factor Positive Affect (PA)</td>
<td>31.92*</td>
<td>2</td>
<td>0.06</td>
<td>0.039</td>
<td>0.072</td>
<td>0.99</td>
</tr>
<tr>
<td>2.4</td>
<td>Five latent factors for Body Function, Activity, PA, CA and SP</td>
<td>5303.47*</td>
<td>475</td>
<td>0.05</td>
<td>0.044</td>
<td>0.046</td>
<td>0.92</td>
</tr>
<tr>
<td>2.5</td>
<td>Four latent factors for PhysImp, PA, CA and SP</td>
<td>5459.84*</td>
<td>479</td>
<td>0.05</td>
<td>0.045</td>
<td>0.047</td>
<td>0.91</td>
</tr>
<tr>
<td>2.6</td>
<td>Four latent factors for PhysImp, PA, CA and SP CASP items 1 &amp; 8 removed</td>
<td>2525.22*</td>
<td>425</td>
<td>0.03</td>
<td>0.030</td>
<td>0.033</td>
<td>0.96</td>
</tr>
<tr>
<td>2.7</td>
<td>Four latent factors for PhysImp, PA, CA and SP Poor sleep removed, residual covariances added (Figure 7-4)</td>
<td>1598.48*</td>
<td>393</td>
<td>0.03</td>
<td>0.024</td>
<td>0.026</td>
<td>0.98</td>
</tr>
<tr>
<td>2.8</td>
<td>10 item CASP, two factors (CA and SP)</td>
<td>290.62*</td>
<td>30</td>
<td>0.042</td>
<td>0.038</td>
<td>0.046</td>
<td>0.99</td>
</tr>
<tr>
<td>2.9</td>
<td>10 item CASP, single factor</td>
<td>384.73*</td>
<td>31</td>
<td>0.048</td>
<td>0.044</td>
<td>0.052</td>
<td>0.99</td>
</tr>
</tbody>
</table>

RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index; PA = Positive Affect; CA = control/autonomy; SP = self-realisation/pleasure; PhysImp = Physical Impairment
*p>0.05
Phys Imp = Physical Impairment  PA = Positive Affect  CA = Control/Autonomy  SP = Self-Realisation/Pleasure

<table>
<thead>
<tr>
<th></th>
<th>Loading</th>
<th></th>
<th>Loading</th>
<th></th>
<th>Loading</th>
<th></th>
<th>Loading</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A3. Slow TUG</td>
<td>.446</td>
<td>A12. Pick up small object</td>
<td>.585</td>
<td></td>
<td></td>
<td>C4 WITH C2</td>
<td>.251</td>
<td></td>
</tr>
<tr>
<td>A4. Walking 100m</td>
<td>.778</td>
<td>A10 WITH A11</td>
<td>.610</td>
<td></td>
<td></td>
<td>C9 WITH C2</td>
<td>.068</td>
<td></td>
</tr>
<tr>
<td>A5. Sitting 2 hours</td>
<td>.711</td>
<td>A6 WITH A8</td>
<td>.370</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 7-4: Measurement Model 2.7: structure and standardised parameter estimates
7.5 Step 3: Structural Models

In Step 3, structural relationships were added to the measurement model derived at Step 2 (Model 2.7), along with observed variables for number of chronic conditions, paid employment, social leisure activity and community participation. A simplified version of this model, showing structural relationships only, is displayed in Figure 7-5.

![Diagram of structural model](image)

Notes

1. Measurement models are not shown for ease of presentation and are displayed in Figure 7-4.

2. The effects of covariates on each of the dependent variables (physical impairment, paid work, social activity, community participation and control/autonomy and self-realisation/pleasure) were included in the model.

Legend: PhysImp = Physical Impairment, CA = Control/Autonomy, SP = Self-Realisation/Pleasure, PA = Positive Affect

Figure 7-5: Hypothetical structural model of the relationship between chronic disease and QoL, via physical impairment, participation and positive affect
This structural model displayed good fit to the data (Model 3.1, Table 7-9). Approximate fit indices were within the criteria for good fit (RMSEA <0.045, CFI >0.95, TLI >0.95). Inspection of MLs and EPC statistics suggested the addition of a residual covariance between community participation and social leisure activity (MI = 81.42, EPC = 0.233). This made conceptual sense, as these variables came from the same questionnaire on social activity. This parameter was added to Model 3.2.

The next step was to remove non-significant parameters (p<0.05) from Model 3.2 with the aim of yielding the most parsimonious model (544). Each non-significant structural parameter was removed in a sequential process, with changes in parameter estimates examined following each removal. The direct effect of number of chronic conditions on positive affect, control/autonomy and self-realisation/pleasure was not significant, indicating that the ICF disability domains fully mediated the effect of chronic disease. Among the participation variables, chronic conditions only had a significant direct effect on paid work. Community participation was not significantly related to control/autonomy or positive affect. Conversely, paid work was not significantly related to self-realisation/pleasure. Social activity, on the other hand, had an effect on all three outcomes. Once the non-significant effects along the main pathway had been removed, the next step was to remove non-significant effects of the covariates. Effects of covariates were removed last to ensure that each of the key structural effects in the final model was adjusted for appropriately.

The resultant Model 3.3 displayed good fit across all indices of approximate fit (RMSEA = 0.02, CFI = 0.96, TLI = 0.96). However, the chi-square value was statistically significant, indicating some degree of mis-fit. Residual correlations were inspected to examine whether this model mis-fit was trivial, and due to the large sample size, or indicated that the model should be revised in a theoretically meaningful way. The majority of residuals were <0.1, with only 15 out of 1056 >0.1. There was no systematic pattern of large residuals that would suggest a substantively meaningful or theoretically relevant problem with the model. Therefore, no further changes were made to the model.
Table 7-9: Model fit statistics for structural models tested at Step 3 (n = 4,961)

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Structural Model (Figure 7-5)</td>
<td>2636.87*</td>
<td>708</td>
<td>0.02</td>
<td>0.022</td>
<td>0.024</td>
<td>0.96</td>
</tr>
<tr>
<td>3.2</td>
<td>Model 3.1 with residual covariance added between Social Activity and Participation</td>
<td>2555.67*</td>
<td>707</td>
<td>0.02</td>
<td>0.022</td>
<td>0.024</td>
<td>0.96</td>
</tr>
<tr>
<td>3.3</td>
<td>Model 3.2 with non-significant parameters removed</td>
<td>2512.42*</td>
<td>740</td>
<td>0.02</td>
<td>0.021</td>
<td>0.023</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Legend: df = degrees of freedom, RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index

*p>0.05

Parameter estimates and indirect effects for Model 3.3 are displayed in Table 7-10, with the structure of the model displayed in Figure 7-6. The effects of covariates included in the model are displayed in Table A5.1, Appendix 5. Physical impairment mediated the effects of chronic conditions on participation, affective wellbeing, and QoL. This was consistent with hypotheses 1.2 to 1.4 (see Table 7-1, p. 245). Participation partially mediated effects of physical impairment on positive affect and QoL, consistent with hypotheses 1.8 and 1.9. Positive affect mediated effects of physical impairment and participation on QoL, supporting hypotheses 1.9 and 1.10 (evidence in relation to each hypothesis is summarised in Table 7-22, p. 283).

As shown in Table 7-10, the total effects of chronic disease on control/autonomy (T1), and self-realisation/pleasure (T2), were primarily composed of indirect effects via physical impairment (ID1, ID7) and physical impairment and positive affect (ID4, ID10). Together, these effects represented 88% of the total effect of chronic conditions on control/autonomy, and 85% of the total effect on self-realisation/pleasure. There were small but statistically significant indirect effects of physical impairment on control/autonomy via some indicators of participation (paid work and social activity), at the Bonferroni adjusted level of significance (p<0.002, ID8, ID9). The combined indirect effects via all indicators of participation were small when expressed as a proportion of the total effect of chronic disease on QoL (12% of the effect on control/autonomy and 15% of the effect on self-realisation/pleasure).
Table 7-10: Parameter estimates for direct effects, total effects and indirect effects in Model 3.3

<table>
<thead>
<tr>
<th>Direct effects</th>
<th>Est.</th>
<th>P</th>
<th>Std Est.</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 Chron→PhysImp</td>
<td>0.306</td>
<td>&lt;0.001</td>
<td>0.389</td>
</tr>
<tr>
<td>P2 Chron→Emp</td>
<td>-0.042</td>
<td>0.015</td>
<td>-0.062</td>
</tr>
<tr>
<td>P3 PhysImp→Emp</td>
<td>-0.213</td>
<td>&lt;0.001</td>
<td>-0.248</td>
</tr>
<tr>
<td>P4 PhysImp→SocAct</td>
<td>-0.126</td>
<td>&lt;0.001</td>
<td>-0.149</td>
</tr>
<tr>
<td>P5 PhysImp→Partic</td>
<td>-0.141</td>
<td>&lt;0.001</td>
<td>-0.139</td>
</tr>
<tr>
<td>P6 PhysImp→PA</td>
<td>-0.293</td>
<td>&lt;0.001</td>
<td>-0.326</td>
</tr>
<tr>
<td>P7 PhysImp→CA</td>
<td>-0.279</td>
<td>&lt;0.001</td>
<td>-0.248</td>
</tr>
<tr>
<td>P8 PhysImp→SP</td>
<td>-0.146</td>
<td>&lt;0.001</td>
<td>-0.109</td>
</tr>
<tr>
<td>P9 Emp→PA</td>
<td>0.072</td>
<td>0.006</td>
<td>0.069</td>
</tr>
<tr>
<td>P10 SocAct→PA</td>
<td>0.093</td>
<td>&lt;0.001</td>
<td>0.088</td>
</tr>
<tr>
<td>P11 Emp→CA</td>
<td>0.108</td>
<td>&lt;0.001</td>
<td>0.082</td>
</tr>
<tr>
<td>P12 SocAct→CA</td>
<td>0.187</td>
<td>&lt;0.001</td>
<td>0.140</td>
</tr>
<tr>
<td>P13 SocAct→SP</td>
<td>0.104</td>
<td>&lt;0.001</td>
<td>0.066</td>
</tr>
<tr>
<td>P14 Partic→SP</td>
<td>0.108</td>
<td>0.001</td>
<td>0.069</td>
</tr>
<tr>
<td>P15 PA→CA</td>
<td>0.555</td>
<td>&lt;0.001</td>
<td>0.442</td>
</tr>
<tr>
<td>P16 PA→SP</td>
<td>0.622</td>
<td>&lt;0.001</td>
<td>0.418</td>
</tr>
<tr>
<td>P17 CA WITH SP</td>
<td>0.824</td>
<td>&lt;0.001</td>
<td>0.824</td>
</tr>
</tbody>
</table>

**ID/T**

<table>
<thead>
<tr>
<th>Indirect Effects</th>
<th>ID/T</th>
<th>Est.</th>
<th>P</th>
<th>Std Est.</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1: Total Effect: Chron → SP</td>
<td>1.0</td>
<td>-0.115</td>
<td>&lt;0.001</td>
<td>-0.110</td>
</tr>
<tr>
<td>ID1 Chron→PhysImp→SP</td>
<td>0.39</td>
<td>-0.045</td>
<td>&lt;0.001</td>
<td>-0.042</td>
</tr>
<tr>
<td>ID2 Chron→PhysImp→SocAct→SP</td>
<td>0.03</td>
<td>-0.004</td>
<td>0.003</td>
<td>-0.004</td>
</tr>
<tr>
<td>ID3 Chron→PhysImp→ParticVol→SP</td>
<td>0.03</td>
<td>-0.004</td>
<td>0.003</td>
<td>-0.004</td>
</tr>
<tr>
<td>ID4 Chron→PhysImp→PA→SP</td>
<td>0.49</td>
<td>-0.056</td>
<td>&lt;0.001</td>
<td>-0.053</td>
</tr>
<tr>
<td>ID5 Chron→PhysImp→Emp→PA→SP</td>
<td>0.03</td>
<td>-0.003</td>
<td>0.008</td>
<td>-0.003</td>
</tr>
<tr>
<td>ID6 Chron→PhysImp→SocAct→PA→SP</td>
<td>0.02</td>
<td>-0.002</td>
<td>0.003</td>
<td>-0.002</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indirect Effects</th>
<th>ID/T</th>
<th>Est.</th>
<th>P</th>
<th>Std Est.</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2: Total Effect: Chron → CA</td>
<td>1.0</td>
<td>-0.160</td>
<td>&lt;0.001</td>
<td>-0.181</td>
</tr>
<tr>
<td>ID7 Chron→PhysImp→CA</td>
<td>0.54</td>
<td>-0.086</td>
<td>&lt;0.001</td>
<td>-0.097</td>
</tr>
<tr>
<td>ID8 Chron→PhysImp→Emp→CA</td>
<td>0.04</td>
<td>-0.007</td>
<td>0.001</td>
<td>-0.008</td>
</tr>
<tr>
<td>ID9 Chron→PhysImp→SocAct→CA</td>
<td>0.04</td>
<td>-0.007</td>
<td>&lt;0.001</td>
<td>-0.008</td>
</tr>
<tr>
<td>ID10 Chron→PhysImp→PA→CA</td>
<td>0.31</td>
<td>-0.050</td>
<td>&lt;0.001</td>
<td>-0.056</td>
</tr>
<tr>
<td>ID11 Chron→PhysImp→Emp→PA→CA</td>
<td>0.02</td>
<td>-0.003</td>
<td>0.008</td>
<td>-0.003</td>
</tr>
<tr>
<td>ID12 Chron→PhysImp→SocAct→PA→CA</td>
<td>0.01</td>
<td>-0.002</td>
<td>0.002</td>
<td>-0.002</td>
</tr>
</tbody>
</table>

Legend: Est. = Parameter estimate; Std. Est. = Standardised parameter estimate; Chron = Number of Chronic Diseases; PhysImp = Physical Impairment; Emp = Paid Work; SocAct = Social Activity; Partic = Community Participation; PA = Positive Affect; CA = control/autonomy; SP = self-realisation/pleasure; ID/T = Indirect effect as a proportion of the total effect
Notes

1. Measurement models not shown for ease of presentation and are displayed in Figure 7-4.
2. Only significant effects of covariates were included (see Table A5.1, Appendix 5).

Legend: Phys Imp = Physical Impairment, CA = Control/Autonomy, SP = Self-Realisation/Pleasure, PA = Positive Affect

Figure 7-6: Final structural model (Model 3.3) of the relationship between chronic disease and QoL, via physical impairment, participation and positive affect

A survey weight was added to Model 3.3 to adjust for survey non-response. This model fitted the data well and parameter estimates, including estimates for the total and indirect effects of chronic conditions on the two QoL domains, were almost identical.
The total effects of chronic conditions on both domains of QoL were small (standardised effect <0.2). This was consistent with the systematic review findings outlined in Chapter 2, which found inconsistent or weak effects of chronic disease on psychosocial domains of QoL. The total effect size of physical impairment on control/autonomy (-0.45), on the other hand, was moderate based on Cohen’s d criteria. The total effect of physical impairment on self-realisation/pleasure was smaller (0.28). Wald’s test of parameter constraints indicated that the direct effect of physical impairment on control/autonomy was significantly greater than its effect on self-realisation/pleasure (p < 0.001) (see Section 5.4.4 for a description of Wald's test). This was consistent with hypothesis 1.11.

The next step (Step 3a) was to test hypothesis 1.12 by adding a direct effect of control/autonomy on self-realisation/pleasure to Model 3.3. This was done in Model 3.4. Model fit did not change with the inclusion of this parameter (see Table 7-11). The effect of physical impairment on self-realisation was small and positive (ID1, Table 7-12) indicating that control/autonomy fully mediated the negative effect of physical impairment on self-realisation/pleasure (ID2). This was consistent with hypothesis 1.12. In fact, it appeared that at a given level of control/autonomy, further physical impairment was associated with improved self-realisation/pleasure.

In Model 3.5, the contrary hypothesis was tested: that self-realisation/pleasure mediated the effect of physical impairment on control/autonomy. Again, the model fit the data well (Table 7-11). While self-realisation/pleasure significantly mediated the effect of physical impairment on control/autonomy (ID6, Table 7-12) the mediation was only partial, with physical impairment retaining a significant direct effect on control/autonomy (ID5). On the other hand, self-realisation/pleasure fully mediated the effect of positive affect on control/autonomy (ID7, ID8).
Table 7-11: Model fit statistics for structural models tested at Step 3a (n = 4,961)

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.4</td>
<td>Model 3.3 with ca→sp</td>
<td>2533.97*</td>
<td>740</td>
<td>0.02</td>
<td>0.021</td>
<td>0.023</td>
<td>0.96</td>
</tr>
<tr>
<td>3.5</td>
<td>Model 3.3 with sp→ca</td>
<td>2551.72*</td>
<td>740</td>
<td>0.02</td>
<td>0.021</td>
<td>0.023</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Legend: df = degrees of freedom, RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, ca = control/autonomy, sp = self-realisation/pleasure

*p>0.05

Table 7-12: Parameter estimates for total, direct and indirect effects on CA and SP in Model 3.4 and Model 3.5, respectively

<table>
<thead>
<tr>
<th></th>
<th>Model 3.4</th>
<th></th>
<th>Model 3.5</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PhysImp→CA</td>
<td>-0.284</td>
<td>&lt;0.001</td>
<td>-0.224</td>
<td>-0.258</td>
</tr>
<tr>
<td>PhysImp→SP</td>
<td>0.177</td>
<td>0.001</td>
<td>0.096</td>
<td>-0.148</td>
</tr>
<tr>
<td>PA→CA</td>
<td>0.554</td>
<td>&lt;0.001</td>
<td>0.392</td>
<td>0.083</td>
</tr>
<tr>
<td>PA→SP</td>
<td>0.292</td>
<td>&lt;0.001</td>
<td>0.142</td>
<td>0.622</td>
</tr>
<tr>
<td>CA→SP</td>
<td>1.400</td>
<td>&lt;0.001</td>
<td>0.967</td>
<td></td>
</tr>
<tr>
<td>SP→CA</td>
<td></td>
<td></td>
<td></td>
<td>1.394</td>
</tr>
</tbody>
</table>

Total Effect: Chron→SP -0.200 <0.001 -0.138

Total Effect: Chron→CA -0.274 <0.001 -0.182

Indirect Effects

ID1: Chron→PhysImp→SP 0.054 0.001 0.037
ID2: Chron→PhysImp→CA→SP -0.122 <0.001 -0.084
ID3: Chron→PhysImp→PA→SP -0.027 <0.001 -0.018
ID4: Chron→PhysImp→PA→CA→SP -0.071 <0.001 -0.049
ID5: Chron→PhysImp→CA -0.079 <0.001 -0.052
ID6: Chron→PhysImp→SP→CA -0.063 <0.001 -0.042
ID7: Chron→PhysImp→PA→CA -0.007 0.147 -0.005
ID8: Chron→PhysImp→PA→SP→CA -0.078 <0.001 -0.051

Note: Only indirect effects via physical impairment and positive affect are displayed in the Table. Small indirect effects via participation variables are not shown.

Legend: Chron = Number of Chronic Diseases; PhysImp = Physical Impairment; PA = Positive Affect; CA = control/autonomy; SP = self-realisation/pleasure
7.5.1 Post-hoc exploration of the positive effect of physical impairment on self-realisation/pleasure

In Model 3.4, physical impairment had a positive direct effect on self-realisation/pleasure (see Table 7-12). This suggested that, at a specific level of control/autonomy and all other factors equal, greater physical impairment was associated with higher levels of self-realisation/pleasure. This direct effect is in the opposite direction to negative indirect effects via control/autonomy and positive affect. Opposite directions in direct and indirect effects are termed inconsistent mediation, which is acknowledged as a common effect in mediation analysis (542,571). The positive effect identified in Model 3.4 was small (standardised parameter estimate <0.1). Kline cautions against drawing conclusions from statistically significant associations identified in structural equation models that were not originally hypothesised (526). If there is no initial theoretical rationale or existing evidence for an association, it is more likely that it is generated by random sample-specific variation. In this analysis, a direct effect was included in the model to test for a negative effect, rather than a positive effect, and a positive effect was therefore not included in the original hypothesised model.

It was therefore decided to carry out further post-hoc exploration of the effect of physical impairment on self-realisation/pleasure. The first step was to identify multivariate outliers. This was done by fitting a regression model for the effect of physical impairment on self-realisation/pleasure, adjusting for control/autonomy and all the covariates included in Model 3.4. Bacon distances were calculated for each observation, using the bacon command in Stata 11.0 (572). Bacon distances are similar to Mahalanobis distances. They measure how different each specific participant is to the rest of the participants in the dataset, with regard to the specific combination of the variables that are included in the model. In other words, they indicate the extent to which each participant displays an unusual combination of characteristics.

Participants with the largest bacon distances had low self-realisation/pleasure scores and low physical impairment. Figure 7-7 displays self-realisation/pleasure scores by number of physical impairments. The majority of scores are at the upper end of the distribution. There were many participants with high levels of physical impairment and high scores on self-
realisation/pleasure, while the small number of participants with low scores on self-realisation/pleasure also had low levels of physical impairment. The overall relationship between physical impairment and self-realisation/pleasure was weak, and it is possible that this small number of participants with low impairment and low self-realisation/pleasure scores resulted in a small positive effect, particularly when control/autonomy was held constant.

![Figure 7-7: Self-realisation/pleasure summed score by number of physical impairments](image)

It was decided to also explore a theoretically meaningful reason for the positive effect of physical impairment on self-realisation/pleasure. As discussed in Section 4.3.2, religious belief can help people to attribute meaning to declining physical health. That could potentially explain why some individuals experience higher self-realisation/pleasure with higher physical impairment.

A multiple group model was estimated to test whether the positive effect of physical impairment was only significant for older adults with high religiosity. Model 3.4 was estimated simultaneously for two groups. Group 1 included participants who stated that religion was very important (high religiosity) (n = 2,183, 44%). Group 2 included participants for whom religion was somewhat or not important (low religiosity) (n = 2,768, 56%).
Among low religiosity participants, the effect of physical impairment on self-realisation was not significant, consistent with the hypothesis that control/autonomy mediates the effect of physical impairment on self-realisation/pleasure (unstandardised effect = 0.04, p=0.558). However, among high religiosity participants, the direct effect of physical impairment on self-realisation was significantly positive (unstandardised effect = 0.398, p <0.001). This difference was statistically significant (p<0.01), based on Wald’s test of parameter constraints (see Section 5.4.4 for a description of this test). This confirmed that greater physical impairment was only associated with a greater sense of meaning and enjoyment in life among religious participants. The role of religiosity in modifying effects of physical impairment on self-realisation/pleasure will be examined in more detail in Chapter 8.

### 7.6 Age and Sex Stratified Models

The effects of chronic conditions and disability on QoL may vary across age and sex. In particular, the role of *participation* may vary by stage of life (pre/post retirement age) and across men and women. For this reason, the hypothetical structural model was tested across four groups defined by age (under and over 65) and sex. Initially, the measurement model (Model 2.7) was tested to check if it fitted the data well in each of the groups. Fit was good across groups defined by age and sex and comparable to the fit in the total sample (see Table 7-13).

**Table 7-13: Model fit statistics for Model 2.7 across age and sex groups**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>Df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.7 FU</td>
<td>Women aged &lt;65 (n = 1,755)</td>
<td>763.98*</td>
<td>393</td>
<td>0.02</td>
<td>0.021</td>
<td>0.026</td>
<td>0.98</td>
</tr>
<tr>
<td>2.7 MU</td>
<td>Men aged &lt;65 (n = 1,394)</td>
<td>659.65*</td>
<td>393</td>
<td>0.02</td>
<td>0.019</td>
<td>0.025</td>
<td>0.98</td>
</tr>
<tr>
<td>2.7 FO</td>
<td>Women aged &gt;=65 (n = 923)</td>
<td>609.53*</td>
<td>393</td>
<td>0.02</td>
<td>0.021</td>
<td>0.028</td>
<td>0.97</td>
</tr>
<tr>
<td>2.7 MO</td>
<td>Men aged &gt;=65 (n = 889)</td>
<td>593.68*</td>
<td>393</td>
<td>0.02</td>
<td>0.020</td>
<td>0.028</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Legend: RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, FU = Women aged <65, MU = Men aged <65, FO = Women aged >=65, MO = Men aged >= 65
Next, the structural model 3.2 was tested in each of the groups. The model tested included all of the hypothesised structural relationships, as it was reasoned that the structure might vary across the groups. This model fitted the data reasonably well across all age/sex groups (RMSEA <0.045, TLI >0.94, CFI >0.95). The next step was to remove non-significant parameters, one at a time, following the same procedures as for the model in the overall sample. Fit statistics for the resultant models are displayed in Table 7-14. Model fit was good for women of all ages and men aged <65 (RMSEA = 0.02, CFI = 0.94, TLI = 0.94), and reasonable for men aged 65+ (RMSEA = 0.02, CFI = 0.94, TLI = 0.94).

### Table 7-14: Model fit statistics for Model 3.3 across age and sex groups

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3 FU</td>
<td>Women aged &lt;65 (n = 1,755)</td>
<td>1168.88*</td>
<td>686</td>
<td>0.02</td>
<td>0.018</td>
<td>0.022</td>
<td>0.98</td>
</tr>
<tr>
<td>3.3 MU</td>
<td>Men aged &lt;65 (n = 1,394)</td>
<td>977.18*</td>
<td>625</td>
<td>0.02</td>
<td>0.018</td>
<td>0.023</td>
<td>0.97</td>
</tr>
<tr>
<td>3.3 FO</td>
<td>Women aged &gt;=65 (n = 923)</td>
<td>987.53*</td>
<td>689</td>
<td>0.02</td>
<td>0.019</td>
<td>0.025</td>
<td>0.95</td>
</tr>
<tr>
<td>3.3 FO</td>
<td>Men aged &gt;=65 (n = 889)</td>
<td>937.87*</td>
<td>657</td>
<td>0.02</td>
<td>0.019</td>
<td>0.025</td>
<td>0.94</td>
</tr>
</tbody>
</table>

Legend: RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, FU = Women aged <65, MU = Men aged <65, FO = Women aged >=65, MO = Men aged >= 65

The indirect effects identified in each stratified model are displayed in Table 7-15. Statistically significant indirect effects were similar to the model with the total sample (Model 3.3). The total effect of chronic disease on control/autonomy and self-realisation/pleasure was primarily composed of a pathway via physical impairment and positive affect. Not all of the indirect effects reached statistical significance at the Bonferroni adjusted level (p<0.002). In general, the size of the indirect effects was not significantly different across the four groups. The exception was the indirect negative effect of chronic conditions on self-realisation/pleasure (ID1), which was significantly larger in women aged <65, relative to women aged 65+.

There were some differences in direct effects of participation on QoL. Community participation only had a significant positive effect on QoL in women aged 65+. The size of
this positive effect was significantly larger relative to women aged <65, but only for control/autonomy. Paid work only had a significant effect on positive affect and QoL among women aged <65. Social activity had a positive effect on at least one QoL dimension in all groups, except for men aged 65+. However, differences in effects of paid work and social activity across groups were not statistically significant.

Table 7-15: Unstandardised parameter estimates for total and indirect effects in Model 3.3 across age and sex groups

<table>
<thead>
<tr>
<th></th>
<th>Women &lt;65</th>
<th>Men &lt;65</th>
<th>Women &gt;=65</th>
<th>Men &gt;= 65</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T1: Total Effect: Chron → SP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indirect Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID1: Chron→PhysImp→SP</td>
<td>-0.08</td>
<td>-0.04</td>
<td></td>
<td>-0.05</td>
</tr>
<tr>
<td>ID2: Chron→PhysImp→SocAct→SP</td>
<td>-0.01</td>
<td>-0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID3:Chron→PhysImp→ParticVol→SP</td>
<td>-0.01</td>
<td>-0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID4: Chron→PhysImp→PA→SP</td>
<td>-0.06</td>
<td>-0.06</td>
<td>-0.08</td>
<td>-0.04</td>
</tr>
<tr>
<td>ID5: Chron→PhysImp→Emp→PA→SP</td>
<td>-0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID6: Chron→PhysImp→SocAct→PA→SP</td>
<td>-0.004</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>T2: Total Effect: Chron → CA</strong></td>
<td>-0.18</td>
<td>-0.13</td>
<td>-0.22</td>
<td>-0.13</td>
</tr>
<tr>
<td>Indirect Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID7: Chron→PhysImp→CA</td>
<td>-0.09</td>
<td>-0.06</td>
<td>-0.12</td>
<td>-0.09</td>
</tr>
<tr>
<td>ID8: Chron→PhysImp→ParticVol→CA</td>
<td>-0.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID9: Chron→PhysImp→Emp→CA</td>
<td>-0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID10: Chron→PhysImp→SocAct→CA</td>
<td>-0.01</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID11: Chron→PhysImp→PA→CA</td>
<td>-0.06</td>
<td>-0.05</td>
<td>-0.07</td>
<td>-0.04</td>
</tr>
<tr>
<td>ID12: Chron→PhysImp→Emp→PA→CA</td>
<td>-0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID13: Chron→PhysImp→SocAct→PA→CA</td>
<td>-0.003</td>
<td></td>
<td></td>
<td>-0.01</td>
</tr>
</tbody>
</table>

Bold < 0.001, Italics, <0.01, Normal Type <0.05. Only indirect effects with a p-value <0.05 are included in the table.

Legend: Chron = Number of Chronic Diseases; PhysImp = Physical Impairment; Emp = Paid Work; SocAct = Social Activity; ParticVol = Community Participation; PA = Positive Affect; CA = control/autonomy; SP = self-realisation/pleasure
7.7 Adjustment for low income

Medical card status, a proxy measure of low income in the under 70s (see Section 5.2.5.4, p. 190), was added as a covariate to the models estimated for participants aged <65. Having a medical card was associated with significantly increased physical impairment in men (unstandardised effect = 0.63, p<0.01) and women (0.40, p<0.01). It also had a significant negative effect on control/autonomy in both men (-0.43, p<0.01) and women (-0.30, p=0.01). Effects on self-realisation/pleasure were significant for men (-0.37, p<0.01) but not women (-0.15, p = 0.07).

Table 7-16 compares indirect effects for Model 3.3 among women and men aged <65 (Model 3.3 FU and 3.3 MU) when medical card status is included as a covariate, and when it is not. Its inclusion as a covariate slightly attenuated total and indirect effects of chronic conditions on QoL, with greater attenuation for men than women. For example, the indirect effect of chronic disease on control/autonomy, via physical impairment and positive affect, was reduced from -0.13 to -0.09 for men. However, total and indirect effects were still statistically significant. This supported the contention that low income did not confound the effect of chronic disease and physical impairment on QoL.
Table 7-16: Unstandardised parameter estimates for total and indirect effects in Model 3.3 across age and sex groups, adjusted and unadjusted for low income

<table>
<thead>
<tr>
<th></th>
<th>Women &lt;65</th>
<th>Women &lt;65</th>
<th>Men &lt;65</th>
<th>Men &lt;65</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T1: Total Effect: Chron → SP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unadj. for low income</td>
<td>Adj. for low income</td>
<td>Unadj. for low income</td>
<td>Adj. for low income</td>
</tr>
<tr>
<td>Indirect Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID1: Chron→PhysImp→SP</td>
<td>-0.08</td>
<td>-0.08</td>
<td>-0.04</td>
<td>-0.03</td>
</tr>
<tr>
<td>ID2: Chron→PhysImp→SocAct→SP</td>
<td>-0.06</td>
<td>-0.06</td>
<td>-0.06</td>
<td>-0.05</td>
</tr>
<tr>
<td>ID3: Chron→PhysImp→ParticVol→SP</td>
<td>-0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID4: Chron→PhysImp→PA→SP</td>
<td>-0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID5: Chron→PhysImp→Emp→PA→SP</td>
<td>-0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID6: Chron→PhysImp→SocAct→PA→SP</td>
<td>-0.004</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>T2: Total Effect: Chron → CA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unadj. for low income</td>
<td>Adj. for low income</td>
<td>Unadj. for low income</td>
<td>Adj. for low income</td>
</tr>
<tr>
<td>Indirect Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID7: Chron→PhysImp→CA</td>
<td>-0.09</td>
<td>-0.08</td>
<td>-0.06</td>
<td>-0.05</td>
</tr>
<tr>
<td>ID8: Chron→PhysImp→ParticVol→CA</td>
<td>-0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID9: Chron→PhysImp→Emp→CA</td>
<td></td>
<td>-0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID10: Chron→PhysImp→SocAct→CA</td>
<td>-0.01</td>
<td>-0.01</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>ID11: Chron→PhysImp→PA→CA</td>
<td>-0.06</td>
<td>-0.06</td>
<td>-0.05</td>
<td>-0.04</td>
</tr>
<tr>
<td>ID12: Chron→PhysImp→Emp→PA→CA</td>
<td>-0.01</td>
<td>-0.004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID13: Chron→PhysImp→SocAct→PA→CA</td>
<td>-0.003</td>
<td>-0.003</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Bold < 0.001, Italics, <0.01, Normal Type <0.05. Only indirect effects with a p-value <0.05 are included in the table.**

**Legend:** Chron = Number of Chronic Diseases; PhysImp = Physical Impairment; Emp = Paid Work; SocAct = Social Activity; ParticVol = Community Participation; PA = Positive Affect; CA = control/autonomy; SP = self-realisation/pleasure; Adj for = Adjusted for; Unadj. for = Unadjusted for
7.8 Sensitivity Analysis

This section describes the results of two sensitivity analyses. The definition of chronic disease used in this chapter was inclusive, covering a wide range of chronic conditions of differing levels of severity. A stricter definition was used as part of a sensitivity analysis, the results of which are outlined in Section 7.8.1. In addition, an alternative measure of affective wellbeing was used, based on negative affect. The results of this analysis are outlined in Section 7.8.2. These analyses ensured that the overall findings were not specific to the particular definitions used for chronic disease and affective wellbeing.

7.8.1 Functionally Limiting Conditions

The definition of chronic disease used in the analysis reported thus far in this chapter was broad and inclusive, including potentially asymptomatic conditions such as hypertension and high cholesterol, along with more significant conditions such as stroke or heart attack. To test the sensitivity of the findings to this definition, the structural model was re-tested using a more restrictive definition of chronic conditions (as per the analysis plan outlined in Section 5.4.5, p. 213). Only those conditions which are usually associated with some functional limitation were examined, based on the definition used in the Functional Comorbidity Index (FCI) (496). This meant that high cholesterol, hypertension, heart arrhythmia, heart murmur and varicose ulcer were excluded. Just over half of participants (52.6%) had a condition included in the FCI, compared with 78% who had any chronic condition (see Table 7-17).

<table>
<thead>
<tr>
<th>Number of Conditions</th>
<th>All Chronic Conditions</th>
<th>Functionally Limiting Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>0</td>
<td>1,093</td>
<td>22.0</td>
</tr>
<tr>
<td>1</td>
<td>1,387</td>
<td>28.0</td>
</tr>
<tr>
<td>2</td>
<td>1,132</td>
<td>22.8</td>
</tr>
<tr>
<td>3+</td>
<td>1,349</td>
<td>27.1</td>
</tr>
</tbody>
</table>
The structural model (Model 3.2 FCI, Table 7-18) had comparable fit to the model with the broader definition of chronic conditions (Model 3.2, Table 7-9), as did the model with non-significant parameters excluded (Model 3.3 FCI). The parameter estimates for Model 3.3 FCI are displayed in Table 7-19. Similar to Model 3.3 (see Table 7-10), the effect of chronic disease on both QoL dimensions was primarily composed of indirect effects via physical impairment and affective wellbeing (ID1, ID4, ID7, ID10). Direct effects were also similar to parameter estimates in Model 3.3, except that the effect of number of chronic conditions on physical impairment was larger. The standardised effect was 0.40, compared with 0.31 in Model 3.3. The total effect of chronic conditions on QoL was also larger, but was still small (standardised effect -0.18 for control/autonomy, compared with -0.11 in Model 3.3).

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2 FCI</td>
<td>Structural Model (Figure 7-5)</td>
<td>2563.61*</td>
<td>707</td>
<td>0.02</td>
<td>0.022</td>
<td>0.024</td>
<td>0.96</td>
</tr>
<tr>
<td>3.3 FCI</td>
<td>Model 3.2 FCI, Non-significant parameters removed</td>
<td>2491.52*</td>
<td>742</td>
<td>0.02</td>
<td>0.021</td>
<td>0.023</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Legend: RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, FCI = Functional Comorbidity Index

*p<0.05
Table 7.19: Parameter estimates for direct effects, total effects and indirect effects in Model 3.3

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Est.</th>
<th>P</th>
<th>Standardised Est.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chron→PhysImp</td>
<td>0.468</td>
<td>&lt;0.001</td>
<td>0.400</td>
</tr>
<tr>
<td>PhysImp→Emp</td>
<td>-0.228</td>
<td>&lt;0.001</td>
<td>-0.256</td>
</tr>
<tr>
<td>PhysImp→SocAct</td>
<td>-0.134</td>
<td>&lt;0.001</td>
<td>-0.151</td>
</tr>
<tr>
<td>PhysImp→Partic</td>
<td>-0.146</td>
<td>&lt;0.001</td>
<td>-0.139</td>
</tr>
<tr>
<td>PhysImp→PA</td>
<td>-0.294</td>
<td>&lt;0.001</td>
<td>-0.314</td>
</tr>
<tr>
<td>PhysImp→CA</td>
<td>-0.281</td>
<td>&lt;0.001</td>
<td>-0.242</td>
</tr>
<tr>
<td>PhysImp→SP</td>
<td>-0.149</td>
<td>&lt;0.001</td>
<td>-0.109</td>
</tr>
<tr>
<td>Emp→PA</td>
<td>0.070</td>
<td>0.008</td>
<td>0.067</td>
</tr>
<tr>
<td>SocAct→PA</td>
<td>0.093</td>
<td>0.001</td>
<td>0.087</td>
</tr>
<tr>
<td>Emp→CA</td>
<td>0.101</td>
<td>0.031</td>
<td>0.077</td>
</tr>
<tr>
<td>SocAct→CA</td>
<td>0.189</td>
<td>&lt;0.001</td>
<td>0.144</td>
</tr>
<tr>
<td>SocAct→SP</td>
<td>0.104</td>
<td>&lt;0.001</td>
<td>0.067</td>
</tr>
<tr>
<td>Partic→SP</td>
<td>0.090</td>
<td>0.001</td>
<td>0.069</td>
</tr>
<tr>
<td>PA→CA</td>
<td>0.553</td>
<td>&lt;0.001</td>
<td>0.445</td>
</tr>
<tr>
<td>PA→SP</td>
<td>0.621</td>
<td>&lt;0.001</td>
<td>0.425</td>
</tr>
<tr>
<td>CA WITH SP</td>
<td>0.825</td>
<td>&lt;0.001</td>
<td>0.824</td>
</tr>
</tbody>
</table>

**T2: Total Effect: Chron → CA**

| ID1: Chron→PhysImp→CA | -0.132 | <0.001 | -0.097 |
| ID2: Chron→PhysImp→Emp→CA | -0.011 | 0.002 | -0.008 |
| ID3: Chron→PhysImp→SocAct→CA | -0.012 | <0.001 | -0.009 |
| ID4: Chron→PhysImp→PA→CA | -0.076 | <0.001 | -0.056 |
| ID5: Chron→PhysImp→Emp→PA→CA | -0.004 | 0.009 | -0.003 |
| ID6: Chron→PhysImp→SocAct→PA→CA | -0.003 | 0.002 | -0.002 |

**T1: Total Effect: Chron → SP**

| ID7: Chron→PhysImp→SP | -0.070 | <0.001 | -0.044 |
| ID8: Chron→PhysImp→SocAct→SP | -0.007 | 0.003 | -0.004 |
| ID9: Chron→PhysImp→ParticVol→SP | -0.006 | 0.003 | -0.004 |
| ID10: Chron→PhysImp→PA→SP | -0.085 | <0.001 | -0.053 |
| ID11: Chron→PhysImp→Emp→PA→SP | -0.005 | 0.010 | -0.003 |
| ID12: Chron→PhysImp→SocAct→PA→SP | -0.004 | 0.002 | -0.002 |

Legend: Est. = Parameter estimate; Std. Est. = Standardised parameter estimate; Chron = Number of Chronic Diseases; PhysImp = Physical Impairment; Emp = Paid Work; SocAct = Social Activity; Partic = Community Participation; PA = Positive Affect; CA = control/autonomy; SP = self-realisation/pleasure
7.8.2 Negative Affect

In Steps 2 and 3, the positive affect dimension of the CES-D was used as a measure of affective wellbeing. As a sensitivity analysis, these steps were repeated using the negative affect dimension instead (see Section 5.2.4, p. 186 for a description of both measures). Overall fit statistics for the models tested at each step are displayed in Table 7-20.

First, a single-factor model for negative affect was tested. This model fitted the data reasonably well (Model 2.3 NA). The RMSEA was acceptable, the CFI and TLI were within the criteria for good fit, and all of the residuals covariances were <0.1. A latent factor for negative affect also fitted well in the overall measurement model (Model 2.7 NA). The structural model including negative effect fitted the data well (Model 3.2 NA). Non-significant parameters were excluded from Model 3.3 NA. The key parameter estimates for this final model are displayed in Table 7-21.

Parameter estimates were similar to the main structural Model 3.3 (see Table 7-10). The effect of chronic conditions on each dimension of QoL was still composed of two indirect effects: an effect via physical impairment (ID1; ID7), and an effect via physical impairment and affective wellbeing (ID5; ID11). The standardised effect of negative affect on control/autonomy (-0.52) was slightly larger than the effect of positive affect in Model 3.3 (0.44). Effects on self-realisation/pleasure were similar for negative affect (-0.43) and positive affect (0.42).

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3 NA</td>
<td>Latent factor for negative affect (NA)</td>
<td>274.39*</td>
<td>14</td>
<td>0.06</td>
<td>0.055</td>
<td>0.068</td>
<td>0.98</td>
</tr>
<tr>
<td>2.7 NA</td>
<td>Four latent factors: NA, PhysImp, CA and SP</td>
<td>2235.82*</td>
<td>483</td>
<td>0.027</td>
<td>0.026</td>
<td>0.028</td>
<td>0.97</td>
</tr>
<tr>
<td>3.2 NA</td>
<td>Model 3.2 with negative affect</td>
<td>3267.48*</td>
<td>833</td>
<td>0.024</td>
<td>0.023</td>
<td>0.025</td>
<td>0.96</td>
</tr>
<tr>
<td>3.3 NA</td>
<td>Model 3.2, Non-significant parameters removed</td>
<td>3170.29*</td>
<td>865</td>
<td>0.022</td>
<td>0.022</td>
<td>0.024</td>
<td>0.96</td>
</tr>
</tbody>
</table>

RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index; CA = control/autonomy; SP = self-realisation/pleasure; PhysImp = Physical Impairment; NA = Negative Affect; *p>0.05
Table 7-21: Parameter estimates for direct effects, total effects and indirect effects in Model 3.3

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Est.</th>
<th>P</th>
<th>Standardised Est.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chron→PhysImp</td>
<td>0.315</td>
<td>&lt;0.001</td>
<td>0.395</td>
</tr>
<tr>
<td>Chron→Emp</td>
<td>-0.059</td>
<td>0.001</td>
<td>-0.086</td>
</tr>
<tr>
<td>PhysImp→Emp</td>
<td>-0.202</td>
<td>&lt;0.001</td>
<td>-0.238</td>
</tr>
<tr>
<td>PhysImp→SocAct</td>
<td>-0.138</td>
<td>&lt;0.001</td>
<td>-0.166</td>
</tr>
<tr>
<td>PhysImp→Partic</td>
<td>-0.142</td>
<td>&lt;0.001</td>
<td>-0.143</td>
</tr>
<tr>
<td>PhysImp→NA</td>
<td>0.351</td>
<td>&lt;0.001</td>
<td>0.375</td>
</tr>
<tr>
<td>PhysImp→CA</td>
<td>-0.232</td>
<td>&lt;0.001</td>
<td>-0.204</td>
</tr>
<tr>
<td>PhysImp→SP</td>
<td>-0.102</td>
<td>&lt;0.001</td>
<td>-0.078</td>
</tr>
<tr>
<td>Emp→NA</td>
<td>-0.127</td>
<td>&lt;0.001</td>
<td>-0.116</td>
</tr>
<tr>
<td>Emp→CA</td>
<td>0.074</td>
<td>0.021</td>
<td>0.056</td>
</tr>
<tr>
<td>SocAct→CA</td>
<td>0.237</td>
<td>&lt;0.001</td>
<td>0.174</td>
</tr>
<tr>
<td>SocAct→SP</td>
<td>0.156</td>
<td>&lt;0.001</td>
<td>0.100</td>
</tr>
<tr>
<td>Partic→SP</td>
<td>0.086</td>
<td>0.001</td>
<td>0.066</td>
</tr>
<tr>
<td>NA→CA</td>
<td>-0.636</td>
<td>&lt;0.001</td>
<td>-0.523</td>
</tr>
<tr>
<td>NA→SP</td>
<td>-0.604</td>
<td>&lt;0.001</td>
<td>-0.433</td>
</tr>
<tr>
<td>CA WITH SP</td>
<td>0.808</td>
<td>&lt;0.001</td>
<td>0.812</td>
</tr>
</tbody>
</table>

**T1: Total Effect: Chron → CA**

-0.173 <0.001 -0.181

**Indirect Effects**

| ID1: Chron→PhysImp→CA                     | -0.073| <0.001 | -0.081            |
| ID2: Chron→PhysImp→Emp→CA                | -0.005| 0.014  | -0.005            |
| ID3: Chron→PhysImp→SocAct→CA              | -0.010| <0.001 | -0.011            |
| ID5: Chron→Emp→NA→CA                     | -0.005| 0.014  | -0.005            |
| ID6: Chron→PhysImp→Emp→NA→CA             | -0.005| 0.008  | -0.006            |

**T2: Total Effect: Chron → SP**

-0.119 <0.001 -0.114

**Indirect Effects**

| ID7: Chron→PhysImp→SP                     | -0.032| <0.001 | -0.031            |
| ID8: Chron→PhysImp→SocAct→SP              | -0.007| <0.001 | -0.007            |
| ID9: Chron→PhysImp→ParticVol→SP           | -0.004| 0.005  | -0.004            |
| ID10: Chron→Emp→NA→SP                    | -0.005| 0.010  | -0.004            |
| ID11: Chron→PhysImp→NA→SP                 | -0.067| <0.001 | -0.064            |
| ID12: Chron→PhysImp→Emp→NA→SP            | -0.005| <0.001 | -0.005            |

Legend: Est. = Parameter estimate; Std. Est. = Standardised parameter estimate; Chron = Number of Chronic Diseases; PhysImp = Physical Impairment; Emp = Paid Work; SocAct = Social Activity; Partic = Community Participation; PA = Positive Affect; CA = control/autonomy; SP = self-realisation/pleasure
7.9 Summary of Findings

Chronic conditions affected QoL primarily via increased deficits in *body function* and *activity*, which were combined into an overall physical impairment factor. Reduced positive affect partially mediated the effect of physical impairment on QoL. *Participation* restrictions also mediated the effects of physical impairment on positive affect and QoL, but the size of these effects was small. Control/autonomy was more negatively affected by physical impairment than self-realisation/pleasure. In addition, control/autonomy mediated the effect of physical impairment on self-realisation/pleasure.

Findings in relation to each specific hypothesis are displayed in Table 7-22. In general, the hypotheses were supported, except that it was not possible to estimate separate effects of *body function* and *activity*. In addition, the mediating role of *participation* varied depending on the specific indicator of *participation*. Paid work and social leisure activity mediated effects of physical impairment on control/autonomy and positive affect, while community participation mediated effects on self-realisation/pleasure.

The next phase of analysis will examine each of the key effects along the pathway longitudinally. The effects of incident conditions on change in physical impairment and change in each dimension of QoL will be examined. In addition, effects of change in physical impairment on change in positive affect and change in QoL will be examined. The indirect effect via *participation* restrictions only accounted for a small proportion of the total effect of chronic conditions on QoL, and *participation* restrictions were therefore not examined any further.

The next chapter will also explore personal and environmental factors that modify or moderate effects along the pathway between chronic conditions and QoL. The analysis reported in this chapter included some initial exploration of cross-sectional effect modification, by examining how effects varied across age and sex, and by religiosity. Analysis Phase 3 will involve a more comprehensive evaluation of moderating effects, focussing on how longitudinal effects varied according to personal characteristics (e.g., personality) and environmental factors (e.g., social support).
<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 <em>Body function</em> mediates the effect of chronic conditions on <em>activity</em></td>
<td><strong>Not supported.</strong> <em>Body function</em> and <em>activity</em> were too closely related to examine separately. These domains were combined as physical impairment for remainder of analysis.</td>
</tr>
<tr>
<td>1.2 <em>Body function</em> and <em>activity</em> mediate the effect of chronic conditions on <em>participation</em></td>
<td><strong>Supported.</strong> Physical impairment fully mediated the effects of chronic conditions on social leisure activity and community participation, and partially mediated effects on paid work.</td>
</tr>
<tr>
<td>1.3 <em>Body function, activity</em> and <em>participation</em> mediate the effect of chronic conditions on affective wellbeing.</td>
<td><strong>Supported.</strong> Physical impairment fully mediated the effect of chronic conditions on positive affect. Paid work partially mediated effects of chronic conditions on positive affect.</td>
</tr>
<tr>
<td>1.4 <em>Body function, activity, participation</em> and affective wellbeing mediate the effect of chronic conditions on QoL</td>
<td><strong>Supported.</strong> Physical impairment, <em>participation</em> and positive affect fully mediated the effect of chronic conditions on both QoL dimensions, though effects via <em>participation</em> were small.</td>
</tr>
<tr>
<td>1.5 <em>Activity</em> mediates the effect of <em>body function</em> on <em>participation</em></td>
<td><strong>Not supported.</strong> <em>Body function</em> and <em>activity</em> were too closely related to examine separately.</td>
</tr>
<tr>
<td>1.6 <em>Activity</em> and <em>participation</em> mediate the effect of <em>body function</em> on affective wellbeing</td>
<td><strong>Partially supported.</strong> Paid work and social leisure activity partially mediated the effect of physical impairment on positive affect. <em>Body function</em> and <em>activity</em> were too closely related to examine separately.</td>
</tr>
<tr>
<td>1.7 <em>Activity, participation</em> and affective wellbeing mediate the effect of <em>body function</em> on QoL</td>
<td><strong>Partially supported.</strong> <em>Participation</em> and positive affect mediated the effect of physical impairment on QoL. <em>Body function</em> and <em>activity</em> were too closely related to examine separately.</td>
</tr>
<tr>
<td>1.8 <em>Participation</em> mediates the effect of <em>activity</em> on affective wellbeing</td>
<td><strong>Supported.</strong> Paid work and leisure activity partially mediated the effect of physical impairment on positive affect.</td>
</tr>
<tr>
<td>1.9 <em>Participation</em> and affective wellbeing mediate the effect of <em>activity</em> on QoL</td>
<td><strong>Supported.</strong> <em>Participation</em> and positive affect partially mediated the effect of physical impairment on both dimensions of QoL.</td>
</tr>
</tbody>
</table>
1.10 Affective wellbeing mediates the effect of participation on QoL

**Supported.** Positive affect partially mediated the effects of participation variables on QoL.

1.11 Chronic conditions, body function and activity have a stronger effect on control/autonomy relative to self-realisation/pleasure

**Supported.** The negative effects of physical impairment on control/autonomy, and of chronic conditions via physical impairment, were significantly greater than effects on self-realisation/pleasure.

1.12 Chronic conditions, body function and activity affect self-realisation/pleasure indirectly via control/autonomy

**Supported.** The negative effect of physical impairment on self-realisation/pleasure was no longer significant once the indirect effect via control/autonomy was estimated. Conversely, physical impairment retained a negative effect on control/autonomy when an indirect effect via self-realisation/pleasure was included in the model.
Chapter 8  Results 3: Protective Effects along the Pathway between Chronic Disease and QoL

8.1 Introduction

This chapter presents the results of Analysis Phase 3. This involved examining longitudinal effects along the pathway between chronic conditions and QoL, and evaluating how these effects were modified by personal factors (age, sex, personality and religiosity) and environmental factors (social support, social participation and socio-economic position). The procedure for this analysis was described in Section 5.5 in Chapter 5. Based on the results of Analysis Phase 2 (reported in Chapter 7) four key effects were identified for examination, outlined below and displayed in Figure 8-1.

a. Effect of incident chronic conditions on change in physical impairment

b. Effect of change in physical impairment on change in positive affect

c. Effect of change in physical impairment on change in control/autonomy

d. Effect of change in physical impairment on change in self-realisation/pleasure

Figure 8-1: Cross-sectional pathway between chronic disease and QoL in W1 (Analysis Phase 2)
Specific hypotheses tested will be briefly outlined in Section 8.1.1. The initial hypotheses were refined on the basis of the cross-sectional analysis reported in Chapter 7. Data from TILDA participants at W1 and W2 were included in this analysis, and a profile of the included participants will follow in Section 8.2. Participants with complete data (n = 2,701) will be compared with those who had non-response on one or more study variables at either wave (n = 1,846). Descriptive statistics will also be presented for the key study variables. Following the analysis reported in Chapter 7, it was decided to exclude items 1 and 8 from the control/autonomy score, based on their close association with the physical impairment factor (see Section 7.4).

In the following three sections, predictors of change in the four key outcomes along the pathway will be examined: control/autonomy and self-realisation/pleasure (Section 8.3), physical impairment (Section 8.4) and positive affect (Section 8.5). For each outcome, effects of baseline and change in chronic conditions, physical impairment, employment status, marital status, lifestyle factors, religiosity, social support, social participation and SEP were examined. Effects of age, sex and education at W1 and personality at W2 on each outcome were also explored. As the primary outcome examined in this thesis is QoL, effects on control/autonomy and self-realisation/pleasure will be reported in detail, with a briefer summary presented for effects on physical impairment and positive affect.

Finally, Section 8.6 will present an analysis of interaction effects. This analysis will be used to evaluate the extent to which personal factors (age, sex, religiosity, personality) and environmental factors (social support, social participation and socioeconomic position (SEP)) interacted with or moderated effects along the pathway between chronic conditions and QoL. The focus will be on interactions with the four key effects displayed in Figure 8.1 (a, b, c and d).

### 8.1.1 Hypotheses

Hypotheses concerning longitudinal effects were based on the model displayed in Figure 8.1, and are outlined in Table 8.1. As each individual effect in the model was examined separately in the longitudinal analysis, it was decided to focus on the effects that were most relevant to the thesis topic. These were the effects of physical health (chronic
conditions and disability) on subjective outcomes (positive affect and QoL). Therefore, effects of positive affect on control/autonomy and self-realisation/pleasure, and of control/autonomy on self-realisation/pleasure, were not examined in this analysis.

Table 8-1: Hypothesised longitudinal effects

<table>
<thead>
<tr>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Incident chronic conditions are associated with decline in physical impairment</td>
</tr>
<tr>
<td>2.2 Declining physical impairment is associated with decline in affective wellbeing control/autonomy and self-realisation/pleasure</td>
</tr>
</tbody>
</table>

Hypotheses concerning moderating effects were based on resilience theory, as discussed in Section 4.3 in Chapter 4. This theory suggests that people draw on personal resources, such as personality traits and religious beliefs, and on environmental resources, such as socioeconomic resources, and emotional and instrumental support from others, to "buffer" or moderate effects of adversity on QoL (337–343). Eight potentially important moderating or protective effects along the pathway between chronic conditions and QoL were identified on the basis of existing theory and evidence (discussed in detail in Section 4.3).

Hypotheses concerning moderating effects of these eight factors (3.1-3.8) on four effects (a-d) were tested (see Table 8-2). The direction of effect (i.e. positive or negative) for each moderating factor was specified in advance, with the exception of age and sex. Existing evidence did not clearly indicate whether older or younger age, or male or female sex, was likely to be protective (see Section 4.3.5). Combining each protective factor and each effect resulted in a total of 32 hypotheses, ranging from 3.1a (higher extraversion reduces the effect of incident chronic conditions on physical impairment) to 3.8d (sex modifies the effect of increasing physical impairment on self-realisation/pleasure).
Table 8.2: Hypothesised moderation effects

<table>
<thead>
<tr>
<th>Hypothesised moderation effects</th>
<th>Effect on incident chronic conditions on physical impairment</th>
<th>Effect on increasing physical impairment on positive affect</th>
<th>Effect on increasing physical impairment on control/autonomy</th>
<th>Effect on increasing physical impairment on self-realisation/pleasure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher extraversion (3.1), lower neuroticism (3.2), higher SEP (3.3), good quality social support (3.4), more frequent social participation (3.5), and higher religiosity (3.6):</td>
<td>a: reduce</td>
<td>b: reduce</td>
<td>c: reduce</td>
<td>d: reduce</td>
</tr>
<tr>
<td>Age (3.7) and sex (3.8):</td>
<td>a: modify</td>
<td>b: modify</td>
<td>c: modify</td>
<td>d: modify</td>
</tr>
</tbody>
</table>

8.2 Sample Characteristics and Missing Data

This section presents a profile of the sample included in this phase of analysis, and also includes a description of missing data and excluded participants. Descriptive statistics will be presented for incident chronic conditions, change in physical impairment, and changes in QoL and affective wellbeing.

8.2.1 Missing Data Profile

There were 4,547 individuals who completed the health assessment (HA) at TILDA W1 and the self-completion questionnaire (SCQ) at both waves (see flow chart displayed in Figure 8-2). Attrition from the W1 sample used for the cross-sectional analysis was relatively low, at 7.4%. The main analysis presented in this chapter is based on participants who had complete data on all study variables. This included 2,701 participants, or 59.4% of the available sample.
Completed SCQ & HA W1
n = 5,376

Refused / unable to contact W2
n = 396 (7.4%)

Participated W2
n = 4,980

Did not complete SCQ W2
n = 433 (8.7%)

Completed SCQ W2
n = 4,547

Missing data
n = 1,846 (40.6%)

Complete data on all study variables
n = 2,701

Values imputed for missing CASP, personality or positive affect items
n = 713

Imputed dataset n = 3,414

Figure 8-1: Participant flow chart, Analysis Phase 3
A profile of missing data in the sample is displayed in Table 8-3. None of the individual variables were missing data for more than 6% of participants. However, the use of aggregated scores for multi-item scales, and the large number of study variables, resulted in a large proportion of participants with at least one variable missing (n = 1,846, 41%) (see Figure 8-2). Over a third of participants with missing data (n = 713, 38.6%) were missing fewer than 50% of items in each of four multi-item scales: control/autonomy, self-realisation/pleasure, positive affect and the two personality sub-scales. Among these 713 participants, missing item values were imputed using multiple imputations by chained equations, following the described in Section 5.5.5. The analysis of interaction effects was repeated using this imputed dataset, as a sensitivity analysis. The results of the imputation process will be described in Section 8.7.1.

There was also missing data on social support, social participation and importance of religion variables. These were categorical variables with some small cell sizes, particularly when transitions between waves were accounted for, for example, changes in having a supportive partner between waves. Imputing values for small cells would add considerable uncertainty into the imputed dataset. Cell size would be reduced further if interaction terms for these variables were imputed, which would be necessary to avoid biasing the interaction terms towards zero. Similarly, while there was some non-response for two physical impairment indicators, this variable was involved in a large number of interaction terms. Imputing values for this variable would have required imputing values for each of the interaction terms, including interactions with variables with multiple categories (e.g., supportive partner). Participants with missing data on physical impairment, religion, social support and social participation were therefore excluded from the imputed data analysis. This resulted in a total sample of 3,431 or 75% of the available sample, for the imputed analysis. Within this imputed sample, 713 participants (20.8%) had incomplete data.
### Table 8-3: Number and % of participants with missing data by study variable (n = 4,547)

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Neuroticism (12 items) (W2)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 item</td>
<td>208</td>
<td>4.6</td>
</tr>
<tr>
<td>2-6 items</td>
<td>180</td>
<td>4.0</td>
</tr>
<tr>
<td>&gt;6 or 50% of items</td>
<td>30</td>
<td>0.7</td>
</tr>
<tr>
<td><strong>Extraversion (12 items) (W2)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 item</td>
<td>296</td>
<td>6.5</td>
</tr>
<tr>
<td>2-6 items</td>
<td>82</td>
<td>1.8</td>
</tr>
<tr>
<td>&gt;6 or 50% of items</td>
<td>38</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Control/Autonomy (5 items) (W1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 items</td>
<td>289</td>
<td>6.4</td>
</tr>
<tr>
<td>&gt;2 or 50% of items</td>
<td>66</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Control/Autonomy (5 items) (W2)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 items</td>
<td>165</td>
<td>3.6</td>
</tr>
<tr>
<td>&gt;2 or 50% of items</td>
<td>93</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Self-Realisation/Pleasure (5 items) (W1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 items</td>
<td>165</td>
<td>3.6</td>
</tr>
<tr>
<td>&gt;2 or 50% of items</td>
<td>72</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Self-Realisation/Pleasure (5 items) (W2)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 items</td>
<td>107</td>
<td>2.4</td>
</tr>
<tr>
<td>&gt;2 or 50% of items</td>
<td>46</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Positive Affect (4 items) (W1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 items</td>
<td>85</td>
<td>1.9</td>
</tr>
<tr>
<td>&gt;2 or 50% of items</td>
<td>71</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Positive Affect (4 items) (W2)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 items</td>
<td>41</td>
<td>0.9</td>
</tr>
<tr>
<td>&gt;2 or 50% of items</td>
<td>2</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Importance of Religion (W1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>270</td>
<td>5.9</td>
</tr>
<tr>
<td><strong>Importance of Religion (W2)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>272</td>
<td>6.0</td>
</tr>
<tr>
<td><strong>Supportive Partner (W1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>128</td>
<td>2.8</td>
</tr>
<tr>
<td><strong>Supportive Partner (W2)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>84</td>
<td>1.9</td>
</tr>
<tr>
<td><strong>Supportive Friends (W1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>206</td>
<td>4.5</td>
</tr>
<tr>
<td><strong>Supportive Friends (W2)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>192</td>
<td>4.2</td>
</tr>
<tr>
<td><strong>Supportive Relatives (W1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>109</td>
<td>2.4</td>
</tr>
<tr>
<td><strong>Supportive Relatives (W2)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>126</td>
<td>2.8</td>
</tr>
<tr>
<td><strong>Community Participation (W1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>187</td>
<td>4.1</td>
</tr>
<tr>
<td><strong>Community Participation (W2)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>108</td>
<td>2.4</td>
</tr>
<tr>
<td><strong>Slow TUG (W1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Slow TUG (W2)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>81</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>Poor balance (W1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Poor balance (W2)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>0.1</td>
</tr>
</tbody>
</table>

*Note: This table includes only variables which had missing data. Participants in bold were included in imputed analysis (n = 3,414).*

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8.2.2 Sample Characteristics

The characteristics of participants with complete and missing data are compared in Table 8-4. The average age at W1 of the sample with complete data was 62, and almost 80% had at least secondary education. There were slightly more women (54.6%) than men (45.4%). A tenth of the sample were smokers at W2 (10.1%), while over a third was obese (34.4%). Four in ten participants were retired at W2 (42.2%), while a smaller proportion was in employment (36.7%). A tenth of the sample had retired between study waves (10.4%). A third of the sample reported an incident chronic condition between W1 and W2 (33.4%). Follow-up time ranged from one and a half to three years, with an average follow-up time of two years.

Participants with missing data were older, more likely to be smokers and less likely to be employed. The educational profile also differed, with excluded participants slightly less likely to have completed secondary or third level education. Excluded participants also had higher scores on neuroticism and lower scores on extraversion. While participants with missing data had more chronic conditions at baseline, there were no differences in incidence of chronic disease between W1 and W2.
Table 8-4: Sample characteristics for participants with complete and missing data

<table>
<thead>
<tr>
<th></th>
<th>Complete Data</th>
<th></th>
<th>Missing Data</th>
<th></th>
<th>Range</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n = 2,701</td>
<td></td>
<td>n = 1,846</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (yrs) (W1)</td>
<td>61.9</td>
<td>8.5</td>
<td>64.4</td>
<td>9.5</td>
<td>50-93</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>17.9</td>
<td>7.4</td>
<td>19.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.5</td>
<td>0-47</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Extraversion</td>
<td>28.6</td>
<td>5.6</td>
<td>27.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.7</td>
<td>0-48</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Chronic Diseases</td>
<td>1.7</td>
<td></td>
<td>1.9</td>
<td></td>
<td>0-10</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Average Follow-up (yrs)</td>
<td>2.0</td>
<td>0.23</td>
<td>2.0</td>
<td>0.23</td>
<td>1.5-3.0</td>
<td>0.164</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>562</td>
<td>20.8</td>
<td>504</td>
<td>27.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>1,143</td>
<td>42.3</td>
<td>745</td>
<td>40.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third Level</td>
<td>996</td>
<td>36.9</td>
<td>597</td>
<td>32.3</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Men</td>
<td>1,225</td>
<td>45.4</td>
<td>809</td>
<td>43.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>1,476</td>
<td>54.6</td>
<td>1037</td>
<td>56.2</td>
<td></td>
<td>0.309</td>
</tr>
<tr>
<td>Smoker W1</td>
<td>346</td>
<td>12.8</td>
<td>291</td>
<td>15.8</td>
<td></td>
<td>0.005</td>
</tr>
<tr>
<td>Smoker W2</td>
<td>274</td>
<td>10.1</td>
<td>238</td>
<td>12.9</td>
<td></td>
<td>0.004</td>
</tr>
<tr>
<td>Quit Smoking</td>
<td>72</td>
<td>2.7</td>
<td>53</td>
<td>2.9</td>
<td></td>
<td>0.015</td>
</tr>
<tr>
<td>Obese</td>
<td>930</td>
<td>34.4</td>
<td>595</td>
<td>32.2</td>
<td></td>
<td>0.204</td>
</tr>
<tr>
<td>Retired W1</td>
<td>980</td>
<td>36.3</td>
<td>704</td>
<td>38.1</td>
<td></td>
<td>0.212</td>
</tr>
<tr>
<td>Retired W2</td>
<td>1,141</td>
<td>42.2</td>
<td>829</td>
<td>44.9</td>
<td></td>
<td>0.07</td>
</tr>
<tr>
<td>Retired between W1 and W2</td>
<td>281</td>
<td>10.4</td>
<td>227</td>
<td>12.3</td>
<td></td>
<td>0.038</td>
</tr>
<tr>
<td>Employed W1</td>
<td>1,123</td>
<td>41.6</td>
<td>627</td>
<td>34.0</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Employed W2</td>
<td>991</td>
<td>36.7</td>
<td>538</td>
<td>29.1</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Home Duties W1</td>
<td>346</td>
<td>12.8</td>
<td>304</td>
<td>16.5</td>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td>Home Duties W2</td>
<td>380</td>
<td>14.1</td>
<td>302</td>
<td>16.4</td>
<td></td>
<td>0.037</td>
</tr>
<tr>
<td>Incident Condition</td>
<td>902</td>
<td>33.4</td>
<td>625</td>
<td>33.9</td>
<td></td>
<td>0.746</td>
</tr>
</tbody>
</table>

<sup>a</sup>Of the sample with missing data, 77% (n = 1,428) had complete data on items measuring neuroticism;  
<sup>b</sup>Of the sample with missing data, 77% (n =1,430) had complete data on items measuring extraversion
8.2.3 Incidence of Chronic Conditions

Just over a third of the sample reported an incident chronic disease diagnosis between W1 and W2 (see Table 8-5). Approximately 8% reported more than two or more incident diagnoses. Almost 13% of all participants had an incident diagnosis accompanied by an increase in overall physical impairment. This meant that fewer than half of the participants who reported an incident condition also had an increase in physical impairment. Participants with no conditions at baseline were most likely to report any incident condition, while those with multi-morbidity at baseline were most likely to report an incident condition with increased disability. These differences were not statistically significant. The effects of incident conditions on physical impairment will be considered in more detail in Section 8.4.

The most common incident condition was high cholesterol, followed by osteoporosis, arthritis and hypertension. Hypertension and high cholesterol were most common among those with no conditions at baseline, while arthritis was more common among those with already existing diagnoses. Incidence of hypertension, high cholesterol and osteoporosis diagnosis may have been influenced by participation in the W1 HA. This is because objective indicators of hypertension, high cholesterol and osteoporosis were assessed, and this information was provided to participants to follow up on, which may have led to a diagnosis from a doctor. The relationship between objective disease indicators at the W1 HA and incidence of specific diagnoses at W2 is explored briefly in Appendix 6.
Table 8-5: Incident chronic conditions by baseline chronic disease status

<table>
<thead>
<tr>
<th>Incident Condition Type</th>
<th>Baseline chronic disease status</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>All</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
<td>Single</td>
<td>Multimorbidity</td>
<td></td>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Any new chronic condition</td>
<td>219</td>
<td>36.9</td>
<td>252</td>
<td>32.6</td>
<td>431</td>
<td>32.3</td>
<td>902</td>
</tr>
<tr>
<td>1 new condition</td>
<td>169</td>
<td>28.5</td>
<td>191</td>
<td>24.7</td>
<td>325</td>
<td>24.3</td>
<td>685</td>
</tr>
<tr>
<td>2+ new conditions</td>
<td>50</td>
<td>8.4</td>
<td>61</td>
<td>7.9</td>
<td>106</td>
<td>7.9</td>
<td>217</td>
</tr>
<tr>
<td>New condition + increase in disability</td>
<td>65</td>
<td>11.0</td>
<td>95</td>
<td>12.3</td>
<td>185</td>
<td>13.8</td>
<td>345</td>
</tr>
<tr>
<td>New condition + increase in medication</td>
<td>113</td>
<td>19.1</td>
<td>157</td>
<td>20.3</td>
<td>262</td>
<td>19.6</td>
<td>532</td>
</tr>
<tr>
<td>New condition FCI&lt;sup&gt;a&lt;/sup&gt;</td>
<td>98</td>
<td>16.5</td>
<td>169</td>
<td>21.9</td>
<td>345</td>
<td>25.8</td>
<td>612</td>
</tr>
<tr>
<td>High Cholesterol</td>
<td>99</td>
<td>16.7</td>
<td>83</td>
<td>10.8</td>
<td>74</td>
<td>5.5</td>
<td>256</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>45</td>
<td>7.6</td>
<td>55</td>
<td>7.1</td>
<td>94</td>
<td>7.0</td>
<td>194</td>
</tr>
<tr>
<td>Arthritis</td>
<td>32</td>
<td>5.4</td>
<td>57</td>
<td>7.4</td>
<td>78</td>
<td>5.8</td>
<td>167</td>
</tr>
<tr>
<td>Hypertension</td>
<td>58</td>
<td>9.8</td>
<td>48</td>
<td>6.2</td>
<td>54</td>
<td>4.0</td>
<td>160</td>
</tr>
<tr>
<td>Total</td>
<td>593</td>
<td>100</td>
<td>772</td>
<td>100</td>
<td>1,336</td>
<td>100</td>
<td>2,701</td>
</tr>
</tbody>
</table>

Note: increase in disability defined as increase in physical impairment (total number of body function and activity deficits)

<sup>a</sup>Excludes conditions which are not included in the Functional Comorbidity Index (see Section 5.2.1).

8.2.4 Change in Physical Impairment

In Chapter 7, physical impairment was measured as a latent factor made up of dichotomous indicators of body function and activity. In the present analysis, the variable was measured as an overall count of the number of deficits in body function and activity, based on the same set of dichotomous indicators. The prevalence of each deficit at both waves is displayed in Table 8-6. Weak grip was excluded for W2 analysis, due to evidence of measurement bias. Participants, in general, performed better at this test in W2 than at W1. The mode of administration changed (instructed by nurses vs. instructed by field interviewers) between waves and this possibly influenced this bias.

The number of deficits ranged from 0 to 14 in both waves. As Figure 8-3 shows, the modal number of deficits in W2 was zero (n = 1,015, 37.6%). The change in number of deficits
ranged from -10 to +10 (Figure 8-4). Four out of 10 participants had no change in the number of impairments reported (n = 1,005; 37.2%). Three out of ten experienced a decrease in the number of impairments (30.8%), while a slightly higher proportion experienced an increase in physical impairment (32.0%).

Table 8-6: Prevalence of physical impairments, W1 and W2 (n = 2,701)

<table>
<thead>
<tr>
<th>Body Function</th>
<th>W1</th>
<th></th>
<th>W2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate or Severe Pain</td>
<td>629</td>
<td>23.3</td>
<td>592</td>
<td>21.9</td>
</tr>
<tr>
<td>Poor balance</td>
<td>653</td>
<td>24.2</td>
<td>765</td>
<td>28.3</td>
</tr>
<tr>
<td>Incontinent</td>
<td>331</td>
<td>12.3</td>
<td>395</td>
<td>14.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of mobility deficits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>483</td>
<td>17.9</td>
<td>482</td>
<td>17.8</td>
</tr>
<tr>
<td>2</td>
<td>264</td>
<td>9.8</td>
<td>268</td>
<td>9.9</td>
</tr>
<tr>
<td>3</td>
<td>156</td>
<td>5.8</td>
<td>172</td>
<td>6.4</td>
</tr>
<tr>
<td>4</td>
<td>89</td>
<td>3.3</td>
<td>95</td>
<td>3.5</td>
</tr>
<tr>
<td>&gt;=5</td>
<td>107</td>
<td>4.0</td>
<td>106</td>
<td>3.9</td>
</tr>
<tr>
<td>Any ADLs</td>
<td>166</td>
<td>6.1</td>
<td>85</td>
<td>3.1</td>
</tr>
<tr>
<td>Any IADLs</td>
<td>104</td>
<td>3.9</td>
<td>103</td>
<td>3.8</td>
</tr>
<tr>
<td>Slow Timed Up and Go</td>
<td>465</td>
<td>17.2</td>
<td>493</td>
<td>18.3</td>
</tr>
</tbody>
</table>

ADLs = Difficulties with basic activities of daily living; IADLs = Difficulties with instrumental activities of daily living
Figure 8-3: Distribution of number of physical impairments, W2 (n = 2,701)

Figure 8-4: Distribution of change in number of physical impairments, W2 (n = 2,701)
8.2.5 Change in QoL and Positive Affect

There was a statistically significant mean decrease in both dimensions of QoL between W1 and W2, displayed in Table 8-7. There was a statistically significant increase in positive affect between the two waves. In each case, the size of the change was small. For control/autonomy, the mean decrease was equivalent to 0.12 of a standard deviation (SD) (0.27/2.3 = 0.12). The equivalent effect size was 0.09 of an SD for both self-realisation/pleasure and positive affect. These are small effect sizes using criteria based on Cohen's d. A similar effect size was observed for the difference in the total CASP-19 score in previous research with W1 and W2 of ELSA (d = 0.07) (573).

Table 8-7: Mean change in QoL and positive affect between W1 and W2 (n=2,701)

<table>
<thead>
<tr>
<th></th>
<th>Control/Autonomy</th>
<th>Self-Realisation/ Pleasure</th>
<th>Positive Affect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>W1</td>
<td>16.1</td>
<td>2.5</td>
<td>18.3</td>
</tr>
<tr>
<td>W2</td>
<td>15.8</td>
<td>2.7</td>
<td>18.1</td>
</tr>
<tr>
<td>Mean Diff</td>
<td>-0.27</td>
<td>2.3</td>
<td>-0.18</td>
</tr>
<tr>
<td>95% CI</td>
<td>-0.36, -0.19</td>
<td>-0.33, -0.13</td>
<td>0.10, 0.29</td>
</tr>
<tr>
<td>Effect Size</td>
<td>0.12</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>Range</td>
<td>5-20</td>
<td>5-20</td>
<td>4-16</td>
</tr>
</tbody>
</table>

SD = standard deviation

8.3 Predictors of Change in QoL

This section reports the effects of study variables on changes in control/autonomy and self-realisation/pleasure between W1 and W2. Baseline levels and change in several factors were examined, including chronic disease status, physical impairment, socio-demographic characteristics, personality, social support, social participation, religion and SEP.
8.3.1 Baseline and Incident Chronic Conditions

Table 8-8 displays the effect of baseline and incident chronic conditions on change in control/autonomy between W1 and W2. Number of baseline chronic conditions and having any incident condition had a significant negative effect on change in control/autonomy, adjusted for age, sex and education. However, in the fully adjusted model, an incident chronic condition had a significant effect only if it was accompanied by increased physical impairment, or was among the conditions included in the Functional Comorbidity Index (FCI). This was consistent with the cross-sectional findings from W1, which indicated that chronic disease only has a negative effect on QoL via increased disability (see Chapter 6).

Table 8-8: Regression analysis of effects of baseline and incident chronic conditions on control/autonomy (n = 2,701)

<table>
<thead>
<tr>
<th></th>
<th>Control/Autonomy W2&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Control/Autonomy W2&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Number of chronic conditions (W1)</td>
<td>-0.07 0.03 0.01</td>
<td>-0.01 0.03 0.65</td>
</tr>
<tr>
<td>Any new chronic condition</td>
<td>902 -0.19 0.09 0.03</td>
<td>-0.14 0.08 0.07</td>
</tr>
<tr>
<td>New condition + increase in disability</td>
<td>345 -0.53 0.12 &lt;0.01</td>
<td>-0.37 0.11 &lt;0.01</td>
</tr>
<tr>
<td>New condition + increase in medications</td>
<td>532 -0.23 0.1 0.03</td>
<td>-0.16 0.09 0.08</td>
</tr>
<tr>
<td>Any new FCI condition&lt;sup&gt;c&lt;/sup&gt;</td>
<td>612 -0.26 0.10 0.01</td>
<td>-0.21 0.09 0.02</td>
</tr>
</tbody>
</table>

<sup>a</sup>Adjusted for control/autonomy (W1), age, age<sup>2</sup>, sex and education

<sup>b</sup>Adjusted for control/autonomy (W1), age, age<sup>2</sup>, sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)

<sup>c</sup>Excludes conditions which are not included in the Functional Comorbidity Index (see Section 5.2.1).
Table 8-9 displays the effects of baseline and incident chronic conditions on change in self-realisation/pleasure at W2. Having an incident chronic condition only had a significant negative effect on self-realisation/pleasure if it was accompanied by increased physical impairment (disability). This effect was no longer statistically significant in the fully adjusted model. This is consistent with the analysis in Chapter 7 which found that physical impairment had a stronger effect on control/autonomy relative to self-realisation/pleasure.

Table 8-9: Regression analysis of effects of baseline and incident conditions on self-realisation/pleasure (n = 2,701)

<table>
<thead>
<tr>
<th>Number of chronic conditions (W1)</th>
<th>N</th>
<th>Self-Realisation/Pleasure W2(^a)</th>
<th>Self-Realisation/Pleasure W2(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Any new chronic condition</td>
<td>902</td>
<td>-0.03</td>
<td>0.07</td>
</tr>
<tr>
<td>New condition + increase in disability</td>
<td>345</td>
<td>-0.26</td>
<td>0.10</td>
</tr>
<tr>
<td>New condition + increase in medications</td>
<td>532</td>
<td>0.03</td>
<td>0.09</td>
</tr>
<tr>
<td>Any new FCI condition(^c)</td>
<td>612</td>
<td>-0.03</td>
<td>0.08</td>
</tr>
</tbody>
</table>

\(^a\)Adjusted for self-realisation/pleasure (W1), age, sex and education

\(^b\)Adjusted for self-realisation/pleasure (W1), age, sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)

\(^c\)Excludes conditions which are not included in the Functional Comorbidity Index (see Section 5.2.1).

The effects of incident conditions on control/autonomy were explored further to examine differences in effects across baseline chronic disease status. Having any incident condition had the most negative effect on change in control/autonomy among those who had no conditions at baseline. Having an incident disabling condition, however, had the greatest negative effect among those who already had a single condition at baseline. This suggested that the transition to multi-morbidity may be associated with the greatest decline in QoL.
However, the differences across baseline status were not statistically significant, and results were therefore suggestive of a weak trend.

### 8.3.2 Physical Impairment

Increased physical impairment was associated with a significant reduction in control/autonomy (see Table 8-10). With each additional deficit, there was a 0.17 decrease in control/autonomy score, adjusting for age, sex, education and baseline impairment. In the fully adjusted model, it was associated with a 0.11 decrease in control/autonomy.

**Table 8-10: Regression analysis of effect of change in physical impairment on control/autonomy**

<table>
<thead>
<tr>
<th></th>
<th>Control/Autonomy W2(^a)</th>
<th>Control/Autonomy W2(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Control/autonomy (W1)</td>
<td>0.59</td>
<td>0.02</td>
</tr>
<tr>
<td>Physical impairment (W1)</td>
<td>-0.18</td>
<td>0.02</td>
</tr>
<tr>
<td>Change in Physical Impairment</td>
<td>-0.17</td>
<td>0.02</td>
</tr>
</tbody>
</table>

\(^a\) Adjusted for age, age\(^2\), sex and education  
\(^b\) Adjusted for age, age\(^2\), sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)

The analysis presented in Table 8-10 shows the incremental effect of each additional physical impairment deficit on control/autonomy score. The effect of having *any* increase in physical impairment, compared with having no increase or a decrease in impairment, was also examined. Any increase in physical impairment was associated with a 0.57 decrease in control/autonomy score and with a reduction of 0.36 in the fully adjusted model (see Table 8-11).
Table 8-11: Regression analysis of effect of any increase in physical impairment on control/autonomy

<table>
<thead>
<tr>
<th></th>
<th>Control/Autonomy W2&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Control/Autonomy W2&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Control/autonomy (W1)</td>
<td>0.59</td>
<td>0.02</td>
</tr>
<tr>
<td>Physical impairment (W1)</td>
<td>-0.14</td>
<td>0.02</td>
</tr>
<tr>
<td>Any increase in physical impairment</td>
<td>-0.57</td>
<td>0.09</td>
</tr>
</tbody>
</table>

<sup>a</sup> Adjusted for age, age<sup>2</sup>, sex and education<br>
<sup>b</sup> Adjusted for age, age<sup>2</sup>, sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)

The size of the negative effect of any increase in physical impairment was small, equivalent to approximately one quarter of a SD of change in control/autonomy (0.57/2.3 = 0.26).

Similarly, analysis of change in CASP score in ELSA found that most changes in life circumstances were associated with a change of 0.2–0.3 standard deviations (573). A difference of approximately one half of a standard deviation is usually considered minimally important in QoL measurement (574).

Change in physical impairment also had a significant negative effect on change on self-realisation/pleasure, adjusted for age, sex and education (see Table 8-12). Each additional deficit, relative to number of deficits at baseline, was associated with a 0.07 decrease in self-realisation/pleasure. Any increase in physical impairment was associated with a 0.27 reduction in self-realisation/pleasure score, equivalent to 0.14 of a standard deviation (not shown). In the fully adjusted model, only baseline impairment had a significant negative effect on change in self-realisation/pleasure. This suggested that self-realisation/pleasure score may not be responsive to changes in physical impairment. Of the additional covariates in the fully adjusted model, only personality had a significant effect, indicating that personality may have confounded the effect of physical impairment on self-realisation/pleasure.
<table>
<thead>
<tr>
<th></th>
<th>Self-Realisation/Pleasure</th>
<th></th>
<th></th>
<th>Self-Realisation/Pleasure</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>W2&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td>W2&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>P</td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Self-realisation/pleasure</td>
<td>0.59</td>
<td>0.02</td>
<td>&lt;0.01</td>
<td>0.43</td>
<td>0.02</td>
</tr>
<tr>
<td>Physical impairment (W1)</td>
<td>-0.11</td>
<td>0.02</td>
<td>&lt;0.01</td>
<td>-0.04</td>
<td>0.02</td>
</tr>
<tr>
<td>Change in physical impairment</td>
<td>-0.07</td>
<td>0.02</td>
<td>&lt;0.01</td>
<td>-0.02</td>
<td>0.03</td>
</tr>
</tbody>
</table>

<sup>a</sup>Adjusted for age, age<sup>2</sup>, sex and education
<sup>b</sup>Adjusted for age, age<sup>2</sup>, sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)

### 8.3.3 Personal and Environmental Predictors

This section presents effects of personal and environmental factors on control/autonomy and self-realisation/pleasure. Descriptions of each measure are presented in Section 5.2.

#### 8.3.3.1 Socio-demographic characteristics and personality

Table 8-13 displays effects of socio-demographic factors, personality and lifestyle factors (obesity and smoking) on changes in QoL. A higher control/autonomy score at W2 was predicted by older age, female sex, a lower neuroticism score, a higher extraversion score, not being obese, and not being a smoker. Higher self-realisation score at W2 was predicted by female sex, lower neuroticism and higher extraversion. Marital and retirement status did not have an effect on either QoL dimension.
Table 8-13: Regression analysis of effect of socio-demographic factors, personality and lifestyle on QoL

<table>
<thead>
<tr>
<th></th>
<th>Control/Autonomy W2</th>
<th></th>
<th>Self-Realisation/Pleasure W2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>P</td>
<td>B</td>
</tr>
<tr>
<td>Control/autonomy W1</td>
<td>0.59</td>
<td>0.02</td>
<td>&lt;0.01</td>
<td></td>
</tr>
<tr>
<td>Self-realisation/pleasure W1</td>
<td></td>
<td></td>
<td></td>
<td>0.43</td>
</tr>
<tr>
<td>Age</td>
<td>0.27</td>
<td>0.06</td>
<td>&lt;0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Age²</td>
<td>-0.002</td>
<td>0.0004</td>
<td>&lt;0.01</td>
<td></td>
</tr>
<tr>
<td>Sex: Men (Ref)</td>
<td></td>
<td></td>
<td></td>
<td>0.19</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
<td>0.31</td>
</tr>
<tr>
<td>Education: Primary (Ref)</td>
<td></td>
<td></td>
<td></td>
<td>-0.04</td>
</tr>
<tr>
<td>Secondary</td>
<td>0.12</td>
<td>0.10</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td>Third Level</td>
<td>0.20</td>
<td>0.10</td>
<td>0.07</td>
<td>0.09</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>-0.10</td>
<td>0.01</td>
<td>&lt;0.01</td>
<td>-0.07</td>
</tr>
<tr>
<td>Extraversion</td>
<td>0.03</td>
<td>0.01</td>
<td>&lt;0.01</td>
<td>0.08</td>
</tr>
<tr>
<td>Retired (W1)</td>
<td>0.04</td>
<td>0.12</td>
<td>0.76</td>
<td>0.09</td>
</tr>
<tr>
<td>Retired (W2)</td>
<td>-0.01</td>
<td>0.11</td>
<td>0.94</td>
<td>0.02</td>
</tr>
<tr>
<td>Married (W1)</td>
<td>0.19</td>
<td>0.32</td>
<td>0.55</td>
<td>0.18</td>
</tr>
<tr>
<td>Married (W2)</td>
<td>-0.02</td>
<td>0.32</td>
<td>0.94</td>
<td>-0.04</td>
</tr>
<tr>
<td>Obese (W1)</td>
<td>-0.25</td>
<td>0.08</td>
<td>&lt;0.01</td>
<td>-0.04</td>
</tr>
<tr>
<td>Smoker (W1)</td>
<td>-0.53</td>
<td>0.23</td>
<td>0.02</td>
<td>-0.28</td>
</tr>
<tr>
<td>Smoker (W2)</td>
<td>0.18</td>
<td>0.26</td>
<td>0.46</td>
<td>0.14</td>
</tr>
</tbody>
</table>
8.3.3.2 Religion

Changes in the importance of religion to participants, and associated changes in QoL, are displayed in Table 8-14. Over a third of the sample (37.5%) said that religion was very important to them in both survey waves. These participants, and those with an increase in religiosity (10.0%), had higher self-realisation/pleasure scores at W2, relative to those with low religiosity at either wave. Religiosity was not significantly associated with control/autonomy score. Most participants (57.2%) attended religious services at least once a week. Church attendance was not related to QoL scores on either dimension.

Table 8-14: Regression analysis of effect of religiosity on QoL

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
<th>Control/Autonomy W2</th>
<th>Self-Realisation/Pleasure W2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Control/Autonomy W1</td>
<td></td>
<td></td>
<td>0.48</td>
<td>0.02</td>
</tr>
<tr>
<td>Self-Realisation/Pleasure W1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Religion not/somewhat</td>
<td>1,175</td>
<td>43.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>important at W1 &amp; W2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Importance Declined</td>
<td>243</td>
<td>9.0</td>
<td>0.02</td>
<td>0.14</td>
</tr>
<tr>
<td>Importance Increased</td>
<td>270</td>
<td>10.0</td>
<td>0.09</td>
<td>0.14</td>
</tr>
<tr>
<td>Religion Very Important at W1 &amp; W2</td>
<td>1,013</td>
<td>37.5</td>
<td>0.09</td>
<td>0.10</td>
</tr>
<tr>
<td>Church less than one a week</td>
<td>924</td>
<td>34.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>at W1 &amp; W2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attendance declined</td>
<td>144</td>
<td>5.3</td>
<td>-0.27</td>
<td>0.18</td>
</tr>
<tr>
<td>Attendance increased</td>
<td>89</td>
<td>3.3</td>
<td>0.21</td>
<td>0.22</td>
</tr>
<tr>
<td>Regular church attendance</td>
<td>1,544</td>
<td>57.2</td>
<td>0.17</td>
<td>0.10</td>
</tr>
<tr>
<td>at W1 &amp; W2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Adjusted for age, age^2, sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2), church attendance (W1), church attendance (W2)
8.3.3.3 Supportive partner

Changes in social support from a partner, and associated changes in QoL are displayed in Table 8-15. Of the total sample, most participants (60.7%) reported having a supportive partner at both waves. This represented 80% of all participants who were living as married. Less than 10% of the sample experienced a change in the level of support from their partner. Participants who were married, but who received low support from their partner at both waves, had significantly lower control/autonomy and self-realisation/pleasure relative to those who were not married. Participants with a supportive partner at both waves, on the other hand, had significantly higher QoL scores than non-married participants.

Table 8-15: Regression analysis of effect of supportive partner on QoL

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
<th>Control/Autonomy W2</th>
<th></th>
<th>Self-Realisation/Pleasure W2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>B       SE    P</td>
<td></td>
<td>B           SE    P</td>
<td></td>
</tr>
<tr>
<td>Control/Autonomy W1</td>
<td></td>
<td></td>
<td>0.47    0.02   &lt;0.01</td>
<td></td>
<td>0.40         0.02   &lt;0.01</td>
<td></td>
</tr>
<tr>
<td>Self-Realisation/Pleasure W1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.81        0.15   &lt;0.01</td>
<td></td>
</tr>
<tr>
<td>Not married (ref)</td>
<td>623</td>
<td>24.3</td>
<td></td>
<td></td>
<td>-0.39        0.18   0.03</td>
<td>-0.25      0.15   0.10</td>
</tr>
<tr>
<td>Non-supportive partner at W1 &amp; W2</td>
<td>152</td>
<td>5.6</td>
<td>-0.21    0.18   0.25</td>
<td>-0.25      0.15   0.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decline in support</td>
<td>131</td>
<td>4.9</td>
<td></td>
<td></td>
<td>0.15         0.19   0.42</td>
<td>-0.04      0.16   0.81</td>
</tr>
<tr>
<td>Increase in support</td>
<td>124</td>
<td>4.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supportive partner at W1 &amp; W2</td>
<td>1,639</td>
<td>60.7</td>
<td>0.26     0.09   &lt;0.01</td>
<td></td>
<td>0.30         0.08   &lt;0.01</td>
<td></td>
</tr>
</tbody>
</table>

Adjusted for age, age², sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)
Supportive relationship = understands their feelings, can be relied upon if they have a serious problem and can open up to them if they need talk, at least some or all of the time
8.3.3.4 Supportive relatives and friends

Less than half of participants (41%) reported having supportive relatives at both waves (see Table 8-16). Participants with consistently supportive relatives, and those who experienced an increase in support from relatives, had higher scores on both QoL dimensions at W2, relative to those reporting no supportive relatives at either wave. Almost half of participants (48%) reported having supportive friends (see Table 8-17). Consistent support from friends, and an increase in support from friends, was associated with significantly higher control/autonomy scores at W2. Support from friends was not significantly associated with self-realisation/pleasure.

Table 8-16: Regression analysis of effect of support from relatives on QoL

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Control/Autonomy W2</th>
<th>Self-Realisation/Pleasure W2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control/Autonomy W1</td>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Self-Realisation/Pleasure W1</td>
<td></td>
<td>0.48</td>
<td>0.02</td>
</tr>
<tr>
<td>No supportive relatives at W1 &amp; W2 (Ref) (includes no relatives, n = 74)</td>
<td>818</td>
<td>30.2</td>
<td></td>
</tr>
<tr>
<td>Decline in support</td>
<td>324</td>
<td>12.0</td>
<td>0.05</td>
</tr>
<tr>
<td>Increase in support</td>
<td>351</td>
<td>13.0</td>
<td>0.31</td>
</tr>
<tr>
<td>Supportive relatives at W1 &amp; W2</td>
<td>1,111</td>
<td>41.1</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Adjusted for age, age², sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)

Supportive relationship = understands their feelings, can be relied upon if they have a serious problem and can open up to them if they need talk, at least some or all of the time
Table 8-17: Regression analysis of effect of support from friends on QoL

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
<th>Control/Autonomy W2</th>
<th>Self-Realisation/Pleasure W2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Control/Autonomy W1</td>
<td></td>
<td></td>
<td>0.48</td>
<td>0.02</td>
</tr>
<tr>
<td>Self-Realisation/Pleasure W1</td>
<td></td>
<td></td>
<td>0.43</td>
<td>0.02</td>
</tr>
<tr>
<td>No supportive friends at W1 &amp; W2 (Ref)</td>
<td>729</td>
<td>27.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decline in support</td>
<td>365</td>
<td>13.5</td>
<td>0.08</td>
<td>0.12</td>
</tr>
<tr>
<td>Increase in support</td>
<td>302</td>
<td>11.2</td>
<td>0.44</td>
<td>0.13</td>
</tr>
<tr>
<td>Supportive friends at W1 &amp; W2</td>
<td>1,305</td>
<td>48.3</td>
<td>0.40</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Adjusted for age, age², sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)

8.3.3.5 Social activity and participation

Most participants (65%) engaged in social leisure activity at least weekly at both waves (see Table 8-18). Approximately 10% improved their social activity frequency from less than weekly between W1 and W2, with a similar proportion reducing activity to less than weekly. Weekly social activity at both waves had a positive effect on both dimensions of QoL. Effects for monthly social activity were similar, except that effects were not significant for self-realisation/pleasure. In addition, participants whose frequency of activity improved also experienced an increase in control/autonomy.
Table 8-18: Regression analysis of effect of social leisure activity on QoL

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
<th>Control/Autonomy W2</th>
<th>Self-Realisation/Pleasure W2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Control/Autonomy W1</td>
<td></td>
<td></td>
<td>0.47</td>
<td>0.02</td>
</tr>
<tr>
<td>Self-Realisation/Pleasure W1</td>
<td></td>
<td></td>
<td>0.43</td>
<td>0.02</td>
</tr>
<tr>
<td>Social activity &lt; Weekly at W1 &amp; W2 (Ref)</td>
<td>390</td>
<td>14.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decline in activity</td>
<td>281</td>
<td>10.4</td>
<td>0.20</td>
<td>0.15</td>
</tr>
<tr>
<td>Increase in activity</td>
<td>264</td>
<td>9.8</td>
<td>0.16</td>
<td>0.15</td>
</tr>
<tr>
<td>Activity at least weekly at W1 &amp; W2</td>
<td>1,766</td>
<td>65.4</td>
<td>0.47</td>
<td>0.11</td>
</tr>
</tbody>
</table>

Adjusted for age, age², sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2).

Just over 50% of the sample was involved in community participation at both waves (see Table 8-19). Approximately 11% started volunteering between W1 and W2, with a similar proportion ceasing to volunteer. Starting to volunteer, and volunteering at both waves, had a positive effect on self-realisation/pleasure, but not control/autonomy.

Table 8-19: Regression analysis of effect of community participation on QoL

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
<th>Control/Autonomy W2</th>
<th>Self-Realisation/Pleasure W2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Control/Autonomy W1</td>
<td></td>
<td></td>
<td>0.48</td>
<td>0.02</td>
</tr>
<tr>
<td>Self-Realisation/Pleasure W1</td>
<td></td>
<td></td>
<td>0.43</td>
<td>0.02</td>
</tr>
<tr>
<td>No Community Participation at W1 &amp; W2 (Ref)</td>
<td>698</td>
<td>25.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decline in participation</td>
<td>253</td>
<td>9.4</td>
<td>-0.10</td>
<td>0.14</td>
</tr>
<tr>
<td>Increase in participation</td>
<td>306</td>
<td>11.3</td>
<td>0.13</td>
<td>0.13</td>
</tr>
<tr>
<td>Community Participation at W1 &amp; W2</td>
<td>1,444</td>
<td>53.5</td>
<td>0.11</td>
<td>0.11</td>
</tr>
</tbody>
</table>

Adjusted for age, age², sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2).
8.3.3.6 Socio-economic Position

Possession of a medical card is an indicator of low income among those aged <70 (see Chapter 5, Section 5.2.5.4, p.190). Over two-thirds of the sample (68.0%) aged <70 did not have a medical card at W2. Just under a quarter had a medical card at both waves. Having a medical card, or receiving one between the waves, was associated with a negative effect on control/autonomy; however these effects were only marginally statistically significant (p=0.05). As discussed in Section 5.2.5.4, medical cards are allocated based on assessments of income, and receiving a medical card is likely to be an indicator of a drop in income. There was no association with change in self-realisation/pleasure (see Table 8-20).

Table 8-20: Regression analysis of effect of medical card status on QoL (n = 2,033)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
<th>Control/Autonomy W2</th>
<th>Self-Realisation/Pleasure W2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Control/Autonomy W1</td>
<td></td>
<td></td>
<td>0.48</td>
<td>0.02</td>
</tr>
<tr>
<td>Self-Realisation/Pleasure W1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Medical Card at W1 &amp; W2 (Ref)</td>
<td>1,383</td>
<td>68.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lost Medical Card</td>
<td>43</td>
<td>2.1</td>
<td>-0.50</td>
<td>0.30</td>
</tr>
<tr>
<td>Gained Medical Card</td>
<td>132</td>
<td>6.5</td>
<td>-0.35</td>
<td>0.18</td>
</tr>
<tr>
<td>Medical Card at W1 &amp; W2</td>
<td>475</td>
<td>23.4</td>
<td>-0.22</td>
<td>0.11</td>
</tr>
</tbody>
</table>

Adjusted for age, age², sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2).

Private health insurance was also used as a proxy measure of SEP, on the basis that it indicates sufficient financial resources to pay an insurance premium (see Section 5.2.5.4). Over two-thirds of the sample (68%) had private health insurance at both waves (see Table 8-21). Fewer than 5% of participants changed their health insurance status between waves. Having insurance at W1 and W2 was associated with higher control/autonomy scores at W2 (p<0.01). There was no significant effect on self-realisation/pleasure score.
<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
<th>Control/Autonomy W2</th>
<th>Self-Realisation/Pleasure W2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>P</td>
<td>B</td>
</tr>
<tr>
<td>Control/Autonomy W1</td>
<td>0.47</td>
<td>0.02</td>
<td>&lt;0.01</td>
<td>0.43</td>
</tr>
<tr>
<td>Self-Realisation/ Pleasure W1</td>
<td>0.43</td>
<td>0.02</td>
<td>&lt;0.01</td>
<td>0.43</td>
</tr>
<tr>
<td>No Insurance at W1 &amp; W2 (REF)</td>
<td>770</td>
<td>28.5</td>
<td></td>
<td>0.13</td>
</tr>
<tr>
<td>Lost Insurance</td>
<td>71</td>
<td>2.6</td>
<td>0.26 0.24 0.28</td>
<td>0.13</td>
</tr>
<tr>
<td>Gained Insurance</td>
<td>39</td>
<td>1.4</td>
<td>0.41 0.32 0.20</td>
<td>-0.43</td>
</tr>
<tr>
<td>Insurance at W1 &amp; W2</td>
<td>1,821</td>
<td>67.5</td>
<td>0.40 0.09 &lt;0.01</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Adjusted for age, age², sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2).

8.3.4 Change in QoL: Summary

Control/autonomy was negatively affected by chronic conditions only when associated with increased physical impairment. Self-realisation/pleasure was not responsive to either incident chronic conditions or change in physical impairment. These findings were consistent with the cross-sectional analysis reported in Chapter 7. In relation to other study variables, both dimensions of QoL were significantly affected by social support, social leisure activity and personality. Control/autonomy was significantly affected by lifestyle factors and indicators of SEP. Self-realisation/pleasure, on the other hand, was associated with factors directly related to having meaning and purpose in life (religiosity and community participation). This supports the idea that control/autonomy is more responsive to physical health and socio-economic circumstances (38,215,220,566,567), while self-realisation/pleasure captures eudaimonic dimensions of wellbeing.
8.4 Predictors of Change in Physical Impairment

8.4.1 Baseline and Incident Chronic Conditions

Effects on physical impairment were explored for a range of definitions of incident chronic disease diagnosis. This included baseline conditions, having any incident chronic condition, number of incident conditions, having an incident condition with an increase in medication, and specific incident conditions. As discussed in Chapter 5, Section 5.5.3.1 (p. 218), there are two options for modelling a dispersed count outcome – a negative binomial model, and a zero-inflated negative binomial model. The zero-inflated approach takes account of the fact that different processes may be responsible for producing zero physical impairment deficits, and for determining the number of deficits. Both approaches were used to examine effects of incident chronic conditions on number of physical impairments.

For each model, a likelihood-ratio test for alpha=0 indicated that the data were over-dispersed, and that a negative binomial approach was preferred to a Poisson model. The z-test associated with the vuong test for the zero-inflated model was significant, indicating that a zero-inflated negative binomial model was preferable to a standard negative binomial model (see Section 5.5.3.1). However, trivial differences in model fit may lead to a significant vuong test (553). In the logit portion of the zero-inflated model, having an incident condition was not associated with the probability of having zero deficits. Therefore, the zero-inflated approach did not contribute anything additional to understanding the effect of incident chronic conditions on physical impairment, relative to the negative-binomial approach.

The results of the negative binomial approach are therefore reported in Table 8-22. Each definition of incident chronic condition was associated with a significant increase in the expected number of deficits. However, effect sizes were small. Holding all other factors constant, a participant with an incident chronic disease diagnosis had an additional 0.5 expected deficits, relative to someone who did not report an incident diagnosis. It is possible that the timing of chronic disease diagnoses may not be very well aligned with disease progression, in terms of impacts on body function and activity. Patients may experience increased disease-related deficits prior to diagnosis. Alternatively, diagnosis may occur at an early stage of disease progression, so that the functional impact occurs
later. This may explain why incident diagnoses did not have a strong association with change in physical impairment over a two year period.

Table 8-22: Negative binomial model of the effect of incident chronic conditions on physical impairment

<table>
<thead>
<tr>
<th>Incident Chronic Conditions</th>
<th>Expected Number of Deficits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td>Baseline number of conditions</td>
<td></td>
</tr>
<tr>
<td>Any new chronic condition</td>
<td>902</td>
</tr>
<tr>
<td>One new condition</td>
<td>685</td>
</tr>
<tr>
<td>2+ new conditions</td>
<td>217</td>
</tr>
<tr>
<td>New condition + inc. meds</td>
<td>532</td>
</tr>
<tr>
<td>Hypertension</td>
<td>163</td>
</tr>
<tr>
<td>High Cholesterol</td>
<td>263</td>
</tr>
<tr>
<td>Arthritis</td>
<td>173</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>199</td>
</tr>
</tbody>
</table>

Adjusted for age, sex, education, baseline physical impairment, baseline chronic conditions, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)

Note: The coefficient is equivalent to the difference in the log of expected counts of numbers of deficits.
8.4.2 Personal and Environmental Predictors

A number of personal and environmental factors were associated with increased physical impairment at W2. Significant predictors are outlined below. The following covariates were adjusted for in this analysis: age, sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2).

- **Socio-demographic factors**: older age (p<0.01), female sex (p<0.01), primary education relative to third level (p<0.01)

- **Personality**: Higher neuroticism score (p<0.01), lower extraversion score (p=0.03).

- **Lifestyle**: Obesity at W1 (p<0.01).

- **Social support**: Increasing partner support, relative to no partner (p<0.01), no supportive relatives, compared with consistent support (p = 0.02).

- **Social participation**: social leisure activity less than weekly (p<0.01) at either wave.

- **Religion**: Religion important at W1 (p=0.02), not attending church regularly at W2 (p <0.01).

- **Socioeconomic position**: having a medical card (p<0.01), not having private health insurance (p<0.01).

Physical impairment was determined by a wide range of factors related to the person and their environment, consistent with the evidence discussed in Section 4.3. In addition, consistent with current literature concerning "mobilisation effects" (446) (discussed in Section 4.3.4, p. 145), increased physical impairment between waves was predicted by increased spousal support. One interpretation of this finding is that spousal support may have been induced or "mobilised" by worsening physical function. This effect can complicate the detection of beneficial effects of social support, as it seems as though better support is associated with worse outcomes. This effect will be discussed further in examination of the moderating effects of social support in Section 8.7.4.1.
8.5 Predictors of Change in Positive Affect

8.5.1 Baseline and Incident Chronic Conditions

Table 8.23 displays the effects of baseline and incident chronic conditions on change in positive affect at W2. Number of baseline chronic conditions had a negative effect on positive affect at follow-up. However, having an incident chronic condition only had a significant negative effect on positive affect if it was accompanied by increased physical impairment (disability). This effect was no longer statistically significant in the fully adjusted model.

Table 8.23: Regression analysis of effect of baseline and incident conditions on positive affect

<table>
<thead>
<tr>
<th></th>
<th>Positive Affect W2&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Positive Affect W2&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>B</td>
</tr>
<tr>
<td>Number of chronic conditions (W1)</td>
<td>-0.12 0.03 &lt;0.01</td>
<td>-0.07 0.03 &lt;0.01</td>
</tr>
<tr>
<td>Any new chronic condition</td>
<td>902</td>
<td>-0.11 0.08 0.18</td>
</tr>
<tr>
<td>New condition + increase in disability</td>
<td>345</td>
<td>-0.29 0.11 0.01</td>
</tr>
<tr>
<td>New condition + increase in medications</td>
<td>532</td>
<td>-0.11 0.10 0.24</td>
</tr>
<tr>
<td>Any new FCI condition&lt;sup&gt;c&lt;/sup&gt;</td>
<td>612</td>
<td>-0.17 0.09 0.06</td>
</tr>
</tbody>
</table>

<sup>a</sup>Adjusted for positive affect (W1), age, age<sup>2</sup>, sex and education
<sup>b</sup>Adjusted for positive affect (W1), age, age<sup>2</sup>, sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)
<sup>c</sup>Excludes conditions which are not included in the Functional Comorbidity Index (see Section 5.2.1).
8.5.2 Physical Impairment

Change in physical impairment had a significant effect on change in positive affect between W1 and W2, as displayed in Table 8-24. An additional deficit, relative to physical impairment at baseline, was associated with an additional 0.17 decline in positive affect score, adjusting for age, sex and education. In the fully adjusted model, it was associated with an additional 0.11 decline in positive affect score.

Table 8-24: Regression analysis of effect of change in physical impairment on positive affect

<table>
<thead>
<tr>
<th></th>
<th>Positive Affect W2&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Positive Affect W2&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Positive Affect (W1)</td>
<td>0.27</td>
<td>0.02</td>
</tr>
<tr>
<td>Physical Impairment (W1)</td>
<td>-0.17</td>
<td>0.02</td>
</tr>
<tr>
<td>Change in physical impairment</td>
<td>-0.17</td>
<td>0.02</td>
</tr>
</tbody>
</table>

<sup>a</sup> Adjusted for age, age<sup>2</sup>, sex and education

<sup>b</sup> Adjusted for age, age<sup>2</sup>, sex and education, personality, marital and employment status and lifestyle.

Having any increase in physical impairment was associated with a 0.42 decrease in positive affect score (adjusted for age, sex and education; p<0.01), equivalent to 0.22 of a standard deviation. This is a small effect size based on Cohen’s criteria (536), but is consistent with the size of the effect of physical impairment on control/autonomy.

8.5.3 Personal and Environmental Predictors

A limited number of personal and environmental factors were associated with increased positive affect at W2. Significant predictors are outlined below. The following covariates were adjusted for in this analysis: age, sex and education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2).

- **Socio-demographic factors**: Female sex (p=0.01).
- **Personality**: Lower neuroticism score (p<0.01), higher extraversion score (p<0.01).
- **Lifestyle**: None.
• **Social support**: Supportive partner, relative to no partner (p<0.01); Supportive relatives (p < 0.01), relative to no supportive relatives.

• **Social participation**: None.

• **Religion**: Increasing importance of religion between W1 and W2 (p=0.03)

• **Socioeconomic position**: None.

Positive affect was affected by only a small number of personal and environmental factors: personality, social support and sex. This is consistent with previous evidence that affective wellbeing is more susceptible to personal characteristics and relationships than life circumstances such as health or SEP (254).

### 8.6 Longitudinal Effects: Summary

Hypotheses concerning longitudinal effects along the pathway between chronic disease and QoL were generally supported (see Table 8-25). Evidence that self-realisation/pleasure was not responsive to increasing physical impairment was consistent with hypothesis 1.12, which stated that physical impairment affects self-realisation/pleasure only indirectly via control/autonomy (see Section 7.5, p. 269).

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Table 8-25: Longitudinal effects: summary of findings</th>
</tr>
</thead>
</table>
| **2.1** Incident chronic conditions are associated with an increase in physical impairment  
**Supported**  
Having an incident chronic condition was associated with increased physical impairment between W1 and W2. The effect size was small, however, with having an incident condition associated with only a small increase in expected number of deficits, relative to not having an incident condition. |
| **2.2** Increasing physical impairment is associated with a decline in positive affect, control/autonomy and self-realisation/pleasure  
**Partially supported**  
Increasing physical impairment was associated with decline in positive affect and control/autonomy, but not self-realisation/pleasure. Again, effect sizes were small. |
8.7 Interaction Effects

Interaction effects were examined for each effect along the pathway between chronic conditions and QoL, as displayed in Figure 8-1 and outlined below:

a. Effect of incident chronic conditions on change in physical impairment
b. Effect of change in physical impairment on change in positive affect
c. Effect of change in physical impairment on change in control/autonomy
d. Effect of change in physical impairment on change in self-realisation/pleasure

Interactions were estimated for each of these effects with the following factors: 1) age; 2) sex; 3) personality (neuroticism and extraversion); 4) religion (importance of religion and church attendance); 5) social support from partner, relatives and friends; 6) social participation (social leisure activity and community participation); and 7) socio-economic position (medical card status, education and private health insurance).

Detailed results are presented only for those effects associated with a p-value below or close to 0.01. As outlined in Section 5.5.4.1, this more conservative level of significance was selected to account for multiple testing. The coefficient, standard error and p-value for each interaction tested will be presented in a table at the beginning of each section. For each effect, interaction effects were first estimated for the sample with complete data (n = 2,701). As a sensitivity analysis, the analysis was also carried out on an imputed sample (n = 3,414). Details of the imputation procedure are described briefly in Section 8.7.1.

8.7.1 Multiple Imputations

Missing item responses for extraversion (12 items, W2 only), neuroticism (12 items, W2 only), control/autonomy (5 items at each wave), self-realisation/pleasure (5 items at each wave) and positive affect (4 items at each wave) were imputed. Predictive mean matching was used to impute values for each item, conditional on a comprehensive set of covariates (displayed in Appendix 7, Table A7.1). These covariates included all of the variables included in Analysis Phase 3, including interaction effects. This helped to ensure that the
structure of the data was preserved in the imputed dataset, and to avoid introducing a bias towards zero for the interaction effects.

Twenty imputed datasets were generated for 3,414 participants (see Figure 8-2, p. 289). The number of imputations was equivalent to the percentage of participants with incomplete data in the imputed dataset (n = 713, 20.9%) (555). Summed scores were generated for control/autonomy, self-realisation/pleasure, extraversion, neuroticism and positive affect, based on imputed item responses. Regression models were estimated using the multiple imputation "mi" estimate commands available in Stata, which combine coefficient estimates and standard errors across imputed datasets using Rubin's rules (554,555,558).

Table 8-26 compares sample characteristics across the total sample that completed the HA and SCQ at two waves, the imputed dataset, and the sample who had complete data across all study variables. The profile of the imputed dataset was slightly more similar to the full dataset, compared with the complete data sample. Sample characteristics were not significantly different across datasets, however, with the exception of the age profile. The average age of participants included in the imputed and complete datasets was younger than in the full sample.

As noted in Section 5.5.5, missing data was also imputed for the full sample (n=4,547). The results of the analysis of interactions conducted with the fully imputed dataset are presented in Appendix 7, Table A7.2 – A7.5. Results did not vary substantially from the analysis presented here.
Table 8-26: Sample characteristics for participants in the full, imputed and complete samples

<table>
<thead>
<tr>
<th></th>
<th>Full Sample n = 4,547</th>
<th>Imputed Data n = 3,414</th>
<th>Complete Data n = 2,301</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Age (W1)</td>
<td>62.9</td>
<td>8.9</td>
<td>62.4</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>1066</td>
<td>23.4</td>
<td>22.9</td>
</tr>
<tr>
<td>%</td>
<td>20.3</td>
<td>42.1</td>
<td>42.3</td>
</tr>
<tr>
<td>Secondary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>1888</td>
<td>41.5</td>
<td>34.9</td>
</tr>
<tr>
<td>%</td>
<td>41.5</td>
<td>42.1</td>
<td>42.3</td>
</tr>
<tr>
<td>Third Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>1593</td>
<td>35.0</td>
<td>34.9</td>
</tr>
<tr>
<td>%</td>
<td>35.0</td>
<td>42.1</td>
<td>42.3</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>2034</td>
<td>44.7</td>
<td>44.3</td>
</tr>
<tr>
<td>%</td>
<td>44.7</td>
<td>42.1</td>
<td>42.3</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>2513</td>
<td>55.3</td>
<td>55.7</td>
</tr>
<tr>
<td>%</td>
<td>55.3</td>
<td>42.1</td>
<td>42.3</td>
</tr>
<tr>
<td>Smoker W1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>637</td>
<td>14.0</td>
<td>13.4</td>
</tr>
<tr>
<td>%</td>
<td>14.0</td>
<td>42.1</td>
<td>42.3</td>
</tr>
<tr>
<td>Smoker W2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>512</td>
<td>11.3</td>
<td>10.8</td>
</tr>
<tr>
<td>%</td>
<td>11.3</td>
<td>42.1</td>
<td>42.3</td>
</tr>
<tr>
<td>Obese</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>1525</td>
<td>33.5</td>
<td>34.3</td>
</tr>
<tr>
<td>%</td>
<td>33.5</td>
<td>42.1</td>
<td>42.3</td>
</tr>
<tr>
<td>Retired W1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>1684</td>
<td>37.0</td>
<td>36.4</td>
</tr>
<tr>
<td>%</td>
<td>37.0</td>
<td>42.1</td>
<td>42.3</td>
</tr>
<tr>
<td>Retired W2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>1970</td>
<td>43.3</td>
<td>42.6</td>
</tr>
<tr>
<td>%</td>
<td>43.3</td>
<td>42.1</td>
<td>42.3</td>
</tr>
<tr>
<td>New Condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>1527</td>
<td>33.6</td>
<td>33.3</td>
</tr>
</tbody>
</table>

8.7.2 Effect of Incident Chronic Conditions on Physical Impairment

Negative binomial models were used to estimate interactions between moderating factors and the effect of incident chronic conditions on physical impairment. The estimated interaction effects are displayed in Table 8-27. Each interaction effect was estimated separately, adjusting for baseline physical impairment, baseline number of chronic conditions, age, sex, education, obesity, smoking, personality, marital status and retirement status.

None of the interaction effects had a p-value below or close to 0.01 (see Table 8-27). Two moderating factors, living as married and medical card status, had interactions that were significant at the p<0.05 level. In both cases the interaction effect was in the opposite direction than expected, with low income associated with a reduced effect of incident conditions on physical impairment, and marriage associated with an increased effect. When both interaction terms were included in a single model, only the interaction between incident condition and medical card status (low income) had a significant effect on physical impairment. While this effect was not statistically significant at the p<0.01 level, it was
contrary to the initial hypothesis (hypothesis 3.3a, see Table 8-2) and warranted further examination.

Table 8-27: Interactions with the effect of incident chronic conditions on physical impairment (n = 2,701)

<table>
<thead>
<tr>
<th>Interaction</th>
<th>Coef.</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incident condition*Age</td>
<td>-0.004</td>
<td>0.004</td>
<td>0.28</td>
</tr>
<tr>
<td>Incident condition*Sex</td>
<td>0.02</td>
<td>0.08</td>
<td>0.80</td>
</tr>
<tr>
<td>Physical impairment*Religion Somewhat Imp (ref = not important)</td>
<td>-0.11</td>
<td>0.12</td>
<td>0.37</td>
</tr>
<tr>
<td>Physical impairment*Religion Very Imp (ref = not important)</td>
<td>-0.07</td>
<td>0.11</td>
<td>0.53</td>
</tr>
<tr>
<td>Incident condition*Neuroticism</td>
<td>-0.003</td>
<td>0.01</td>
<td>0.52</td>
</tr>
<tr>
<td>Incident condition*Extraversion</td>
<td>-0.005</td>
<td>0.01</td>
<td>0.47</td>
</tr>
<tr>
<td><strong>Incident condition*Living as Married</strong></td>
<td><strong>0.21</strong></td>
<td><strong>0.09</strong></td>
<td><strong>0.02</strong></td>
</tr>
<tr>
<td>Incident condition*Supportive friends</td>
<td>-0.04</td>
<td>0.08</td>
<td>0.86</td>
</tr>
<tr>
<td>Incident condition*Supportive relatives</td>
<td>-0.03</td>
<td>0.08</td>
<td>0.67</td>
</tr>
<tr>
<td>Incident condition*Weekly social activity</td>
<td>0.04</td>
<td>0.09</td>
<td>0.62</td>
</tr>
<tr>
<td>Incident condition*Monthly social activity</td>
<td>0.24</td>
<td>0.13</td>
<td>0.06</td>
</tr>
<tr>
<td>Incident condition*Community participation</td>
<td>-0.10</td>
<td>0.08</td>
<td>0.23</td>
</tr>
<tr>
<td><strong>Incident condition*Medical card</strong></td>
<td><strong>-0.24</strong></td>
<td><strong>0.10</strong></td>
<td><strong>0.02</strong></td>
</tr>
<tr>
<td>Incident condition*Private insurance</td>
<td>-0.002</td>
<td>0.08</td>
<td>0.98</td>
</tr>
<tr>
<td>Incident condition*Secondary education (ref = primary)</td>
<td>-0.04</td>
<td>0.10</td>
<td>0.72</td>
</tr>
<tr>
<td>Incident condition*Third level (ref = primary)</td>
<td>0.09</td>
<td>0.11</td>
<td>0.38</td>
</tr>
</tbody>
</table>

Note: The coefficient is equivalent to the difference in the log of expected counts of numbers of deficits. Effects with p-values <0.05 are shown in **bold.**

Adjusted for age, sex, education, baseline physical impairment, baseline chronic conditions, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)

<sup>3</sup>n = 2,033
Figure 8-5: Average marginal effects of an incident chronic condition on predicted number of physical impairments, by medical card status (age at W2 < 70) (n = 2,033)

All other factors held constant, participants who did not report an incident condition between waves, and who did not have a medical card, had an expected additional 1.2 deficits at W2 (see Figure 8-5). Those with no incident condition and a medical card had a slightly greater increase in physical impairment, with an expected additional 1.5 deficits. This was a small difference. However, among those with an incident condition, there was no difference in additional deficits between those who had a medical card, and those who did not. This suggested that more advantaged participants had a greater deterioration in function associated with an incident condition, consistent with the "convergence" effect described in Section 4.3.3. However, this effect was so tiny that it was unlikely to be clinically meaningful, and did not reach significance at the p<0.01 level.
8.7.2.1 Sensitivity Analysis: FCI Conditions and Imputed Data

Two sensitivity analyses were undertaken for the analysis of interactions with the effect of incident chronic conditions on change in physical impairment. As discussed in Section 5.2.1 (p. 176), an alternative, stricter definition of chronic conditions was used, counting only conditions included in the Functional Comorbidity Index (FCI). The results were the same when interactions between incident FCI conditions and protective factors were estimated, with none of the findings significant at the p<0.01 level. The results were also the same when imputed data (n = 3,414) were used, with none of the interaction effects reaching statistical significant at the p<0.01 level (see Table 8-28).

Table 8-28: Interactions with the effect of incident chronic conditions on physical impairment, imputed data (n = 3,414)

<table>
<thead>
<tr>
<th>Interaction</th>
<th>Coef.</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incident condition*Age</td>
<td>-0.004</td>
<td>0.004</td>
<td>0.26</td>
</tr>
<tr>
<td>Incident condition*Sex</td>
<td>0.01</td>
<td>0.07</td>
<td>0.93</td>
</tr>
<tr>
<td>Incident condition*Religion very important</td>
<td>-0.10</td>
<td>0.08</td>
<td>0.20</td>
</tr>
<tr>
<td>Incident condition*Neuroticism</td>
<td>-0.003</td>
<td>0.004</td>
<td>0.46</td>
</tr>
<tr>
<td>Incident condition*Extraversion</td>
<td>-0.001</td>
<td>0.01</td>
<td>0.91</td>
</tr>
<tr>
<td>Incident condition*Living as Married</td>
<td>0.14</td>
<td>0.08</td>
<td>0.07</td>
</tr>
<tr>
<td>Incident condition*Supportive partner (ref = not married)</td>
<td>0.13</td>
<td>0.08</td>
<td>0.10</td>
</tr>
<tr>
<td>Incident condition*Supportive friends</td>
<td>-0.01</td>
<td>0.08</td>
<td>0.93</td>
</tr>
<tr>
<td>Incident condition*Supportive relatives</td>
<td>0.03</td>
<td>0.08</td>
<td>0.74</td>
</tr>
<tr>
<td>Incident condition*Weekly social activity</td>
<td>0.01</td>
<td>0.09</td>
<td>0.94</td>
</tr>
<tr>
<td>Incident condition*Monthly social activity</td>
<td>0.14</td>
<td>0.14</td>
<td>0.32</td>
</tr>
<tr>
<td>Incident condition*Community participation</td>
<td>-0.05</td>
<td>0.08</td>
<td>0.51</td>
</tr>
<tr>
<td>Incident condition*Medical Card</td>
<td>-0.16</td>
<td>0.10</td>
<td>0.12</td>
</tr>
<tr>
<td>Incident condition*Private insurance</td>
<td>-0.03</td>
<td>0.07</td>
<td>0.64</td>
</tr>
<tr>
<td>Incident condition*Secondary education (ref = primary)</td>
<td>0.05</td>
<td>0.09</td>
<td>0.53</td>
</tr>
<tr>
<td>Incident condition*Third level (ref = primary)</td>
<td>0.05</td>
<td>0.09</td>
<td>0.59</td>
</tr>
</tbody>
</table>

Note: The coefficient is equivalent to the difference in the log of expected counts of numbers of deficits. Effects with p-values <0.05 are shown in **bold**.

Each interaction effect was adjusted for age, sex, education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)

*n = 2,486
8.7.3 Effect of Physical Impairment on Positive Affect

Interactions between moderating factors and the effect of change in physical impairment on change in positive affect were estimated. The results are displayed in Table 8-29. Most of the interaction effects were not statistically significant. Having a medical card was associated with an increased effect of physical impairment on positive affect (p<0.05). This was consistent with hypothesis 3.3b. Only the interaction between increasing physical impairment and extraversion was significant at the p<0.01 level. This effect was consistent with hypothesis 3.1b and is presented in detail in Section 8.7.3.1.

Table 8-29: Interactions with the effect of physical impairment on positive affect (n = 2,701)

<table>
<thead>
<tr>
<th>Interaction effect</th>
<th>Coef.</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical impairment*Age</td>
<td>0.004</td>
<td>0.002</td>
<td>0.05</td>
</tr>
<tr>
<td>Physical impairment*Sex</td>
<td>-0.07</td>
<td>0.04</td>
<td>0.06</td>
</tr>
<tr>
<td>Physical impairment*Neuroticism</td>
<td>-0.002</td>
<td>0.003</td>
<td>0.54</td>
</tr>
<tr>
<td><strong>Physical impairment*Extraversion</strong></td>
<td><strong>0.01</strong></td>
<td><strong>0.003</strong></td>
<td><strong>0.01</strong></td>
</tr>
<tr>
<td>Physical impairment*Religion somewhat important (ref = not important)</td>
<td>0.09</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Physical impairment*Religion very important (ref = not important)</td>
<td>0.08</td>
<td>0.05</td>
<td>0.09</td>
</tr>
<tr>
<td>Physical impairment*Living as married (partner)</td>
<td>0.04</td>
<td>0.04</td>
<td>0.28</td>
</tr>
<tr>
<td>Physical impairment*Supportive partner (ref = no partner)</td>
<td>0.05</td>
<td>0.04</td>
<td>0.23</td>
</tr>
<tr>
<td>Physical impairment*Supportive friends</td>
<td>0.01</td>
<td>0.04</td>
<td>0.69</td>
</tr>
<tr>
<td>Physical impairment*Supportive relatives</td>
<td>0.02</td>
<td>0.04</td>
<td>0.57</td>
</tr>
<tr>
<td>Physical impairment*Weekly social activity</td>
<td>0.02</td>
<td>0.04</td>
<td>0.66</td>
</tr>
<tr>
<td>Physical impairment*Monthly social activity</td>
<td>-0.05</td>
<td>0.05</td>
<td>0.34</td>
</tr>
<tr>
<td>Physical impairment*Community participation</td>
<td>-0.07</td>
<td>0.04</td>
<td>0.07</td>
</tr>
<tr>
<td><strong>Physical impairment*Medical card (low income)</strong></td>
<td><strong>-0.09</strong></td>
<td><strong>0.05</strong></td>
<td><strong>0.04</strong></td>
</tr>
<tr>
<td>Physical impairment*Private insurance</td>
<td>0.03</td>
<td>0.04</td>
<td>0.40</td>
</tr>
<tr>
<td>Physical impairment*Second level (ref = primary)</td>
<td>0.07</td>
<td>0.05</td>
<td>0.11</td>
</tr>
<tr>
<td>Physical impairment*Third level (ref = primary)</td>
<td>0.02</td>
<td>0.05</td>
<td>0.69</td>
</tr>
</tbody>
</table>

Each interaction effect was adjusted for age, sex, education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2) Effects with p-values <0.05 are shown in **bold.**

* n = 2,033
8.7.3.1 Extraversion

The effect of physical impairment on positive affect was significantly moderated by scores on the extraversion personality trait, consistent with hypothesis 3.1b. The estimated interaction effect is displayed in Table 8-30.

At higher extraversion scores, change in physical impairment had a reduced negative effect on positive affect. This is illustrated in Figure 8-6. At one standard deviation above the mean extraversion score, the effect of physical impairment on positive affect was -0.05 (p = 0.09). At one standard deviation below the mean, the effect was -0.15 (p<0.01).

The negative effect of physical impairment on positive affect was small regardless of extraversion score. For older adults with low extraversion, seven additional physical impairment deficits would be required to cause a reduction of a half a standard deviation in positive affect score, which is a moderate effect size (7 x 0.15 = 1.1 = 0.5 x 2.2). While such a substantial increase in disability was rare in the current sample (<1%) it could be observed more frequently over a longer time period. Adults with high extraversion on the other hand, would require 22 additional physical impairments before positive affect was affected in a similar way.

Table 8-30: Regression analysis of effect of interaction between extraversion and change in physical impairment on positive affect (n = 2,701)

<table>
<thead>
<tr>
<th></th>
<th>Positive Affect W2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td>Positive Affect W1</td>
<td>0.19</td>
</tr>
<tr>
<td>Physical Impairment W1</td>
<td>-0.10</td>
</tr>
<tr>
<td>Change in physical impairment (centred)</td>
<td>-0.10</td>
</tr>
<tr>
<td>Extraversion (centred)</td>
<td>0.03</td>
</tr>
<tr>
<td>Change in physical impairment x Extraversion</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Adjusted for age, sex, education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)
8.7.3.2 Sensitivity Analysis: Imputed Data

The interaction effects on positive affect estimated using the imputed dataset (n = 3,414) are displayed in Table 8-31. The protective effect of extraversion remained significant (p<0.01). However, older age was also associated with a reduced negative effect of physical impairment on positive affect, consistent with hypothesis 3.7b. The size of the coefficient was similar to the analysis with the complete dataset (0.006 versus 0.004), suggesting the reduced p-value may have been due to increased power. Having a medical card was again associated with a more negative effect of physical impairment on positive affect. Again this effect was only significant at the p<0.05 level.
Table 8-31: Interactions with the effect of physical impairment on positive affect, imputed data (n = 3,414)

<table>
<thead>
<tr>
<th>Interaction effect</th>
<th>Coef.</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical impairment*Age</td>
<td>0.006</td>
<td>0.001</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Physical impairment*Sex</td>
<td>-0.05</td>
<td>0.03</td>
<td>0.11</td>
</tr>
<tr>
<td>Physical impairment*Neuroticism</td>
<td>-0.002</td>
<td>0.002</td>
<td>0.35</td>
</tr>
<tr>
<td>Physical impairment*Extraversion</td>
<td>0.01</td>
<td>0.003</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Physical impairment*Religion very important (ref = not important)</td>
<td>0.06</td>
<td>0.04</td>
<td>0.12</td>
</tr>
<tr>
<td>Physical impairment*Living as married (partner)</td>
<td>0.03</td>
<td>0.04</td>
<td>0.41</td>
</tr>
<tr>
<td>Physical impairment*Supportive partner (ref = no partner)</td>
<td>0.03</td>
<td>0.04</td>
<td>0.50</td>
</tr>
<tr>
<td>Physical impairment*Supportive friends</td>
<td>-0.001</td>
<td>0.04</td>
<td>0.99</td>
</tr>
<tr>
<td>Physical impairment*Supportive relatives</td>
<td>0.02</td>
<td>0.04</td>
<td>0.56</td>
</tr>
<tr>
<td>Physical impairment*Weekly social activity</td>
<td>-0.03</td>
<td>0.04</td>
<td>0.46</td>
</tr>
<tr>
<td>Physical impairment*Monthly social activity</td>
<td>-0.02</td>
<td>0.06</td>
<td>0.70</td>
</tr>
<tr>
<td>Physical impairment*Community participation</td>
<td>-0.002</td>
<td>0.04</td>
<td>0.95</td>
</tr>
<tr>
<td>Physical impairment<em>Medical card (low income)</em></td>
<td>-0.10</td>
<td>0.04</td>
<td>0.02</td>
</tr>
<tr>
<td>Physical impairment*Private insurance</td>
<td>0.03</td>
<td>0.03</td>
<td>0.41</td>
</tr>
<tr>
<td>Physical impairment*Secondary education (ref = primary)</td>
<td>0.05</td>
<td>0.04</td>
<td>0.24</td>
</tr>
<tr>
<td>Physical impairment*Third level education (ref = primary)</td>
<td>-0.01</td>
<td>0.04</td>
<td>0.79</td>
</tr>
</tbody>
</table>

Adjusted for age, sex, education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)

* n = 2,486
8.7.4 Effect of Physical Impairment on Control/Autonomy

Interactions between moderating factors and the effect of change in physical impairment on change in control/autonomy were estimated. The results are displayed in Table 8-32. Having supportive relatives and being a man was protective for the effect of physical impairment on control/autonomy, consistent with hypotheses 3.4c and 3.8c. However, these effects were only significant at the p<0.05 level. Only the interaction of physical impairment with living as married, and with having a supportive partner, was significant at the p<0.01 level. This effect was consistent with hypothesis 3.4c and is presented in detail in Section 8.7.4.1.

Table 8-32: Interactions with the effect of physical impairment on control/autonomy (n = 2,701)

<table>
<thead>
<tr>
<th>Interaction</th>
<th>Coef.</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical impairment*Age</td>
<td>-0.002</td>
<td>0.002</td>
<td>0.42</td>
</tr>
<tr>
<td>Physical impairment*Sex</td>
<td>-0.08</td>
<td>0.04</td>
<td>0.03</td>
</tr>
<tr>
<td>Physical impairment*Religion somewhat important</td>
<td>-0.10</td>
<td>0.05</td>
<td>0.07</td>
</tr>
<tr>
<td>Physical impairment*Religion very important</td>
<td>-0.07</td>
<td>0.05</td>
<td>0.14</td>
</tr>
<tr>
<td>Physical impairment*Neuroticism</td>
<td>-0.0001</td>
<td>0.003</td>
<td>0.96</td>
</tr>
<tr>
<td>Physical impairment*Extraversion</td>
<td>0.002</td>
<td>0.003</td>
<td>0.56</td>
</tr>
<tr>
<td>Physical impairment*Living as married (partner)</td>
<td>0.10</td>
<td>0.04</td>
<td>0.01</td>
</tr>
<tr>
<td>Physical impairment*Supportive partner (ref = no partner)</td>
<td>0.11</td>
<td>0.04</td>
<td>0.01</td>
</tr>
<tr>
<td>Physical impairment*Supportive friends</td>
<td>0.01</td>
<td>0.04</td>
<td>0.715</td>
</tr>
<tr>
<td>Physical impairment*Supportive relatives</td>
<td>0.08</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Physical impairment*Weekly social activity</td>
<td>0.02</td>
<td>0.04</td>
<td>0.64</td>
</tr>
<tr>
<td>Physical impairment*Monthly social activity</td>
<td>0.06</td>
<td>0.06</td>
<td>0.27</td>
</tr>
<tr>
<td>Physical impairment*Community participation</td>
<td>0.03</td>
<td>0.04</td>
<td>0.51</td>
</tr>
<tr>
<td>Physical impairment*Medical Card (low income)[1]</td>
<td>0.06</td>
<td>0.05</td>
<td>0.24</td>
</tr>
<tr>
<td>Physical impairment*Private health insurance</td>
<td>-0.01</td>
<td>0.04</td>
<td>0.82</td>
</tr>
<tr>
<td>Physical impairment*Secondary education (ref = primary)</td>
<td>0.04</td>
<td>0.05</td>
<td>0.43</td>
</tr>
<tr>
<td>Physical impairment*Third level education (ref = primary)</td>
<td>-0.03</td>
<td>0.05</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Adjusted for age, age\[2\], sex, education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)

\[1\]n = 2,033
8.7.4.1 Supportive partner

Having a partner, and having a consistently supportive partner at both W1 and W2, was associated with a reduced negative effect of physical impairment on control/autonomy, relative to non-married participants. Table 8-33 displays the estimated interaction effects for each level of supportive partner, including transitions between the waves.

Table 8-33: Regression analysis of effect of interaction between supportive partner and change in physical impairment on control/autonomy (n = 2,701)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>B</th>
<th>SE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control/Autonomy W1</td>
<td>655</td>
<td>0.45</td>
<td>0.02</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Physical Impairment W1</td>
<td>152</td>
<td>-0.09</td>
<td>0.02</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Change in physical impairment (centred)</td>
<td>124</td>
<td>-0.17</td>
<td>0.04</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Non-supportive W1 + W2</td>
<td>131</td>
<td>-0.34</td>
<td>0.35</td>
<td>0.34</td>
</tr>
<tr>
<td>Increased support</td>
<td>124</td>
<td>0.17</td>
<td>0.35</td>
<td>0.64</td>
</tr>
<tr>
<td>Supportive W1 + W2</td>
<td>1,639</td>
<td>0.15</td>
<td>0.31</td>
<td>0.64</td>
</tr>
<tr>
<td>Change in physical impairment x no partner (Ref)</td>
<td>655</td>
<td>Non-supportive W1 + W2</td>
<td>152</td>
<td>0.18</td>
</tr>
<tr>
<td>Decreased support</td>
<td>131</td>
<td>0.14</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>Increased support</td>
<td>124</td>
<td>-0.08</td>
<td>0.08</td>
<td>0.31</td>
</tr>
<tr>
<td>Supportive W1 + W2</td>
<td>1,639</td>
<td>0.11</td>
<td>0.04</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Interactions effects for each level of marriage supportiveness revealed a complex picture. Having an unsupportive partner at both waves (n = 152) appeared to be associated with a reduced negative effect of physical impairment on control/autonomy. Increasing spousal support (n = 124), on the other hand, was associated with a greater negative effect. It is possible that increasing spousal support was experienced as a threat to autonomy for participants. Alternatively, this finding could be explained with reference to the causal effects of disability and reduced QoL on spousal support. Consider two adults who are both
living as married, but receive low levels of support from their partner at W1. Both experience a similar increase in physical impairment between waves. However, one experiences a greater loss of control/autonomy associated with their physical impairment. This greater loss of control could induce greater support from their partner. In this way, increased spousal support could have been a marker for participants whose health and QoL was worse, resulting in the pattern effects displayed in Table 8-33.

However, there were small samples in each of the categories for low and changing partner support (see Table 8-33), making it difficult to draw firm conclusions regarding moderating effects. The only clearly interpretable protective effect was for consistent support from a partner between waves, compared with those who were not living as married. Figure 8-7 shows the difference in the effect of physical impairment on control/autonomy between participants with a supportive partner, and those who were not living as married. Even for un-married participants, the effect of physical impairment on control/autonomy was small. However, the effect among those who had a supportive marriage is practically zero.

To put the difference in effect size in context, for unmarried participants the model predicts that an additional six physical impairments would result in an approximate reduction of half a standard deviation in control/autonomy score (0.18 X 6 = 1.1 = 0.5 X 2.3), which is usually assumed to be clinically meaningful (574). Again, this level of increase in impairment was rare in the sample (<1.5%), but could be observed more frequently over a longer time period. For participants in a supportive marriage, an additional 21 deficits would be required to lead to a similarly meaningful decrease in control/autonomy. The small difference in effect size observed here is thus likely to be more meaningful at higher levels of disability.

The significant interaction effect also implies that the beneficial effect of supportive marriage increases as physical impairment increases. This effect is displayed in Figure 8-8.
Figure 8-7: Scatterplots of change in physical impairment by control/autonomy score, with lines of best fit, for non-married participants and participants with a supportive partner.
Figure 8-8: Marginal effect of supportive partner on control/autonomy, by change in physical impairment

The model displayed in Table 8-33 was repeated excluding the small number of participants who were separated, divorced or widowed between the waves (n=32). The size of the interaction effect co-efficient stayed the same (0.11), while the p-value increased slightly to p=0.015. Adjustment for clustering at the household level was also added to the model, to account for the fact that a proportion of TILDA participants were living with each other. There were a total of 2,216 households in the sample, suggesting that just under one-fifth of the sample (n=485) lived with one or more other TILDA participants. The co-efficient for the interaction effect again stayed the same, while the p-value increased to p=0.022. The interaction effect was also tested separately for men and women. While the coefficient for the interaction effect was larger for men (0.15) relative to women (0.05), the effect was not significant for either group, likely due to the reduced power associated with splitting the sample.
8.7.4.2 Sensitivity Analysis: Imputed Data

Interactions between moderating factors and the effect of change in physical impairment on change in control/autonomy were estimated using the imputed dataset \((n = 3,414)\). Estimated interaction effects are displayed in Table 8-34. The protective effect of having a supportive partner remained significant \((p<0.01)\). Women were also more likely to have an increased negative effect of physical impairment on control/autonomy \((p=0.01)\), consistent with hypothesis 3.8c. This effect was only significant at the \(p<0.05\) level in the complete data set. The size of the co-efficient was similar in the imputed and complete datasets \((-0.09 \text{ versus } -0.08)\), suggesting that the reduction in \(p\)-value was due to increased power.

Table 8-34: Interactions with the effect of physical impairment on control/autonomy, imputed data \((n = 3,414)\)

<table>
<thead>
<tr>
<th>Interaction</th>
<th>Coef.</th>
<th>SE</th>
<th>(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical impairment*Age</td>
<td>-0.002</td>
<td>0.002</td>
<td>0.36</td>
</tr>
<tr>
<td>Physical impairment*Sex</td>
<td>-0.09</td>
<td>0.04</td>
<td>0.01</td>
</tr>
<tr>
<td>Physical impairment*Religion Very Important</td>
<td>-0.04</td>
<td>0.04</td>
<td>0.30</td>
</tr>
<tr>
<td>Physical impairment*Neuroticism</td>
<td>-0.001</td>
<td>0.002</td>
<td>0.76</td>
</tr>
<tr>
<td>Physical impairment*Extraversion</td>
<td>0.004</td>
<td>0.003</td>
<td>0.28</td>
</tr>
<tr>
<td>Physical impairment*Living as Married</td>
<td>0.08</td>
<td>0.04</td>
<td>0.02</td>
</tr>
<tr>
<td>Physical impairment*Supportive marriage [Ref = not married]</td>
<td>0.10</td>
<td>0.04</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Physical impairment*Supportive friends</td>
<td>-0.01</td>
<td>0.04</td>
<td>0.86</td>
</tr>
<tr>
<td>Physical impairment*Supportive relatives</td>
<td>0.06</td>
<td>0.04</td>
<td>0.12</td>
</tr>
<tr>
<td>Physical impairment*Weekly social activity</td>
<td>-0.03</td>
<td>0.05</td>
<td>0.58</td>
</tr>
<tr>
<td>Physical impairment*Monthly social activity</td>
<td>0.05</td>
<td>0.06</td>
<td>0.49</td>
</tr>
<tr>
<td>Physical impairment*Community participation</td>
<td>0.03</td>
<td>0.04</td>
<td>0.42</td>
</tr>
<tr>
<td>Physical impairment*Medical Card (low income)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.05</td>
<td>0.04</td>
<td>0.28</td>
</tr>
<tr>
<td>Physical impairment*Private health insurance</td>
<td>0.01</td>
<td>0.04</td>
<td>0.70</td>
</tr>
<tr>
<td>Physical impairment*Secondary education</td>
<td>0.07</td>
<td>0.04</td>
<td>0.08</td>
</tr>
<tr>
<td>(Ref = primary education)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical impairment*Third level</td>
<td>0.01</td>
<td>0.04</td>
<td>0.86</td>
</tr>
</tbody>
</table>

<sup>a</sup>n = 2,486
8.7.5 Effect of Physical Impairment on Self-Realisation/Pleasure

Interactions between moderating factors and the effect of change in physical impairment on change in self-realisation/pleasure were estimated. The results are displayed in Table 8-35. One protective factor, secondary education, had an interaction with physical impairment that was significant at the p<0.05 level, consistent with hypothesis 3.3d. Two interactions were significant at the p<0.01 level; these were the interactions of physical impairment with age, and with religiosity. These interaction effects are presented in detail in Sections 8.7.5.1 and 8.7.5.2.

Table 8-35: Interactions with the effect of physical impairment on self-realisation/pleasure (n = 2,701)

<table>
<thead>
<tr>
<th>Interaction</th>
<th>Coef.</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical impairment*Age</td>
<td>0.005</td>
<td>0.002</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Physical impairment*Sex</td>
<td>-0.07</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>Physical impairment*Neuroticism</td>
<td>0.0003</td>
<td>0.002</td>
<td>0.87</td>
</tr>
<tr>
<td>Physical impairment*Extraversion</td>
<td>0.002</td>
<td>0.003</td>
<td>0.48</td>
</tr>
<tr>
<td>Physical impairment*Religion somewhat important (ref = not important)</td>
<td>0.07</td>
<td>0.05</td>
<td>0.17</td>
</tr>
<tr>
<td>Physical impairment*Religion very important (ref = not important)</td>
<td>0.15</td>
<td>0.04</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Physical impairment*Living as married (partner)</td>
<td>0.05</td>
<td>0.03</td>
<td>0.17</td>
</tr>
<tr>
<td>Physical impairment*Supportive partner (ref = no partner)</td>
<td>0.02</td>
<td>0.04</td>
<td>0.59</td>
</tr>
<tr>
<td>Physical impairment*Supportive friends</td>
<td>-0.02</td>
<td>0.03</td>
<td>0.54</td>
</tr>
<tr>
<td>Physical impairment*Supportive relatives</td>
<td>-0.04</td>
<td>0.03</td>
<td>0.21</td>
</tr>
<tr>
<td>Physical impairment*Weekly social activity</td>
<td>0.03</td>
<td>0.04</td>
<td>0.34</td>
</tr>
<tr>
<td>Physical impairment*Monthly social activity</td>
<td>-0.01</td>
<td>0.05</td>
<td>0.77</td>
</tr>
<tr>
<td>Physical impairment*Community participation</td>
<td>0.02</td>
<td>0.03</td>
<td>0.50</td>
</tr>
<tr>
<td>Physical impairment*Medical card (low income)</td>
<td>-0.004</td>
<td>0.04</td>
<td>0.93</td>
</tr>
<tr>
<td>Physical impairment*Private health insurance</td>
<td>0.01</td>
<td>0.03</td>
<td>0.73</td>
</tr>
<tr>
<td>Physical impairment*Secondary education (ref = primary)</td>
<td>0.08</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>Physical impairment*Third level (ref = primary)</td>
<td>0.003</td>
<td>0.04</td>
<td>0.94</td>
</tr>
</tbody>
</table>

Adjusted for age, sex, education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)

\[n = 2,033\]
8.7.5.1 Age

Age had a significant interaction with change in physical impairment in its effect on change in self-realisation/pleasure between W1 and W2 (see Table 8-36). As Figure 8-9 shows, at one standard deviation (SD) (8.5) below the mean age (54 yrs), the negative effect of physical impairment on self-realisation/pleasure was statistically significant (-0.07, p<0.01). At older ages (+1 SD above the mean), the effect of physical impairment was no longer negative, and the effect was not significant (0.01, p = 0.75).

However, even among younger participants, the negative effect of physical impairment on self-realisation was tiny. Based on the assumption that a difference of half of a standard deviation represents a meaningful change, an additional 14 deficits would be required before self-realisation/pleasure was meaningfully affected among participants aged 54 (-0.07 X 14 = -1.0 = 0.5 x 1.9). This was consistent with the finding reported earlier in this chapter that self-realisation/pleasure was only minimally responsive to changes in physical impairment (Section 8.3.2).

Table 8-36: Regression analysis of effect of interaction between age and change in physical impairment on self-realisation/pleasure (n = 2,701)

<table>
<thead>
<tr>
<th></th>
<th>Self-Realisation/Pleasure W2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td>Self-Realisation/Pleasure W1</td>
<td>0.43</td>
</tr>
<tr>
<td>Physical Impairment W1</td>
<td>-0.04</td>
</tr>
<tr>
<td>Change in physical impairment (centred)</td>
<td>-0.03</td>
</tr>
<tr>
<td>Age (centred)</td>
<td>0.01</td>
</tr>
<tr>
<td>Change in physical impairment x Age</td>
<td>0.005</td>
</tr>
</tbody>
</table>

Adjusted for age, sex, education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)
Effects of physical impairment on self-realisation were also modified by the importance of religion to the person. The estimated interaction effect is displayed in Table 8-37. Among participants for whom religion was very important, the negative association between increased physical impairment and self-realisation/pleasure was reduced. No protective effect was observed for participants who saw religion as somewhat important, relative to not important.

Church attendance was also adjusted for to account for the social and environmental aspects of religious participation, versus religiosity as a personal characteristic. Geographical location was also adjusted for to take account of the possibility that there may be higher levels of religiosity in rural areas.
Table 8-37: Regression analysis of effect of interaction between importance of religion and change in physical impairment on self-realisation/pleasure (n = 2,701)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>B</th>
<th>SE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Realisation/Pleasure W1</td>
<td></td>
<td>0.42</td>
<td>0.02</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Physical Impairment W1</td>
<td></td>
<td>-0.04</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>Change in physical impairment (centred)</td>
<td></td>
<td>-0.11</td>
<td>0.04</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Religion not important W2 [Ref]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Religion Somewhat Important W2</td>
<td>0.05</td>
<td>0.10</td>
<td>0.63</td>
<td></td>
</tr>
<tr>
<td>Religion Very Important W2</td>
<td>0.29</td>
<td>0.12</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Change in physical impairment x Religion not important W2 [Ref]</td>
<td>545</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in physical impairment x Religion Somewhat Important W2</td>
<td>873</td>
<td>0.07</td>
<td>0.05</td>
<td>0.17</td>
</tr>
<tr>
<td>Change in physical impairment x Religion Very Important W2</td>
<td>1283</td>
<td>0.15</td>
<td>0.04</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Adjusted for age, sex, education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2), church attendance, geographical location (Dublin/town/rural area), importance of religion (W1)

As Figure 8-10 shows, among participants for whom religion was very important, the effect of physical impairment on control/autonomy was close to zero and not statistically significant (0.04, p = 0.10). The effect of change in physical impairment on self-realisation/pleasure for participants with low religiosity, on the other hand, was significantly negative (-0.09, p<0.001). However, even for low religiosity participants the effect of each additional physical impairment on self-realisation/pleasure was small (<0.1 SD). It is thus likely that the protection associated with religion is only clinically important at very high increases in physical impairment. This is consistent with evidence found throughout this thesis that self-realisation/pleasure is not strongly affected by physical impairment.

Another way of interpreting this interaction effect is that religiosity is more beneficial for sense of meaning and enjoyment in life when a person is experiencing greater declines in health. Figure 8-11 displays how high religiosity has little impact on self-
realisation/pleasure when level of disability is improving or staying the same, but becomes increasingly beneficial as physical impairment increases.

Figure 8-10: Scatterplots of change in physical impairment by self-realisation/pleasure score, with lines of best fit, by religiosity
Weekly church attendance was also associated with a reduced effect of physical impairment on self-realisation/pleasure. However, when interaction terms for church attendance and importance of religion were included in the same model, only the protective effect of importance of religion was statistically significant. This suggests that importance of religion was the key protective factor, rather than church attendance. Interaction terms for age, church attendance and importance of religion were also all included in the same model. In this model, only importance of religion was significantly protective. This indicates that the observed protective effect of age could have been due to the close association between age and religiosity, rather than an independent protective effect of age.
8.7.5.3 Sensitivity Analysis: Imputed Data

The interaction effects estimated using the imputed dataset (n = 3,414) are displayed in Table 8-38. The protective effect of importance of religion remained significant (p<0.01). The protective effect of increasing age, on the other hand, was no longer significant at the p<0.01 level.

<table>
<thead>
<tr>
<th>Interaction</th>
<th>Coef.</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical impairment*Age</td>
<td>0.004</td>
<td>0.002</td>
<td>0.03</td>
</tr>
<tr>
<td>Physical impairment*Sex</td>
<td>-0.05</td>
<td>0.03</td>
<td>0.11</td>
</tr>
<tr>
<td>Physical impairment*Neuroticism</td>
<td>-0.001</td>
<td>0.002</td>
<td>0.78</td>
</tr>
<tr>
<td>Physical impairment*Extraversion</td>
<td>0.004</td>
<td>0.003</td>
<td>0.11</td>
</tr>
<tr>
<td>Physical impairment*Religion very important</td>
<td>0.12</td>
<td>0.03</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Physical impairment*Living as married (partner)</td>
<td>0.05</td>
<td>0.03</td>
<td>0.14</td>
</tr>
<tr>
<td>Physical impairment*Supportive partner (ref = no partner)</td>
<td>0.05</td>
<td>0.03</td>
<td>0.12</td>
</tr>
<tr>
<td>Physical impairment*Supportive friends</td>
<td>0.03</td>
<td>0.03</td>
<td>0.31</td>
</tr>
<tr>
<td>Physical impairment*Supportive relatives</td>
<td>-0.01</td>
<td>0.03</td>
<td>0.73</td>
</tr>
<tr>
<td>Physical impairment*Weekly social activity</td>
<td>-0.01</td>
<td>0.03</td>
<td>0.82</td>
</tr>
<tr>
<td>Physical impairment*Monthly social activity</td>
<td>-0.03</td>
<td>0.04</td>
<td>0.49</td>
</tr>
<tr>
<td>Physical impairment*Community participation</td>
<td>-0.02</td>
<td>0.05</td>
<td>0.72</td>
</tr>
<tr>
<td>Physical impairment*Medical card (low income)</td>
<td>-0.003</td>
<td>0.03</td>
<td>0.93</td>
</tr>
<tr>
<td>Physical impairment*Private health insurance</td>
<td>0.02</td>
<td>0.04</td>
<td>0.60</td>
</tr>
<tr>
<td>Physical impairment*Secondary education (ref = primary)</td>
<td>0.02</td>
<td>0.03</td>
<td>0.51</td>
</tr>
<tr>
<td>Physical impairment*Third level education (ref = primary)</td>
<td>0.07</td>
<td>0.03</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Adjusted for age, sex, education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)

^n = 2,486
8.8 Interaction Effects: Summary

The evidence in relation to specific hypotheses concerning interaction effects is summarised in Table 8-39. Few of the hypothesised protective effects were identified. However, at least one factor was protective for effects of physical impairment on affective wellbeing, control/autonomy and self-realisation/pleasure.

The interaction effects were broadly consistent across the complete sample (n=2,701) and the imputed sample (n=3,414). In the fully imputed sample, the same statistically significant interaction effects were identified (see Appendix 7, Tables A7.2-A7.5). The exception was control/autonomy, for which the protective effect of having a supportive partner was only significant at p<0.05, while supportive relatives were significantly protective at p<0.01. It is possible that the complex pattern of interaction effects observed in relation to spousal support meant that this effect was particularly susceptible to being biased towards zero as a result of the complex structure of the data not being preserved in the imputed dataset.

Overall, mean levels of physical impairment did not increase substantially over the study period. Where physical impairment did increase, the main effect on self-realisation/pleasure was not significant, while negative effects on affective wellbeing and control/autonomy were small in size. However, though the main effects were small, they were significantly smaller again in the presence of specific protective factors. It is possible that the interaction effects detected here are suggestive of a trend which will become more clinically significant as larger increases in physical impairment are observed over subsequent waves of data collection in TILDA.
### Table 8-39: Summary of interaction effects

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher extraversion (3.1), lower neuroticism (3.2), higher SEP (3.3), good quality social support (3.4), more frequent social participation (3.5), and higher religiosity (3.6):</td>
<td></td>
</tr>
<tr>
<td>a  reduce the effect of incident chronic conditions on increased physical impairment:</td>
<td>Not supported</td>
</tr>
<tr>
<td>b  reduce the effect of increasing physical impairment on positive affect</td>
<td><strong>Partially supported</strong>: Higher extraversion scores were associated with a reduced effect. However, the other protective factors were not statistically significant.</td>
</tr>
<tr>
<td>c  reduce the effect of increasing physical impairment on control/autonomy</td>
<td><strong>Partially supported</strong>: Having a supportive partner was associated with a reduced effect. However, the other protective factors were not statistically significant.</td>
</tr>
<tr>
<td>d  reduce the effect of increasing physical impairment on self-realisation/pleasure</td>
<td><strong>Partially supported</strong>: Higher religiosity was associated with a reduced effect. However, the other protective factors were not statistically significant.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age (3.7) and sex (3.8):</th>
</tr>
</thead>
<tbody>
<tr>
<td>a  modify the effect of incident chronic conditions on increased physical impairment</td>
</tr>
<tr>
<td>b  modify the effect of increasing physical impairment on positive affect</td>
</tr>
<tr>
<td>c  modify the effect of increasing physical impairment on control/autonomy</td>
</tr>
<tr>
<td>d  modify the effect of increasing physical impairment on self-realisation/pleasure</td>
</tr>
</tbody>
</table>
Chapter 9 Discussion

9.1 Introduction

The purpose of this chapter is to summarise the thesis findings, discuss the findings in relation to the current literature on the topic and identify the implications of the findings for research and policy in health, health services and ageing. A brief summary of the thesis findings is given below, with the final model of the relationship between chronic disease and QoL displayed in Figure 9-1. The findings will be discussed in more detail under three substantive headings: measurement of QoL (Section 9.2), pathways between chronic conditions and QoL (Section 9.3), and protective factors along the pathway between chronic conditions and QoL (Section 9.4). Under each heading, the original research questions are provided for context, followed by a summary of findings and a discussion of how the findings relate to the current theory and evidence.

The impact of the thesis findings will be discussed in Section 9.5. Potential for impact will be identified across four areas: research, services, policy and society, based on the Research Impact Framework developed by Kuruvilla et al. (2006) (56). Section 9.6 will include a discussion of key methodological strengths and limitations of the thesis. The chapter will conclude with recommendations for further research (Section 9.7). A brief conclusion chapter (Chapter 10) will follow, highlighting the relevance of the thesis findings for research and practice in relation to chronic disease and QoL in later life.

9.1.1 Brief Summary of Findings

- The CASP measure of QoL can be measured using a 12-item or 10-item two-factor model comprising control/autonomy and self-realisation/pleasure.

- Chronic disease affects QoL indirectly via negative effects on physical impairment and affective wellbeing.

- Control/autonomy is more sensitive to variation and change in physical impairment, compared with self-realisation/pleasure.

- A supportive partner reduces the effect of physical impairment on control/autonomy.

- Religiosity reduces the effect of physical impairment on self-realisation/pleasure.
Figure 9-1: Empirically validated model of the pathway between chronic disease and QoL

Figure 9-1: Empirically validated model of the pathway between chronic disease and QoL
9.2 Measurement of QoL

9.2.1 Research Questions

1. Is the CASP-19 a psychometrically valid measure of QoL in the Irish population aged 50+?

   1.1. Do established measurement models for the CASP-19 display good fit in a general-population sample of Irish adults aged 50+?

   1.2. If established measurement models do not fit well the data well, how can the item composition and factor structure be revised to achieve good fit while also remaining consistent with the underlying conceptual model for the scale?

9.2.2 Summary of Findings

The systematic review of current literature on the effects of chronic disease on QoL (Chapter 2) confirmed the on-going dominance of health-related QoL (HRQoL) measures in research with older people (34). HRQoL measures emphasise physical health and function, and tend to be problem-centred, focussed on evaluating the negative aspects of people’s lives (66,204,230). The CASP-19 was identified as an alternative measure of QoL (43). This measure is based on a conceptual model of QoL which is distinct from health and function, and captures positive aspects of QoL in addition to problems. It measures both evaluative and eudaimonic dimensions of QoL: how satisfied older adults are with their lives, and their sense of meaning, purpose, control and autonomy.

However, there was limited evidence for the psychometric validity of two existing versions of the CASP-19 (46,47) (see Chapter 6). Neither version had good model fit in TILDA, and a revised version of the measure was developed. Residual covariances were added across reverse-worded items to adjust for a method effect. The control and autonomy dimensions were combined, and the self-realisation and pleasure dimensions were also combined. Seven poorly fitting items were excluded. This measurement model had excellent fit to the data, and was consistent with the underlying conceptual model for the CASP measure of QoL.
Subsequent analysis found that two items capturing the effect of age and health on control/autonomy (items 1 and 8) were closely related to latent physical impairment (Section 5.4.3.2). These items were removed to ensure that control/autonomy was sufficiently distinct from disability in order to accurately measure the relationship between them. Control/autonomy and self-realisation/pleasure displayed differential relationships with chronic disease and disability in the analyses of cross-sectional (Section 7.5) and longitudinal effects (Section 8.3), with control/autonomy more sensitive to variation and change in chronic disease status and physical impairment. This finding provided further support for the two-factor structure for CASP.

9.2.3 Method Effects

Method effects associated with reverse-worded items have been identified across a range of psychological measures, including measures of QoL (260) and depression (509). A method effect occurs where item responses are a function of the underlying trait, residual factors, and a measurement characteristic – in this case, direction of item wording (559,560). A method effect associated with reverse-worded items in CASP has also been identified in ELSA (263,268). In the CASP measure, a potential source of the problem is the asymmetry of the response options, which range from Never to Often. Never is not the opposite of Often (Always would be the opposite) and there is thus a different threshold for the top response depending on the wording direction.

Reverse-worded items are typically included in questionnaires to minimise acquiescence bias – that is, a tendency to respond positively to items. However, their use is based more on convention than evidence for necessity or effectiveness (561). Identification of method effects related to reverse-worded items across a range of measures suggests that they may confuse participants, and complicate the interpretation of scale scores. The research implications of method effects are briefly discussed in Section 9.5.1.2.

9.2.4 Evaluation of the Impact of Life Circumstances

Items included to evaluate the effect of age and health on control/autonomy were closely associated with indicators of body function and activity. This finding was consistent with suggestions that these items should be excluded from the CASP measure of QoL to ensure
clear conceptual separation between physical health and QoL (268). Evaluations of the impact of ageing and health are not necessarily the same as perception or performance measures of health (212) – a person may have functional deficits, but nevertheless evaluate the impact on their lives as minimal. However, in this case, empirical analysis revealed that evaluations and perceptions were too closely related to be examined separately.

Thus, while it is possible to argue that perceptions and evaluations of health status are ontologically distinct, they may be too highly co-occurring to practically examine them separately. Realist approaches to measurement assert the primacy of ontological considerations (575). However, a coherent argument for the validity of a specific ontological distinction may not be supported by empirical and psychometric evidence. Pragmatic approaches suggest that the utility of a measure is based on how useful it is for describing and explaining reality, in addition to the extent to which it reflects ontological distinctions (576).

9.2.5 Dimensionality of CASP

The factor structure of the CASP measure proposed and used in this thesis has similarities and differences with other versions of CASP. In common with other versions, the control and autonomy dimensions are combined (46,268). However, the combination of self-realisation and pleasure represents a departure from consensus on the dimensionality of CASP (46,47,263). It is possible to argue that self-realisation is more aligned with a sense of having a purpose in life, while pleasure more is focussed on happiness or enjoyment. Previous research with student and adult populations suggests that there are distinct hedonic and eudaimonic dimensions of wellbeing (577,578). Inspection of the item content of the CASP-19 does not suggest that the two dimensions are aligned in this way, with items relevant to eudaimonia (meaning in life) included as pleasure, and items related to hedonia (life satisfaction) included in self-realisation (see Section 6.8.1). Accordingly, exploratory factor analysis (EFA) did not suggest that self-realisation and pleasure were distinct factors.

The differences between living a satisfying and a fulfilling life are subtle and complex, and may be difficult to distinguish with simply worded generic items. For example, responses to items "I look forward to each day" and "I feel my life has meaning" were highly correlated (r
suggesting that happiness and purpose are at least highly co-varying in the TILDA sample. In ELSA, the self-realisation dimension was found to be highly correlated with life satisfaction, the most commonly used measure of hedonic wellbeing (263). A developmental perspective may inform interpretation of the close relationship between hedonic and eudaimonic wellbeing observed in TILDA and ELSA. McGregor et al. (1998) found that meaning in life was more important for wellbeing in a senior manager sample, relative to a student sample (578). The authors speculated that as the life-course progresses, meaning may become increasingly important for happiness. This would imply that hedonia and eudaimonia are less differentiated in older populations.

It is worth noting that studies using a version of the CASP measure of QoL rarely examine pleasure and self-realisation as separate dimensions, with the majority of studies examining summed scores (e.g., 37,40,192,305). The use of summed scores for CASP was supported by the psychometric analysis reported in Chapter 6, which found that a single-factor model had good fit to the data. However, summary QoL scores prevent examination of differential effects across dimensions (204). This is one of the major advantages of a two-factor version of CASP, and this was supported by the differential effects on the two dimensions that were identified. These differential effects will be discussed in more detail in the next sections.

9.3 Pathway between Chronic Conditions and QoL

9.3.1 Research Questions

2. How is the relationship between chronic conditions and QoL mediated?

2.1. Do chronic conditions indirectly affect affective wellbeing and QoL via the ICF domains (body function, activity and participation restrictions)?

2.2. Do the ICF domains indirectly affect QoL via affective wellbeing?

2.3. Are these relationships characterised by full or partial mediation?

2.4. What is the size of the effect at each stage of the pathway?

2.5. Do effects along the pathway vary according to sex and age group?
2.6. If CASP QoL can be measured as more than one dimension, what are the differential effects of chronic conditions and disability on each dimension?

3. How do relationships along the pathway between chronic conditions and QoL operate longitudinally?

3.1. Do incident chronic conditions affect change in each of the ICF domains, affective wellbeing and QoL?

3.2. Is change in each of the ICF domains associated with change in affective wellbeing and QoL?

9.3.2 Summary of Findings

Factor analysis showed that latent factors measuring body function and activity were too closely correlated to be examined as distinct dimensions of disability, and were combined into a single physical impairment factor (Section 7.4). This single physical impairment factor fully mediated the effect of chronic disease on affective wellbeing, control/autonomy and self-realisation/pleasure (Model 3.3, see Figure 7-6, p. 267). Affective wellbeing partially mediated the effect of physical impairment on both control/autonomy and self-realisation/pleasure. Participation restrictions also mediated the effect of physical impairment on affective wellbeing and QoL, although these effects accounted for only a small proportion of the total effect of chronic conditions on QoL. The total effect of chronic conditions on QoL was primarily composed of two indirect effects: an indirect effect via physical impairment and an indirect effect via physical impairment and affective wellbeing (see Table 7-10, p. 266).

Effects were broadly consistent across men and women aged under and over 65 (Section 7.6), and in sensitivity analyses which used alternative definitions of chronic disease and affective wellbeing (Section 7.8). In terms of effect size, the total effect of chronic disease on both dimensions of QoL was small. However, total effects of physical impairment on positive affect and control/autonomy were moderate in size. In contrast, the effect size for the total effect of physical impairment on self-realisation/pleasure was small, and significantly smaller relative to control/autonomy. In addition, at a given level of control/autonomy, additional physical impairment did not have a negative effect on self-
realisation/pleasure, indicating that control/autonomy mediated negative effects of physical impairment on self-realisation/pleasure (see Table 7-12, p. 269).

The cross-sectional effects identified were supported by longitudinal analysis. Incident chronic conditions were associated with increased physical impairment over a two-year period. Change in physical impairment was associated with change in control/autonomy and positive affect. However, the effect sizes were small though, consistent with previous analyses of change in CASP-19 total score over a similar time period (573). Self-realisation/pleasure was less responsive to change in physical impairment, with no significant association once the effects of personality were adjusted for.

9.3.3 Conceptual Frameworks for Defining Disability

Each of the conceptual frameworks for defining disease, disability and QoL reviewed in Section 4.2 made a distinction between body function and activity, and indicated that body function has a causal effect on activity (270–272). However, in this thesis body function and activity were too closely related to empirically distinguish their effects. It is theoretically plausible that underlying deficits in body function, such as pain or physical strength, have a causal effect on activity, such as walking or lifting heavy objects. Examining body function and activity separately allows examination of variation in this causal relationship; for example, people who maintain high levels of activity in a context of pain or poor balance. In this sample, however, the two domains were so closely related that it was not possible to examine any variation in the relationship.

Across the frameworks reviewed in Section 4.2, the boundaries between what constitutes an indicator of body function and an indicator of activity were often poorly defined and inconsistent across different frameworks and studies (see Section 4.2.4). This may partly reflect problems of measurement. Body function can often only be measured by assessing activity. For example, muscle power may be measured by asking someone to grip an object. Similarly, self-reported perceptions of balance may be influenced by the extent to which any balance problems have an effect on activities. Observed deficits in both body function and activity are arguably caused by underlying latent impairment in the functioning of the body, and it therefore makes sense to measure them as a single latent factor (575,579).
The extent to which things should be examined separately or together in health status measurement is an on-going question. Rockwood & Mitnitski’s approach to frailty advises measurement of the total accumulation of deficits, or “things that individuals have wrong with them” (580). However, this prevents comparison of predictors and consequences across different domains of function, for example physical and cognitive domains of function. A balance must therefore be struck between distinguishing unique dimensions of health and disability, and avoiding making refined conceptual distinctions which make conceptual and ontological sense, but are impossible to distinguish empirically. Ultimately, conceptual frameworks for disability and health status need to be theoretically and conceptually sensible, be consistent with the empirical evidence, and have maximum utility for describing and explaining that empirical evidence.

9.3.4 Role of Physical Impairment

The findings of this thesis add to existing evidence for physical function as a mediator of the effect of chronic conditions on QoL. Previous studies have examined this effect using a number of QoL measures, including HRQoL, happiness and the WHOQoL measure of QoL (79,182,187). The measure of QoL used in the thesis was broader, covering happiness and satisfaction with life, but also meaning, purpose, control and autonomy. A relatively comprehensive measure of physical impairment was used, including body function and activity deficits, and this measure fully mediated the effect of chronic disease on QoL. In contrast, when examined separately none of the disability indicators on their own fully mediated the effect of chronic conditions on QoL. This cross-sectional mediation analysis was also supported by longitudinal analysis: incident chronic conditions only had a negative effect on QoL when accompanied by an increase in physical impairment.

The finding that chronic diseases affect QoL only insofar as they are disabling highlights the fact that chronic diseases are not inevitably associated with disability. As the results of the systematic review reported in Chapter 2 demonstrated, chronic conditions are associated with diverse outcomes in terms of health status and physical function. This is also acknowledged in current guidelines for treating multi-morbidity in older adults (581,582). Recent epidemiological evidence from the US and Europe indicates that while overall levels of chronic disease in the older population are increasing, levels of impairment in body
function and activity remain stable (10,15). This may be partly to do with better management of disease with medications and other therapies, and partly to do with higher rates of diagnosis for milder forms of conditions. Either way, it appears that while increasing life expectancy may be associated with an expansion of morbidity, this may not entail a similar expansion of disability (12).

9.3.5 Role of Participation Restrictions

The weak role for participation restrictions found in this thesis was consistent with previous studies which found that participation was not an important mediator of the effects of physical health on HRQoL or happiness (182,288). While participation was a significant predictor of QoL, the negative effects of lower levels of participation were small relative to the negative effects of physical impairment. This suggested that participation restrictions that occur as a result of disability may be of less importance to QoL relative to the effects of the actual disability itself.

The role of participation restrictions in the pathway between chronic conditions and QoL may depend on how important the activity is to the individual. Satisfaction with participation has been found to be a better predictor of QoL relative to observed levels of participation (305). Similarly, there is evidence to suggest that participation is only beneficial for QoL when it is associated with a high degree of control (38,307–310). For example, continued employment during illness is unlikely to improve QoL when done out of financial necessity, rather than a desire to continue working. Comparing QoL across individuals with differing levels of participation does not provide any information on how meaningful or engaging that participation is, nor whether it is freely chosen by the individual concerned.

9.3.6 Role of Affective Wellbeing

The role of affective wellbeing was also consistent with the hypothesised structural model. Positive affect mediated the effect of chronic conditions and disability on QoL, which was consistent with previous studies (276,283,299). However, it did not fully mediate it, and this is consistent with the idea that QoL judgements are not fully determined by mood, and that affect and QoL are distinct constructs (322). The total cross-sectional effect of physical
impairment on affective wellbeing was moderate (-0.45), based on Cohen's d effect size. This adds to existing evidence for the risk of increased depressive symptoms associated with disability (324,327). However, the small effect size found for the longitudinal analysis suggested a high threshold of physical impairment before affective wellbeing is threatened in a meaningful way.

9.3.7 Differential Effects on Dimensions of QoL

The finding that control/autonomy mediated effects of physical impairment on self-realisation/pleasure adds to the current empirical evidence for perceived control as a mediator of the effects of physical health on overall QoL (222,568–570). It also supports Diener's suggestion that physical health primarily affects life satisfaction by interfering with the pursuit and attainment of valued goals (215). This finding is also consistent with the theory of illness intrusiveness, which suggests that disease has a negative effect on activities across life domains, which in turn reduces perceived control, which in turn reduces overall wellbeing (566,567). The weak effects of physical impairment on self-realisation/pleasure found in this thesis are also consistent with earlier findings that purpose in life and positive relations with others are relatively unaffected by chronic disease burden (262).

Recognition of the key role of perceived control could be a solution to the so-called "paradox of wellbeing", which is the finding that older adults maintain high levels of wellbeing in a context of declining health and function (36–39). As shown in this thesis, older adults' sense of meaning and enjoyment in life may not be very sensitive or responsive to variation or change in life circumstances, including chronic conditions and disability. However, increasing disability may have more of a direct, detrimental effect on control/autonomy, which in turn can have an effect on self-realisation/pleasure. When evaluating the negative effects of declining health or the positive effects of health interventions on QoL, it may make sense to focus on control/autonomy as a primary outcome. Measures of life satisfaction or self-realisation/pleasure could then be evaluated as a secondary outcome.
9.4 Protective Factors in the Pathway between Chronic Conditions and QoL

9.4.1 Research Questions

4. How do personal and environmental factors modify longitudinal effects along the pathway between chronic conditions and QoL?

How do the following factors:

4.1. Neuroticism
4.2. Extraversion
4.3. Socio-economic position
4.4. Social support
4.5. Social participation
4.6. Religiosity
4.7. Age
4.8. Sex

Modify the following effects:

i. Effects of incident chronic conditions on physical impairment
ii. Effects of physical impairment on positive affect, control/autonomy and self-realisation/pleasure?

9.4.2 Summary of Findings

Effects of incident chronic conditions on physical impairment were not modified by any personal or environmental factors. Participants with fewer protective resources did not experience a greater decline in body function and activity when diagnosed with a new condition, relative to those with protective factors such as social support or higher income. Overall, the association between an incident chronic disease diagnosis and change in physical impairment was statistically significant but small in size. All else being equal, an incident condition was associated with an average additional increase of only 0.5 physical impairment deficits. It is possible that the timing of a diagnosis of a disease is not always contemporaneous with the progression of that disease in terms of effects on functioning.
Personality was the only factor tested which was protective for the effect of physical impairment on positive affect. A higher extraversion score was associated with a reduced effect of physical impairment on positive affect. This effect was also identified in the multiply imputed dataset. None of the other interactions tested were statistically significant at $p<0.01$. The protective effects of income and older age trended towards statistical significance ($p<0.05$).

Participants with a consistently supportive partner had a reduced negative effect of physical impairment on control/autonomy, relative to those who did not have a partner. This effect was also identified in the multiply imputed dataset. Protective effects of supportive relatives and male sex trended towards statistical significance ($p<0.05$).

Participants for whom religion was very important were more likely to maintain self-realisation/pleasure in response to increasing physical impairment. Regular church attendance and age were also protective. When interactions of physical impairment with church attendance, importance of religion and age were included in the same model, only importance of religion was protective. The protective effect of religiosity was also identified in the multiply imputed dataset.

### 9.4.3 Personality

The association between extraversion and a reduced effect of physical impairment on affective wellbeing is consistent with evidence that this personality trait is associated with more positive emotions, and better coping in the face of stress (348). Previous research has found that emotions are more sensitive to personality than cognitions (366). As discussed in Section 3.6, the CASP measure of QoL is more aligned with cognitive dimensions of wellbeing (evaluative and eudaimonic). This may explain why there was no evidence in this thesis for a protective effect of extraversion for CASP dimensions. A previous study also found that that extraversion did not modify the effect of chronic conditions on life satisfaction, an indicator of evaluative wellbeing (220).

It is not clear why extraversion was protective for the effect of physical impairment on positive affect, while low levels of neuroticism were not. Previous research regarding the protective role of neuroticism is inconsistent (220,375). There is evidence which suggests
that neuroticism tends to decrease across the life course, as people become more skilled at managing their negative emotions (583). In one British sample with an average age of 45, the mean neuroticism score was 19.5 (516) compared with 17.9 for the TILDA participants included in Analysis Phase 3 (see Table 8-4, p. 293). This may explain why low levels of neuroticism did not emerge as an important protective factor.

9.4.4 Religion

Ramsey identifies three pathways via which religion protects against the negative effects of declining health: cognitive, affective and relational (379). Cognitively, religious belief is thought to be conducive to contextualising negative experiences within a larger frame of reference, and attributing meaning to adverse experiences such as declining health. The current finding that self-rated religiosity was protective for the effect of disability on sense of meaning and enjoyment in life supports this cognitive pathway. It is also consistent with previous evidence that spiritual beliefs reduced the negative effect of frailty on eudaimonic wellbeing (393).

As noted in Section 4.3.6, Ireland is historically a very Catholic country. Inglis emphasises the role of an Irish Catholic habitus – defined as a set of values, dispositions and expectations which "go without saying" among a social or cultural group – in shaping how older Irish adults interpret their experiences of life (584). These values and dispositions may include a tendency towards finding meaning in, and acceptance of, declining physical health (585). This process of meaning-making can be seen as a type of response-shift (211,212) and is also consistent with theories of gerotranscendence (383,384) discussed in Section 4.3.2.

Of course, acceptance of declining physical health in older age may not be conducive to the best possible QoL outcomes in all circumstances. For example, acceptance may lead to a less proactive approach to managing disease and disability. Positive evaluations of QoL can sometimes be due to unrealistically low expectations. This issue highlights a tension in QoL research between acknowledging that each individual is the best judge of their own QoL, and awareness that there are situations where people could benefit from having higher standards or expectations for their own QoL.
Religion may also promote resilience by improving affective wellbeing, particularly hope and optimism (379). A previous study found that religious beliefs and practices modified the effect of chronic disease and disability on affective wellbeing (392). In the current analysis, the protective effect of religiosity for positive affect trended towards statistical significance (p=0.09). The relational dimension of religion is also important to consider. Increased sense of belonging and integration in a community, leading to high levels of perceived support, may be a crucial way in which religiosity contributes to resilience (379,389). While church attendance did not exhibit a protective effect independent of the effect of importance of religion, it is possible that importance of religion to a person may be a stronger indicator of engagement with a religious community than church attendance.

9.4.5 Age and Sex

The negative effect of physical impairment on self-realisation/pleasure reduced with age. Age was also protective for the effect of physical impairment on positive affect in imputed analysis. This was consistent with studies identified in the systematic review (Chapter 2) that found that chronic conditions had a reduced effect on QoL at older ages (150,152,162,184,186).

However, age and religiosity are closely related to each other, and it was thus important to disentangle these two protective factors in relation to self-realisation/pleasure. When the two interaction effects were examined together, only religiosity was significantly protective for the impact of physical impairment on self-realisation/pleasure. Theories of gerotranscendence suggest that as people age, they place less of a priority on physical health, and place more value on broader meanings and purpose in life, including spiritual dimensions of existence (383,384). The evidence identified here suggests that higher religiosity may be a key factor which explains why older people tend to experience a reduced negative effect of physical health on QoL.

Current evidence reviewed in Chapter 2 and in Section 4.3.5 in relation to the moderating effects of sex along the pathway between chronic disease and QoL was equivocal. However, in the two studies identified in Chapter 2 which did detect a moderating effect of sex, women experienced an increased negative effect of chronic disease on QoL (137,184). Similarly, in the current analysis, women experienced a greater negative effect of physical
impairment on control/autonomy, although this was only significant in the imputed dataset (p<0.01). Women also experienced greater negative effects on affective well-being and self-realisation/pleasure, though these effects only trended towards statistical significance (p = 0.06, p=0.05) and were not detected in the imputed dataset.

Women tend to be the main carers in families and relationships, and may themselves receive less social support to help them cope with increasing disability. Evidence from the 1980s suggested that men benefit more from marriage than women (586). More recent evidence however, suggests that men and women experience broadly equal benefits from marriage (587). In the current thesis, the coefficient for the protective effect of having a supportive partner was larger for men. However, this difference was not statistically significant, making it difficult to draw firm conclusions.

9.4.6 Social Support and Participation

Availability of support from a partner was protective for the effect of physical impairment on control/autonomy. The protective effect of supportive relatives trended towards significance. No protective effect was observed for supportive friendship. This finding was consistent with previous studies (197,443,444,450), and supports the contention that a partner or family member is best placed to provide the type of "diffuse and unstructured" support required by older adults with declining health and function (449) (p. 187).

The fact that a protective effect was identified for control/autonomy, and not self-realisation/pleasure or affective wellbeing, suggested that the instrumental dimension of support was critical. This is consistent with the hypothesis that emotional support may be more beneficial in the population generally (447,450), but that instrumental support may more important in a context of disability (450).

Evidence was identified for the type of reverse causation effects referred to in the literature as "mobilisation" effects (311,446,447). Among older adults who had unsupportive partner at W1, those who experienced an increase in support appeared to experience a greater negative effect of physical impairment on control/autonomy, relative to those whose partners stayed un-supportive. This could be explained by an increase in support mobilised by physical decline which was accompanied by a loss of control. This
highlights the advantages of examining the buffering effects of social support over more than one time-point, so that such reverse causation effects could be detected.

Social activity and participation were not protective for the effects of physical impairment on any of the outcomes. It is possible that participation in and of itself does not lead to resilience. Similar to the role of participation restrictions in the pathway between chronic conditions and QoL, it is possible that the protective effect of participation depends on the perceived quality and value of participation.

9.4.7 Socioeconomic Position

Higher socioeconomic position (SEP) was not protective for the effect of disability on QoL. Having a medical card was associated with a greater negative effect of physical impairment on affective well-being, though this effect was not significant at the p<0.01 level. Previous research on these effects among older adults is sparse, as outlined in Section 4.3.3. It is possible that socioeconomic resources become less important in later life as inequalities converge (396–398). In the TILDA sample there was some evidence to support convergence. Older adults with a low income had fewer additional deficits associated with an incident condition, although this was not significant at the p<0.01 level. In addition, the effect size was small and unlikely to be of practical significance. Previous research in TILDA found that social class and assets explained only a small proportion of the variance in total CASP-19 score (76).

It is possible that no protective effects of SEP were identified due to the fact that weak, proxy measures of SEP were used. The limitations associated with the SEP measures used will be discussed in Section 9.6.3. Alternatively, it is possible that the Irish welfare regime, characterised by relatively generous basic pension entitlements and a range of healthcare benefits for adults on a low income (see Section 4.3.6), minimises some of the risks associated with low SEP in later life. Finally, it is also likely that socioeconomic factors influenced TILDA participants in multiple ways throughout the life course, and may be more predictive of adult's physical health at the beginning of later life, than trajectories of function during later life.
9.4.8 Theories of Resilience

Both environmental factors and personal attributes functioned as protective factors along the pathway between chronic conditions and QoL. This highlights how individual attributes can function as a significant filter of the experience of disability, but that available social resources also matter. Resilience can only be partially located within the individual.

In addition, the relative importance of environmental factors and personal attributes in contributing to resilience depended on the outcome in question. Personal characteristics played a role in maintaining positive affect and a sense of meaning and enjoyment in life in a context of increasing disability. Maintaining a sense of control/autonomy, on the other hand, was more dependent on characteristics of the environment. This finding that protective effects were specific to certain outcomes is consistent with the notion that resilience is not an "all or nothing" phenomenon (344,346). Smith & Hayslip (344) quote Cohler et al. (1995) in this context, who state that "we all have a checkerboard of strengths and weaknesses leading to relative degrees of resilience across particular situations" (p. 778).

This finding also highlights the multi-dimensional nature of QoL outcomes. An older adult may maintain positive emotions and their sense of meaning and enjoyment as their health declines, but they may experience a loss of control and autonomy, particularly in a context of low family supports. A comprehensive understanding of outcomes in later life thus requires examination of multiple dimensions of resilience and QoL.

9.5 Impact of findings

The Research Impact Framework, developed by Kuruvilla et al. (2006) (56), comprises a set of descriptive categories which allow researchers to systematically identify and describe the actual and potential impact of their research. The framework specifies categories under four broad headings of impact: research, services, policy and society. Research impacts include the generation of knowledge relevant to a specific field of research, development of research methods, communication of research and development of research networks. Service impacts relate to implications for evidence-based practice, quality of care and health services management. With regard to policy impacts, research can inform policy
directly, can be used to mobilise supports for ongoing or emerging policies, and can influence the language and concepts used in policy discourse. Finally, research can ultimately impact society, via improvements in policy and practice, and by changing broader attitudes and behaviour in the population. This framework was used to identify and describe the potential impact of the current thesis findings, outlined under the four headings: research (Section 9.5.1), services (Section 9.5.2), policy (Section 9.5.3) and society (Section 9.5.4).

9.5.1 Research Impacts

9.5.1.1 Theoretical Contribution: Modelling the Relationship between Chronic Disease and QoL

This thesis contributes to the theoretical literature describing the relationship between chronic disease and QoL. A hypothetical model of the relationship was identified based on a synthesis of existing theory and evidence, and empirically validated in a general-population sample of older adults. This model integrated the WHO ICF model of disease and disability with theories of QoL, wellbeing and resilience. It described how chronic disease and disability domains based on the WHO ICF are associated with affective wellbeing, and a measure of QoL based on needs satisfaction, that also captured evaluative and eudaimonic dimensions of wellbeing. The model also described how these relationships can be affected by processes of resilience, whereby protective factors intervene to reduce negative effects.

This thesis contributes to the development of the WHO ICF by showing how this framework, which has been proposed as a common language for describing disease and disability (290,588), can be used as a model to describe the relationship between chronic disease and QoL. It also contributes to refining the model by highlighting the difficulties associated with empirically distinguishing the body function and activity domains, and by suggesting that participation may be a less important mediator of QoL relative to physical domains of disability. By examining how personal and environmental factors moderate the effects of the ICF domains on QoL, this thesis also develops the role of these factors in the WHO ICF, which has been under-developed to date (270–272,275).
The thesis findings also contribute more specifically to resilience theory. Specific protective factors were identified, and it was confirmed that resilience can be located both within the person and their environment. The findings also supported the idea that resilience is not an "all or nothing" phenomenon: protective factors are specific to outcomes.

Theoretical models of the relationship between chronic conditions and QoL are useful for informing the use of QoL measures in intervention studies related to chronic disease care. If QoL is included as an outcome in an intervention study, it is important that a hypothesis is specified in advance regarding how QoL is likely to be affected by the intervention in question (589). Theoretical models are useful for generating and justifying such hypotheses. For example, based on the model described in this thesis, it could be hypothesised that an intervention which is focussed on improving some aspect of body function, such as pain or balance, could translate into increased control/autonomy, which in turn could lead to improvements in self-realisation/pleasure.

9.5.1.2 Measurement of QoL and Health Status in Research

The thesis findings suggest a number of factors which should be considered when measuring health status and QoL in research. The implications for QoL measurement in general will be discussed first, followed by specific implications for users of the CASP measure of QoL. Implications for measurement of health status will also be discussed. Recommendations are outlined in Table 9-1.

First, differential effects of chronic disease and disability across domains of QoL were identified in both a review of existing literature and empirical analysis of control/autonomy and self-realisation/pleasure. These findings highlight the need to examine different domains of QoL where conceptually and psychometrically sensible. Second, methodological problems were identified with reverse-worded items (561). This adds to current evidence that suggests these types of items may confuse respondents and complicate interpretation of scale scores. Such items should be avoided when developing new scales, and where possible should be adjusted for when using existing scales. Third, the close relationship between items evaluating the impact of age and health, and indicators of disability, highlight the problems associated with QoL items which fail to clearly distinguish between QoL and its determinants.
The thesis findings also have specific implications for users of the CASP measure. This measure is used extensively across surveys of ageing populations, including ELSA (48) and SHARE (51,52), but as has been acknowledged, has difficulties with psychometric validity. The alternative version proposed here has psychometric validity in the Irish population aged 50+. It excludes problematic and poorly performing items, and adjusts for a reverse wording effect with the addition of residual covariances. The two-factor approach also allows researchers to examine differential effects across CASP domains, in contrast to the summed score which is generally used (e.g., 37,40,192,305). It is recommended that researchers consider using this version of the CASP measure of QoL, as it has good psychometric properties, and facilitates examination of differential effects on control/autonomy and self-realisation/pleasure.

The thesis findings also have implications for measurement of health status in research. Measures of comorbidity are unlikely to adequately capture an individual's health status. In addition, measures of disability which focus on activity and/or participation, and exclude indicators of body function such as pain and balance, are unlikely to fully capture the negative impact of chronic conditions. These include standard measures of IADLs/ADLs, which are frequently used to measure disability (274,281–285,296), and the WHO Disability Assessment Schedule (WHODAS), which examines activity and participation (590). Measures of health status should therefore go beyond comorbidity, and also include indicators of body function and activity.
Table 9-1: Research Impact: Recommendations for Measurement of QoL and Health Status in Research

1  Recommendations for QoL measurement

1.1 Reverse-worded items
   In scale development, avoid reverse-worded items.
   In existing scales, test and adjust for method effects where methodology allows, for example, when using structural equation modelling approaches.

1.2 Include items measuring control/autonomy, as these are responsive to variation and change in disability.

1.3 Pay attention to dimensionality. Check for conceptual and empirical evidence for distinct dimensions in an instrument, and check for differential effects. When reporting results, be clear about the relative strength of effects across domains.

1.4 Caution is urged in relation to items measuring evaluations of the impact of life circumstances, particularly health. These items may be overly influenced by the specific life circumstances involved.

2  Recommendations for users of the CASP measure of QoL

2.1 Consider exclusion of poorly performing and problematic items.

2.2 Consider examining the CASP measure as two dimensions: control/autonomy and self-realisation/pleasure.

2.3 Adjust for method effect by adding residual covariances to negatively-worded items where methodology allows, for example, when using structural equation modelling approaches.

3  Recommendations for health status measurement

3.1 Measure disability in addition to comorbidity.

3.2 Include indicators of body function and activity in measures of disability.

9.5.1.3 Publication, Conference Presentations and Research Networks

This thesis resulted in two peer-review publications (see Appendix 3), two oral presentations at international conferences and four poster presentations across national and international conferences (see p. 25). At the time of writing, the paper describing the psychometric evaluation of CASP-19 (525) had been cited by nine further publications. The thesis also contributed to strengthening the network of researchers using CASP by collaborating on a Special Section on CASP-19 in the journal Ageing and Mental Health (2014).
9.5.2 Service Impacts

9.5.2.1 Healthcare for Chronic Conditions

The pathway between chronic disease and QoL identified in this thesis highlights that QoL outcomes in chronic disease are more dependent on symptoms and functional status than burden of disease, and are also influenced by characteristics of the individual and the context in which they live. These empirical findings lend support to existing calls for a shift in emphasis in chronic disease care away from disease processes and towards individualised, patient-centred approaches, which take account of the individual’s specific health needs, resources and priorities (591–593).

Healthcare that is focussed on specific disease processes is becoming less appropriate and less useful as more patients present with multiple conditions, and symptoms or problems which do not fit easily within the disease model. Disease-focussed care can lead to over-treatment, as guidelines for specific conditions require multiple medications to treat multiple individual diseases (591). It can also lead to under-treatment due to neglect of symptoms and functional deficits that do not fit easily into the disease model, and the neglect of psychosocial causes and consequences of diseases (591).

Guidelines for treatment of multimorbidity in older adults from the American Geriatrics Society summarise this shift in emphasis:

"Older adults with multimorbidity are heterogeneous in terms of illness severity, functional status, prognosis, personal priorities, and risk of adverse events even when diagnosed with the same pattern of conditions. Not only the individuals themselves, but also their treatment options will differ, necessitating more flexible approaches to care in this population." (582) (p. 1957).

Under an individualised, patient-centred model, treatment of specific diseases is not an end-goal in itself, but part of an overall care plan aimed at improving outcomes that are important to the patient (591–593). Comprehensive assessment is a core element of this model of care. Data are collected on patient concerns, priorities, psychosocial risk and
protective factors, specific symptoms and functional deficits (591,594). This allows care to be based on a specific patient’s goals, strengths and vulnerabilities. Patient-reported outcomes measures, including QoL, have a potentially important function in assessing initial health status and progress over time (595). Chronic disease care oriented towards patient goals and preferences also takes account of the fact that treatment aimed at modifying disease processes could be detrimental to QoL outcomes, and may not therefore be in a patients’ best interests (591).

The emphasis on psychosocial outcomes also requires greater co-ordinated, interdisciplinary and integrated care, with inputs from allied health professionals, including occupational therapists, social workers, physiotherapists and psychologists (591,596). While specific patient risk factors, such as lack of family supports or poor health behaviours, are taken into account, potential strengths are also identified and mobilised, such as community or religious supports (591,593). Healthcare for chronic conditions is thus seen as a fundamentally inter-sectoral activity, rather than a predominantly biomedical approach.

These recommendations for an individualised model of chronic disease care are summarised in Table 9-2. Ten years ago, Tinetti & Fried (2004) acknowledged that the disease model is firmly ingrained in education and training, health system organisation and financing, and that a shift to person-centred care is likely to be challenging (591). Little has changed in the intervening years. However, there is increasing recognition that the disease-focused model, based on "high-cost, reactive and bed-based care" (596)(p.3) is unsustainable given the changing age and health profile of the population.

The findings outlined in this thesis provide empirical evidence to further underpin the need for an individualised model of care. Higher levels of physical impairment were more predictive of lower QoL than higher disease burden. In addition, individual psychosocial resources shaped the extent to which physical impairment had a negative impact on QoL.

The pathway between chronic disease and QoL identified in this thesis also highlights the potential for interventions at multiple points in the pathway. Health interventions which focus on reducing physical impairment, for example by managing symptoms with
medication, are undoubtedly important and have the potential to improve QoL. However, it is also possible to provide services and therapies that reduce the effect of physical impairment on QoL. Interventions designed to improve instrumental support to older adults, for example by providing transport services, home help, or supporting a partner to stay at home, could directly improve control/autonomy, which in turn may improve self-realisation/pleasure.

Table 9-2: Service Impacts: Recommendations for Healthcare Delivery

<table>
<thead>
<tr>
<th></th>
<th>Recommendations for Patient-Centred Care for Chronic Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Elicit and record relevant patient goals, priorities and preferences</td>
</tr>
<tr>
<td>4.1</td>
<td>Tailor treatment to patient-specific health status, including symptoms and functional difficulties, as well as patient goals, priorities and preferences</td>
</tr>
<tr>
<td>4.3</td>
<td>Provide integrated, inter-disciplinary care involving medical and allied health professionals, as well as input from the social care, voluntary and broader community sectors</td>
</tr>
<tr>
<td>4.4</td>
<td>Assess patient family and community context to identify gaps which may require provision of additional supports, and resources which can be mobilised to support the patient. Assess personal psychological resources, such as coping skills, to identify risk and protective factors which may influence outcomes</td>
</tr>
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</table>


9.5.3 Policy Impacts

The findings of this thesis have relevance for policy in relation to the organisation and resourcing of primary care, and for the measurement of QoL and health status in public policy. Policy recommendations arising from the thesis findings are outlined in Table 9-3.

9.5.3.1 Primary Care Policy

Support at the policy level is necessary to support the service recommendations outlined in Section 9.5.2. A greater focus on psychosocial outcomes in the treatment of chronic disease requires improved primary and community care that is both co-ordinated and inter-disciplinary. A primary care strategy for Ireland “Primary Care: A New Direction”, that was
published in 2001, envisaged the development of inter-disciplinary primary care teams, located in primary care centres (597). However, implementation of this policy has been limited (20). One of the problems has been eligibility – approximately 60% of the population access primary care on a private, fee-per-consultation basis, making the financing of multi-disciplinary primary care teams complex and challenging (477). The current government aims to introduce universal primary care free at the point of use (476), although progress on this has been very slow. Greater inter-disciplinary care will require greater resourcing of allied health practitioners, including disciplines with little presence currently in primary care settings, such as psychologists. The proportion of the health spend allocated to mental health in Ireland has tended to be low by European standards, and has decreased since 2008 (598).

9.5.3.2 Measures of QoL in Public Policy

At an international level, there have been increasing calls to use wellbeing measures such as life satisfaction to measure societal progress and to evaluate the effects of policies and services on populations (224–226,269,599). Measurement of life satisfaction and affective wellbeing tend to be emphasised in this context, although reference is also made to the importance of eudaimonic wellbeing (224,269). A concern occasionally voiced by researchers in relation to the use of QoL and wellbeing as measures of social progress is the "divergence" problem: it is argued that wellbeing is not sensitive to variation or change in living circumstances or broader social progress (600). This would imply that such measures are useless or irrelevant, as nothing can be done to improve them.

The current thesis findings highlight the potential value of measures of control/autonomy as a subjective QoL indicator which is responsive to changes in life circumstances, but also predictive of broader evaluative and eudaimonic dimensions of wellbeing. These findings add to increasing evidence that perceived control mediates the effect of life circumstances on broader wellbeing. A recent study found that differences in subjective wellbeing (SWB) among the Finnish and French populations could be explained by differing levels of feelings of freedom or perceived control in the two countries (601). Perceived control could therefore be measured in conjunction with measures of life satisfaction, to evaluate or monitor not just how satisfied people are, but how much control people feel they have
over their lives. Perceived control could thus function as a good indicator of economic and social progress, and of overall QoL or wellbeing.

9.5.3.3 Measures of Health Status in Public Policy

Measurement of health status is a key element of public policy. It is particularly important for assessing need in order to determine how resources should be distributed. For example, acute hospital activity in Ireland is currently measured using a version of the International Classification of Diseases (ICD-10) (5). There are plans to use this system of activity measurement as the basis for hospital financing, under an activity-based financing model (602). However, this assumes that diagnoses are the most appropriate measure of patient need and complexity. Evidence suggests that the ICD does not adequately capture geriatric syndromes that do not fit easily into the disease model (603). There are some suggestions that the ICD and ICF should be combined into a single classification scheme for recording and measuring healthcare activity (604), and the current thesis findings provide evidence to support such a move.

The difficulty with using diseases as a measure of health need was reflected in a recent report (November, 2014) on medical card eligibility in Ireland (605,606). An expert group was tasked with drawing up a list of conditions which would determine eligibility for primary care services free at the point of use, or at a reduced cost. The group concluded that it was not possible to identify a list of conditions that could be used to determine eligibility, as specific diseases or disease profiles do not adequately reflect a person’s health need. In particular, diagnoses do not indicate the impact of an illness on a person’s functioning, or on their daily life. This example illustrates that policy makers and planners still default to diagnosis as a measure of need, and the problems with this approach are becoming increasingly clear in the policy context, with resulting challenges for policy development in this area.
Table 9-3: Policy Impacts: Recommendations for Policy

<table>
<thead>
<tr>
<th>5</th>
<th><strong>Recommendations for Health Policy</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Support inter-disciplinary models of primary care by:</td>
</tr>
<tr>
<td>5.1a</td>
<td>Ensuring access and eligibility for allied healthcare for chronic disease patients</td>
</tr>
<tr>
<td>5.1b</td>
<td>Adequately resourcing inter-disciplinary care, including mental healthcare</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6</th>
<th><strong>Recommendations for measurement and monitoring of QoL in public policy</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>Capture perceived control in addition to life satisfaction when measuring population-level wellbeing or QoL</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7</th>
<th><strong>Recommendations for measurement and monitoring of health status in public policy</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>Incorporate measures of <em>body function</em> and <em>activity</em> in addition to diagnosis for the following purposes:</td>
</tr>
<tr>
<td>7.1a</td>
<td>Measuring patient complexity for financing purposes</td>
</tr>
<tr>
<td>7.1b</td>
<td>Measuring population health for service planning purposes</td>
</tr>
<tr>
<td>7.1c</td>
<td>Determining eligibility for services</td>
</tr>
</tbody>
</table>

**9.5.4 Societal Impacts**

The research reported in this thesis has the potential to contribute to better QoL outcomes in the population, and to improving societal understandings of ageing and QoL. The thesis findings provide empirical support for a patient-centred approach to chronic disease care which, if implemented, could improve QoL outcomes among older people with chronic conditions. The improvements in QoL measurement suggested by this thesis also have the potential to improve our understanding of what constitutes and contributes to QoL in later life. Improved measurement of QoL could also lead to increased attention to QoL as an outcome, and orient efforts towards policies that improve QoL more generally. The thesis findings have the potential to improve attitudes towards ageing by highlighting that chronic conditions are not inevitably disabling, and that older adults often maintain QoL despite declining health, particularly dimensions of QoL related to meaning and enjoyment in life.
9.6 Methodological Strengths and Limitations

9.6.1 The Study Sample

A key strength of this thesis was the use of a general-population sample. QoL was compared across older adults with no chronic conditions, and with different levels of morbidity, multi-morbidity and disability. This made it possible to identify that chronic disease burden was a relatively weak predictor of QoL at the population level, and that QoL was more responsive to disability than disease. The large, heterogeneous sample of older adults also made it possible to examine how the negative effects of chronic conditions and disability varied depending on diverse characteristics of individuals and their environment.

However, there were a number of limitations related to the study sample. The sample who responded to the SCQ in both waves, and participated in the W1 HA were younger, healthier and better educated than the Irish population in general. Participants who had complete data on all items tended to be younger and better educated again. This problem was counter-acted by the use of sample weights where possible, which attached additional weight to older adults with characteristics that were generally under-represented. It was also counter-acted by the use of available case and multiple imputation approaches to handle missing data. An additional strength of the data was that the attrition rate was very low (<8% between W1 and W2).

As noted in Chapter 2, exclusion of less advantaged participants from surveys of ageing populations may lead to under-estimation of the negative effects of declining health on QoL outcomes and over-estimation of resilience. This issue was examined directly in this thesis, by examining how effects of disability were modified according to personal and environmental factors. While the analysis sample could not be said to be representative of the Irish population, it nevertheless included a broad mix of characteristics that made it possible to examine such effect modification. It was possible to identify, for example, that older adults in this sample with a medical card, which is a proxy indicator of low income, did not experience an increased effect of disability on QoL. On the other hand, individuals without a supportive partner were less resilient than the overall sample.
9.6.2 Use of Self-Report and Objective Measures of Health

The use of self-reported doctor diagnosis to measure chronic disease burden can be less accurate than chart review and can exclude undiagnosed conditions. Review of participant medical records is one way to overcome the first problem; however, as noted in Section 5.2.1, it was not possible to perform record linkage due to the lack of a unique patient identifier in Ireland. In addition, evidence suggests that measures of chronic disease burden based on chart review and self-report tend to have similar effects on QoL (489). This may be because participants tend to be aware of or report conditions that are detrimental to their QoL. In relation to undiagnosed conditions, as noted in Section 5.2.1, undiagnosed conditions tend to be a less severe form of the condition and may not be associated with reduced QoL (490). Problems with doctor-diagnosis as a measure of disease burden reflect its inherent problems as a measure of health status, as highlighted by the findings of this thesis. A specific diagnosis or pattern of diagnoses may not reflect a person's level of body function and activity, and vice versa.

Perceptions of impairments in body function and activity may be more reflective of a person's health status than their diagnosis profile. However, these perceptions may have been vulnerable to response styles which can inflate relationships with subjective outcomes (210,214). For example, specific personality traits may be associated with a greater likelihood of reporting symptoms, worse appraisals of function and worse appraisals of QoL (369–372). Adjusting for personality attenuated but did not eliminate the negative effect of increasing physical impairment on control/autonomy. However, it did eliminate effects of disability on self-realisation/pleasure (see Chapter 8, Section 8.3.2). The use of objective performance measures supplemented measures based on perception, helping to minimise the influence of response styles. In addition, perceptions are the only way to measure some aspects of health status, such as pain.

9.6.3 Measures of SEP

There was no clear evidence for the protective effect of higher SEP in the pathway between chronic conditions and QoL, when using education and proxy measures of income as indicators of SEP. Medical card status may have been problematic as a measure of the moderating effect of SEP, however, as having a medical card confers access to a range of
state benefits and services, such as occupational therapy and physiotherapy, which may not be readily accessible to adults without a medical card. These services may in fact buffer the detrimental effects of low income.

Higher quality measures of SEP, such as disposable income, assets, or area-level deprivation, would improve understanding of the role of SEP. It is likely that the role of socio-economic factors at older ages is complex. Older adults of higher SEP may experience greater losses as they age due to their better initial health; but higher SEP may nonetheless buffer some of the negative effects of ageing. The effects of SEP in resilience processes may be difficult to identify, but that does not mean that they do not play an important role.

9.6.4 Instability of Interaction Effects

As noted in Section 4.3, interaction effects tend to be statistically unstable, due to low power and small effect sizes, introducing uncertainty in the detection of differences in effects across groups. This instability was reflected in inconsistencies in the interaction effects detected across and within studies reviewed in Section 4.3. Low power was partially overcome in this thesis by using a larger sample size compared with previous studies, while Type 1 error was minimised by using a conservative level of statistical significance (p<0.01). However, there were several interaction effects which were of marginal statistical significance (e.g., the increased effect of physical impairment on positive affect associated with low income), and it is possible that some of these effects represented real differences. Replications of effects over several independent samples and the use of meta-analysis may be required to improve certainty regarding interaction effects in the relationship between chronic disease, disability and QoL.

9.6.5 Observational data: Assessing Causality

A weakness of observational data is the possibility that observed relationships are correlational rather than causal. However, observation is the only way to examine phenomena which are not amenable to experimental manipulation, including effects of chronic disease and disability on QoL. Howick et al. (607) have proposed guidelines for assessment of the extent to which causal inferences can be made from observational evidence, based on earlier criteria set out by Bradford Hill (608). These criteria were
applied to assess seven key causal claims made in the thesis. The results of this assessment are displayed in Table 9-4 and discussed in Sections 9.6.5.1 to 9.6.5.4.

Table 9-4: Assessment of criteria for causality, based on Howick et al. (607)

<table>
<thead>
<tr>
<th>Causal Effect</th>
<th>Independent of Confounding</th>
<th>Effect Size</th>
<th>Evidence for temporal ordering/ responsiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical impairment has a negative effect on affective wellbeing</td>
<td>Yes</td>
<td>Moderate</td>
<td>Small</td>
</tr>
<tr>
<td>Physical impairment has a negative effect on control/autonomy</td>
<td>Yes</td>
<td>Moderate</td>
<td>Small</td>
</tr>
<tr>
<td>Physical impairment has a negative effect on self-realisation/pleasure</td>
<td>No</td>
<td>Small</td>
<td>None</td>
</tr>
<tr>
<td>Having a supportive partner leads to a reduced effect of physical impairment on control/autonomy</td>
<td>Yes</td>
<td>N/A</td>
<td>Small</td>
</tr>
<tr>
<td>Higher religiosity leads to a reduced effect of physical impairment on self-realisation/pleasure</td>
<td>Yes</td>
<td>N/A</td>
<td>Small</td>
</tr>
<tr>
<td>Higher extraversion scores lead to a reduced effect of physical impairment on positive affect</td>
<td>Yes</td>
<td>N/A</td>
<td>Small</td>
</tr>
<tr>
<td>Physical impairment and affective wellbeing mediate the effect of chronic conditions on control/autonomy and self-realisation/pleasure</td>
<td>Yes</td>
<td>Large: Indirect effect=100% of the total effect</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Based on Cohen’s d for mean differences, and the proportion of the indirect effect relative to the total effect for mediation

9.6.5.1 Effect size and confounding

The size of an effect, independent of likely confounders, is an important indicator of the extent to which a probabilistic association reflects an underlying causal relationship (607). Cross-sectional effects of physical impairment on affective wellbeing and control/autonomy were moderate in size, and independent of the effects of a range of confounders, including age, sex, lifestyle, SEP, marital status and employment status. The cross-sectional effect of physical impairment on self-realisation/pleasure was small in size,
but independent of confounders. In terms of mediation effects, physical impairment and positive affect fully mediated the effect of chronic conditions on QoL, which qualifies as a large mediation effect (543).

In longitudinal analysis, effects of physical impairment on affective wellbeing and control/autonomy were small in size, but independent of confounding, including the confounding effects of personality. The longitudinal effect of physical impairment on self-realisation/pleasure was no longer significant once personality was adjusted for. It is possible that a longer follow-up time is needed to observe larger differences in these outcomes. Another study of change in CASP-19 scores examined change over a four-year time period to ensure adequate effect size for changes in QoL (202). The small effects associated with incremental changes in physical impairment found in this thesis suggest a high threshold of impairment before affective wellbeing and QoL are negatively affected in a meaningful way.

Estimating effect size for interaction effects is challenging. In each case, the main effect size was small at all levels of the moderating factor. However, the relative difference in the size of the effects was substantial. In each case, participants who lacked or had low levels of the protective effect experienced a negative effect three times the size of the effect relative to other participants (e.g., -0.06 for the effect of physical impairment on control/autonomy for participants with a supportive marriage, -0.18 for those who were not married).

9.6.5.2 Appropriate temporal proximity and responsiveness

A key criterion for establishing causality is that the predictor is temporally prior to the outcome variable (607). Longitudinal analysis showed that baseline levels of physical impairment predicted change in control/autonomy and positive affect, consistent with a causal effect of physical impairment on both outcomes. In addition, changes in control/autonomy and positive affect were responsive to changes in physical impairment. In other words, increasing physical impairment was associated with increases in both outcomes. Patterns of "dose-responsiveness" across associations are consistent with a causal relationship (607). Self-realisation/pleasure, on the other hand, was not responsive to changes in physical impairment, providing weaker support for a causal relationship.
Responsiveness over two time-points, however, does not rule out reciprocal effects. Decreasing control/autonomy may have led to increasing physical impairment rather than, or in addition to, the other way around. Further waves of TILDA will make it possible to examine trajectories of physical impairment, control/autonomy and positive affect over multiple time-points and examine the extent to which effects are temporally-ordered or reciprocal (324,327). Three or more time points would also allow examination of longitudinal mediation. This would involve examining change in physical impairment (T2) as a mediator of the effect of incident conditions (T1) on change in control/autonomy and positive affect (T3) (325,609).

Protective effects of personal and environmental factors were estimated while adjusting for the presence of protective effects at both baseline and follow-up. It was thus possible to identify whether a protective factor was induced by increasing or decreasing disability, thus establishing the temporal priority of the protective factor. For example, a reduced effect of physical impairment was not only observed among participants who had increasing religiosity, but also among those who had high religiosity at W1. This indicated that religiosity was not induced by increasing self-realisation/pleasure. It was not possible to establish temporal priority for personality, however this variable tends to be relatively stable over time (354).

9.6.5.3 Plausible mechanisms and coherence

A causal claim can be made with more confidence if the mechanism of the effect is well understood (607), and is consistent with existing theory and evidence. In this thesis, the mechanism by which chronic conditions affect QoL was a direct focus of study. A hypothetical model of the relationship between chronic disease and QoL was identified based on existing theory and evidence, and empirically tested and validated. Evidence of causality for each individual effect in the model is strengthened by the fact that it is part of an overall, theoretically coherent model of the relationship between chronic disease and QoL. Being part of a greater causal story lends weight to each element of that story.
9.6.5.4 Parallel Evidence

The extent to which a causal effect has been identified in other samples and settings is important for assessing evidence for a genuine causal relationship. In this thesis, each hypothesis tested was generated on the basis of assessment of the existing evidence. Although the thesis findings extend existing evidence, throughout this discussion chapter it has been shown that none of the findings are contrary to or inconsistent with findings from other similar studies. This increases confidence in the extent to which the thesis findings are evidence of underlying causal relationships.

9.6.5.5 Summary

The summary of the causal evidence presented in Table 9-4 shows that there was reasonable evidence for causality across the key thesis findings. Only the evidence for the causal effect of physical impairment on self-realisation/pleasure was weak. However, this weak effect was in itself a key finding of the thesis. Nevertheless, some aspects of the evidence for other causal effects were weak. In particular, the short follow-up time and two-time points meant that longitudinal effect sizes were small, and that it was not possible to examine trajectories over time, or longitudinal mediation effects. In Section 9.7, opportunities for further research as more waves of TILDA data become available will be discussed.

9.7 Recommendations for Further Research

9.7.1 QoL Measurement

The emphasis in QoL measurement has shifted beyond the proliferation of multiple measures of similar constructs, towards the development of comprehensive banks of high-quality items. The Patient-Reported Outcomes Information System (PROMIS), for example, is a publicly available bank of items measuring patient self-reported health outcomes (610,611). Recently, an item bank of measures of psychological wellbeing has been developed as part of The National Institutes of Health (NIH) Toolbox project (612). The bank comprises items measuring affective wellbeing, life satisfaction, meaning and purpose in life. However, no measure of perceived control is included in the item bank at present.
Development of a similar well-validated item bank to measure control/autonomy would have potential utility for research, clinical and policy evaluation purposes.

### 9.7.2 Pathway between Chronic Conditions and QoL

Analysis of the pathway between chronic conditions and QoL could be developed in a number of ways. Further investigation of the role of participation restrictions is required. In particular, the extent to which subjective evaluations of restriction mediate the effect of physical impairment on QoL could be examined. Further dimensions of psychological function, such as anxiety and stress, could also be examined as mediators along the pathway. The mediating role of cognitive impairment could be examined in a sample with higher prevalence of cognitive problems. As noted above, further waves of data will make it possible to examine the pathway longitudinally, evaluating trends and trajectories across multiple time-points.

### 9.7.3 Resilience in Chronic Conditions and QoL

#### 9.7.3.1 Resilience over time

The short follow-up of participants, and absence of multiple time-points, meant that it was not possible to examine trajectories of decline and recovery in physical health and QoL over time in this thesis. Oswald & Powdthavee found that while people experience a decrease in life satisfaction following an increase in disability, levels of satisfaction with life showed some recovery over a three-year period (613). It is unknown whether control/autonomy would show similar patterns of recovery, or is less susceptible to such processes of adaptation over time.

Further waves of TILDA will also make it possible to examine how an accumulation of stressors affect QoL, making resilience or recovery more or less feasible (409). For example, increasing disability could be accompanied by financial or relationship difficulties which make it more difficult to maintain QoL. Alternatively, experience of adversity over time could help people to build their coping skills, ultimately improving their ability to maintain QoL. Further research with subsequent waves of TILDA will facilitate examination of how resilience can be built up and eroded over time.
9.7.3.2 Mechanisms for Protective Effects

Protective effects were identified for having an extravert personality and high religiosity with regard to effects of physical impairment on positive affect and self-realisation/pleasure. It is likely that the beneficial effect of these factors operated via psychological resources or coping skills, such as the ability to cognitively re-frame or re-structure the illness experience, or to maintain positive emotions in the face of stress. Further research could focus on identifying these mechanisms, using both quantitative and qualitative data. It would be useful to examine the extent to which these psychological resources can be cultivated by individuals who are not religious, or do not have pre-disposing personality traits.

9.7.4 Cross-Cultural and Cross-National Research

Culture is a key influence in shaping QoL evaluations (257) and the role of religious belief in shaping the effect of declining health on QoL identified in this thesis supports this influence of culture. Differences in religious beliefs, and other differences in *habitus* (614), may help to explain observed cultural differences in QoL evaluations. For example, could cultural differences in QoL evaluations be attributed to differing levels of religiosity across cultures? It is also interesting to speculate whether the protective role of religiosity varies cross-culturally. For example, are the protective effects of religiosity observed in this thesis specific to Irish Catholicism, or are they observed in relation to other forms of Christianity, or other religions such as Islam?

The importance of SEP as a protective factor in the relationship between chronic disease and QoL may also vary across countries. In countries with weaker social protection structures, the extent to which illness has a negative effect on QoL may be more dependent on SEP. Current cross-national comparisons of CASP show that QoL is higher in countries with social-democratic welfare regimes, compared with those with liberal welfare regimes, with the lowest QoL observed in former USSR and post-communist countries (615,616).

The inclusion of versions of the CASP-19 measure across TILDA, ELSA and SHARE presents an excellent opportunity to compare processes of resilience across different countries.
Cross-cultural investigation of QoL also requires that attention is paid to variation in the psychometric properties of instruments across different cultures and countries. For example, in relation to CASP, the importance of control/autonomy may vary across cultures, as individuals vary in the value they place on maintaining control in their lives (568). Evidence of partial measurement invariance across countries and cultures has been identified for the CASP-19 (268,615,617) and it would be useful to explore measurement invariance in relation to the version of CASP proposed in this thesis.

9.7.5 Summary: Further Research

Cross-cultural research represents one of the many opportunities provided by the existence of large-scale longitudinal surveys of ageing populations across countries. These rich and detailed longitudinal datasets have the potential to greatly contribute to our understanding of all facets of later life, allowing investigation of how older adults adapt to the ageing process, and how society adapts to changing demographic structures. The concluding chapter will reflect on the importance of this type of research for helping society to respond to the opportunities and challenges posed by ageing populations.
Chapter 10  Conclusion

The increase in life expectancy seen in the 20th century is one of the greatest achievements in human history. In 1926, life expectancy at birth in Ireland was less than 58 years for both men and women. By 2006, it was 77 for men and 82 for women. The value of these additional years of life to both individuals and society should not be under-stated. The challenge for society now is to ensure that the quality of those additional years of life is as high as possible. This requires research that measures and monitors health status and QoL outcomes in later life, and improves our understanding of how the best QoL outcomes can be achieved. Improving subjective QoL outcomes is important in and of itself, but also because there is an increasing body of evidence that suggests that good subjective QoL prospectively predicts better physical health and function (261,618–620). Improved population health not only further improves levels of QoL in the population, but also reduces overall spending on health and social care.

The findings of this thesis suggest that there is much to be optimistic about. Chronic conditions were found to have a negative effect on QoL only when associated with increased physical disability. In longitudinal analysis, incremental effects of increasing disability on QoL outcomes were small in size. Sense of meaning and enjoyment in life was largely maintained in later life, even in a context of declining health. However, sense of control/autonomy was more likely to be negatively affected by declining health. In addition, the negative effects of disability on QoL varied across individuals. Those who did not have a supportive partner were more likely to experience a loss of control as a result of disability, and those who were not religious were more likely to experience a negative effect of disability on sense of meaning and enjoyment in life.

These findings highlight the multi-dimensional nature of health status and QoL in later life. Chronic conditions are not inevitably disabling and greater disability does not always translate to poor QoL outcomes. Health status cannot be reduced to a diagnostic profile, and QoL cannot be reduced to measures of physical function, or simple measures of wellbeing such as life satisfaction. There are multiple types of resilience and multiple pathways to resilience. It is critical that ageing research fully captures the multi-
dimensional nature of these outcomes, to ensure that we have a comprehensive understanding of QoL in later life.

A health and social care system that maximises QoL outcomes in later life also needs to take account of the complexity of health and QoL outcomes. The ideal system is integrated, inter-disciplinary and patient-centred, with well-funded primary and community care, and is oriented towards outcomes beyond morbidity and mortality. It provides on-going support to older adults and their families to manage illness and disability, allowing them to maintain control over the lives as their health declines, minimising the use of acute hospital services and admission to long-term residential care.

The current Irish health system does not match this vision. The dysfunctional nature of the current UK and Irish health systems was thrown into sharp relief by the recent emergency department over-crowding crisis of January 2015. For perhaps the first time, it was widely acknowledged in both media and political discourse that the roots of this problem were not only located in the acute hospitals themselves, but could also be located within the under-resourced primary and social care sectors (621,622). Reform of this system is arguably not just desirable, but necessary – if current patterns of health-care utilisation continue, current acute hospital capacity will not be even close to adequate for the increasing numbers of older people in society (623).

The data available in TILDA and other longitudinal datasets will make it possible to analyse changing patterns in health status, service utilisation and QoL in the coming years and potentially decades. This will allow us to track and monitor changes in QoL outcomes among older people as society adapts to a new demographic structure. This in turn will allow us to identify where and how the best possible outcomes can be achieved in later life, while also acknowledging that there is no one model for “successful” ageing and that good QoL comes in many forms.
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# Appendix 1: Sample Search Strategy (PubMed)


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</tr>
<tr>
<td>#5</td>
<td>(&quot;community&quot;[Title/Abstract] OR &quot;national&quot;[Title/Abstract] OR &quot;incidence&quot;[Title/Abstract] OR &quot;prevalence&quot;[Title/Abstract] OR &quot;population sample&quot;[Title/Abstract] OR &quot;random sample&quot;[Title/Abstract] OR &quot;probability sample&quot;[Title/Abstract] OR &quot;sampling study&quot;[Title/Abstract] OR &quot;sampling studies&quot;[Title/Abstract] OR &quot;sampling studies&quot;[Mesh])</td>
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<td>#6</td>
<td>(&quot;older&quot;[Title/Abstract] OR &quot;aged&quot;[Title/Abstract] OR &quot;old&quot;[Title/Abstract] OR &quot;middle-aged&quot;[Title/Abstract] OR &quot;middle aged&quot;[Title/Abstract] OR &quot;middle age&quot;[Title/Abstract] OR &quot;elderly&quot;[Title/Abstract] OR &quot;middle aged&quot;[MeSH Terms] OR &quot;aged&quot;[MeSH Terms])</td>
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<tr>
<td>#7</td>
<td>#3 AND #4 AND #5 AND #6</td>
</tr>
<tr>
<td>#8</td>
<td>(&quot;infant&quot;[MeSH Terms] OR &quot;child&quot;[MeSH Terms] OR &quot;adolescent&quot;[MeSH Terms] OR &quot;young adult&quot;[MeSH Terms] OR &quot;adult&quot;[MeSH Terms:noexp])</td>
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<tr>
<td>#9</td>
<td>#7 NOT #8</td>
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<tr>
<td>#10</td>
<td>#9 AND English[lang]) AND (&quot;2001/01/01&quot;[PDAT] : &quot;2013/12/31&quot;[PDAT]))</td>
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</table>
Appendix 2: Forest Plots for Meta-Analysis

![Forest Plots for Meta-Analysis](image-url)

**Figure A2-1: Random Effects Meta-analysis of Effects of Chronic Conditions on Physical Domain of SF HRQoL**

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### Figure A2-2: Random Effects Meta-analysis of Effects of Chronic Conditions on Mental Domain of SF HRQoL

<table>
<thead>
<tr>
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<td><strong>Diabetes</strong></td>
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<tr>
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<td>Bindawas 2011</td>
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<td>Subtotal</td>
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<td><strong>Cancer</strong></td>
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<tr>
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<tr>
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<td><strong>Angina</strong></td>
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NOTE: Weights are from random effects analysis.
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**Figure A2-3:** Random Effects Meta-Analysis of Adjusted Effects of Chronic Conditions on Physical SF HRQoL
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<td></td>
</tr>
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<td>Hobbs 2002</td>
<td>-5.10 (-6.88, -3.32)</td>
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<td>Overall (I-squared = 87.4%, p = 0.000)</td>
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</table>

NOTE: Weights are from random effects analysis

Figure A2.4: Random Effects Meta-Analysis of Adjusted Effects of Chronic Conditions on Mental SF HRQoL
Appendix 3: Publications arising from this thesis


Psychometric evaluation of the CASP-19 quality of life scale in an older Irish cohort

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Dr. Bellinda L King-Kallimanis
Department of Medical Gerontology, TILDA Project, Trinity College Dublin, Ireland

Prof. Ronan Conroy
Royal College of Surgeons in Ireland, Dublin, Ireland

Dr. Anne Hickey
Royal College of Surgeons in Ireland, Dublin, Ireland

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Fax: (+353) 1 402 2764
Abstract

Purpose

This study aims to evaluate the validity of current measurement models for the CASP (Control, Autonomy, Self-Realisation, Pleasure) measure of quality of life (QoL) – a second-order four-factor CASP-19 model and a second-order three-factor CASP-12 version – in a recent population survey. A previous large-sample study did not report good fit for these measurement models. The study also aims to re-develop the model and propose a well-fitting alternative.

Methods:

To evaluate the current measurement models, confirmatory factor analysis (CFA) was used. A cross-sectional sample (n = 6,823) representative of the Irish community-dwelling population aged 50 and over was obtained from the Irish Longitudinal Study of Ageing (TILDA). Model revision was based on descriptive statistics, exploratory factor analysis (EFA) and examination of fit diagnostic statistics. Revised models were tested using CFA.

Results:

The results of the CFA did not support the validity of the established measurement models. A reformulated 12-item, two-factor model comprising control/autonomy and self-realisation/pleasure, with residual covariances for negatively-worded items, had excellent fit to the data (chi-sq 161.90, df = 44, p < .001; RMSEA = 0.03, 90% CI 0.02-0.03), and a clearer conceptual rationale. The same model with one overall QoL factor had similar excellent fit.

Conclusions:

We recommend the use of the single-factor model (CASP-R12) when assessing overall quality of life. The dimensions of control/autonomy and self-realisation/pleasure can be examined separately by researchers interested in those constructs. Researchers using structural equation modelling can use the well-fitting measurement model outlined here, included adjustment for residual covariances.

Keywords: quality of life, confirmatory factor analysis, exploratory factor analysis, method effect, psychometrics, older people
**Introduction**

People are living longer, with these additional years often accompanied by chronic illness, eventual loss of independence and erosion of social networks. Interest has hence increased in measuring and improving quality of life (QoL) in older age. Commentators have criticised a tendency to assume that QoL declines with age, and to equate poor QoL at older ages with poor health and function (1,2). It is argued, rather, that older people can maintain high quality fulfilling lives, even in the presence of poor physical health, and that this potential should be captured by measures of QoL (3).

The CASP-19 QoL scale was designed for use at middle and older ages in the context of a need for such a measure (4). It is based on a theory of needs satisfaction developed by Maslow (5) and elaborated by Doyal and Gough (6). It is argued that humans share a hierarchical set of basic and higher needs, and that QoL is best thought of as fulfilment of these needs. The scale comprises four higher needs: Control, Autonomy, Self-Realisation and Pleasure.

Control is defined as the ability to shape one’s own life situation and environment, while autonomy refers to self-determination or an absence of unwanted interference from others. Doyal and Gough describe autonomy as formulating valued goals and initiating actions to achieve them, and identify this capacity as a basic human need (6). Pleasure and self-realisation involve the pursuit of enjoyable activities which are also personally fulfilling, corresponding to the "Third Age" described by Laslett (7) - a period of life focussed on personal development once the challenges of career development and child-rearing have been met. The Pleasure domain captures hedonic, enjoyment aspects of well-being, while Self-Realisation focuses on fulfilment of human potential. In particular, Self-realisation corresponds to the reflexive construction of self and identity described by Giddens (8) as necessary for participation in a modernist, disembedded society.

The measure has been widely adopted, particularly for large surveys of general ageing populations - including the English Longitudinal Study of Ageing (ELSA, age 50+), the Irish Longitudinal Study of Ageing (TILDA, age 50+) and the Health and Retirement Survey (HRS, age 50+). The Survey of Health, Ageing and Retirement in Europe (SHARE, age 50+) uses a modified 12-item version of the scale.

Initial psychometric assessment supported a second-order, four-factor structure (4). However, subsequent evaluation with larger samples from ELSA and the British Health Panel Survey (BHPS) suggested that a second order, four-factor model was not consistent with the item responses, i.e.,
the model did not exhibit good fit to the data (9). A 12-item, second-order, 3-factor model showed better fit to the data, and the authors acknowledged that the control and autonomy domains were not clearly delineated conceptually. This 12-item version is slightly different to the version used by SHARE. The fit indices reported for this version of the scale remained outside the range commonly accepted as indicating good fit – reported RMSEA was 0.072 in ELSA and 0.103 in BHPS (9), where an RMSEA of ≤ 0.05 indicates good fit.

Recent evaluation of the scale with a smaller retirement community sample found that the second-order, three-factor 12-item version exhibited better fit to the data than the second-order four-factor 19-item version (10). They concluded, however, that the scale could benefit from further psychometric evaluation with larger samples.

The first objective of the current study was to test the 19-item and 12-item versions of the CASP scale with a recent, large-scale community-dwelling population sample aged 50 years and over obtained from the Irish Longitudinal Study of Ageing (TILDA). The major studies that use CASP-19 include a 50+ population (e.g. SHARE; ELSA), and the measure is generally used with this age group (11-15). As there were already grounds for believing that the established measurement models would not fit the TILDA data well (9,10), the second objective of the study was to explore an alternative factor structure and item composition for the scale. We used a framework combining exploratory and confirmatory factor analysis, with the objective of constructing a model with acceptable fit to the data that also retains the theoretical value of the scale.

**Methods**

*Data*

The study uses data from the first wave of the Irish Longitudinal Study of Ageing (TILDA), comprising a random sample of community-dwelling individuals aged 50 and over in the Republic of Ireland. TILDA used multi-stage stratified random sampling, sampling 640 geographical clusters stratified by socioeconomic group, followed by 40 households within each cluster.

A total of 8,175 home interviews were conducted between 2009 and 2011. Of these, 6,912 returned a self-completion questionnaire including the CASP-19 scale. Of these, 6,823 answered 10 or more items (>50%) in the CASP-19 scale, and are included in this analysis. The household response rate was 62%. Further sampling details are provided by Kearney and colleagues (16).
Measures

The CASP-19 measure comprises 19 Likert scale items. Participants are asked to rate how often a statement describes how they feel – for example “I feel left out of things” or “I look forward to each day”. A four-point response scale is used with the following options: Often, Sometimes, Rarely, or Never. Thirteen positively-worded items are reverse-coded so that a higher score indicates higher QoL.

Psychometric Analysis

The analysis plan consisted of three broad steps. In Step 1, the current CASP-19 and CASP-12 measurement models were tested using confirmatory factor analysis (CFA). If neither of these models fitted the data well, as anticipated from the literature, then Step 2 was to investigate alternative factor structures using exploratory factor analysis (EFA), followed by CFA to test models indicated by EFA. In Step 3, parameter estimates and model fit statistics generated by CFA were used sequentially to refine the model structure identified in Step 2. Revisions to the model were guided by theoretical and conceptual considerations, ensuring that model re-specification was not driven by sample-specific variation (17).

Mplus (Version 6) was used for all statistical analyses. Descriptive statistics, including response proportions for each item, and inter-item correlations were generated and inspected. For CFA and EFA, the weighted least-squares mean and variance adjusted (WLSMV) estimator was used, consistent with the ordinal nature of the items. Survey weights, clustering and stratification were also adjusted for, using the complex survey options available in MPlus. Cases with less than 50% missing items were included in the analysis, using procedures available in Mplus to predict missing values based on observed item responses.

Model fit was assessed using the adjusted chi-square test statistic (18) and a range of other approximate fit indices as recommended by Brown (19). The root mean square error of approximation (RMSEA) and its 90% confidence interval were used. Values less than or equal to 0.05 indicate ‘close’ fit. Two comparative fit indices were used – the comparative fit index (CFI) and the Tucker-Lewis index (TLI); in each case values > 0.95 indicated good fit. Finally, the weighted root mean square residual (WRMR) was used as this index is appropriate for use with ordinal data (20). For the WRMR, values close to one indicate good fit. While these cut-offs are best interpreted as
rules-of-thumb rather than golden rules (21), they are useful indicators, in conjunction with conceptual considerations, of potential for model improvement.

**Step 1: Testing CASP-19 and CASP-12**

The original four-dimension 19-item scale (4), and the modified three-dimension 12-item scale (9), were tested using CFA. Fit was assessed using the goodness-of-fit statistics detailed above.

**Steps 2 – 3: Model Revision**

Descriptive statistics were inspected for evidence of problematic items, for example, severe ceiling effects or low inter-item correlations, using the full sample. These items were excluded from further analysis.

The sample was then divided into two random sub-samples comprising 40% (sub-sample A) and 60% (sub-sample B) of the cases. Sub-sample A was used for model revision and development, with sub-sample B used for confirmatory testing of models. This cross-validation approach attempts to minimise sensitivity to sample-specific variation. The larger size of sub-sample B allows for more precise estimates in the final validation models.

**Step 2: EFA followed by CFA**

EFA was conducted in sub-sample A, using oblique rotation for correlated factors. Potentially well-fitting models were identified based on eigenvalues greater than one (22), patterns of factor loadings and overall fit indices.

If more than one meaningful model was identified by the EFA, the models were tested and compared using CFA.

**Step 3: Model Modification based on Fit Diagnostics**

The best fitting model developed in Step 2 was examined for evidence of model misspecification based on fit diagnostics. Modification indices associated with specific parameters were examined. These indicate the expected size in improvement in the chi-square model fit if the parameter were freely estimated. As large sample sizes may lead to large modification indices where the size of the parameter is trivial (23), values for expected parameter change (EPC) were also examined. In
addition, residual variances were examined as a measure of the difference between observed and predicted covariance between items.

Based on these values, the model was modified by freeing the relevant parameter, or removing one or more relevant items. Any changes to the model were done sequentially, with the chi-square difference test used at each step to confirm significant difference in model fit.

Model Cross-Validation

The models developed in Steps 2 to 3 were validated in sub-sample B using CFA, and assessed using the goodness-of-fit statistics described above.

Compatibility with CASP-12

The CASP-12 version of the scale, used in SHARE, includes only 12 of the original 19 items (see Table 2). The model revision and validation process as described were repeated with these 12 items.

Results

Descriptive Statistics

There were 6,823 cases available for analysis, 5,886 of which had complete data for all items. Most items had ≤2% missing data. Item 3 had the highest level of missingness at 3.6%. Just over half the participants were women (54%), while the mean age was 63.6 years (SD = 9.6). Sample characteristics are displayed in Table 1.

Descriptive statistics revealed a strong positive skew towards higher QoL (Table 2). The proportion of responses at the highest end of the response scale varied from 15 to 85% across items, with an average of 53% endorsement for the most positive option, which was the modal response for 17 out of 19 items. Similarly, the lowest end of the scale had an average endorsement of just 5%, with endorsement falling below 5% in 12 of 19 items. Items in the Pleasure domain showed marked ceiling effects, with between 68% and 85% of responses at the highest level of the scale.

Step 1: Testing CASP-19 and CASP-12

Results from the CFA of the established measurement models for CASP-19 (Model 1.1) and CASP-12 (Model 1.2) are displayed in Table 3. Fit indices for Model 1.1 indicate poor fit to the data (e.g., RMSEA=0.096, 90% CI 0.094-0.097).
While the CASP-12 model appears to display better fit to the data, the fit indices are outside the bounds of good model fit (e.g., RMSEA=0.072, 90% CI 0.07-0.075), suggesting that this measurement model can be improved upon.

Steps 2 – 3: Model Revision

Item 12 “I enjoy the things that I do” showed a strong ceiling effect, with 85% of participants giving the most positive response, and less than 2% choosing the two least positive options (Table 2). Item 6 “Family responsibilities prevent me from doing what I want to do” had weak inter-item correlations with the majority smaller than 0.2 (Table 4). Both items were excluded from all further analyses.

Step 2: EFA followed by CFA

An EFA was conducted in sub-sample A (n = 2,272). Four eigenvalues were greater than one, suggesting suitability of solutions with up to four factors (22). In the four-factor solution, negatively-worded control/autonomy items loaded on to the first factor, self-realisation and pleasure items loaded on to the second factor, while positively-worded control/autonomy items loaded on to the third factor. A fourth factor had low communality, with weak loadings for all but one item (item 4).

This pattern was suggestive of a method effect (24,25) indicating that responses are a function of the underlying trait, residual factors, and a measurement characteristic (in this case, the direction of the item wording). The presence of a method effect complicates interpretation of the results of an EFA, which cannot take into account covarying residuals arising from method effects. However, the pattern of factor loadings suggested the possibility of two factors – control/autonomy and pleasure/self-realisation. Conceptually, there is a high level of similarity between the Control and Autonomy items – e.g. “My age prevents me from doing the things I would like to" (C) and "My health stops me from doing things I want to do" (A), and between the Self-Realisation and Pleasure items – e.g. "I feel satisfied with the way my life has turned out"(SR) and "On balance, I look back on my life with a sense of happiness" (P).

Therefore, a CFA in sub-sample A with two factors was fit. The results indicated that a two factor-model (Model 2.1a, Table 5) had improved fit relative to CASP-19 (Model 1.1).

Method factors or residual covariances can be added to a model to adjust for method effects. Specification of method factors leads to more easily interpretable solutions and are often seen as preferable (19). However, they are frequently associated with identification problems, leading some
to recommend the use of residual covariances (26). Consistent with this, the addition of method factors to Model 2.1a led to inadmissible solutions.

In addition, model identification requires that each factor has at least two indicators without a residual covariance (27). In the present model, therefore, it is not possible to include residual covariances for positively-worded items, as all of the self-realisation/pleasure items are positively-worded. It is, however, possible to include residual covariances for the negatively-worded items. Inclusion of these led to substantially and statistically significant improved fit (2.2a, Table 5).

In this model, the two factors were highly correlated (0.9), suggesting that a single-factor solution may be sensible. CFA indicated that a single-factor model with residual covariances for negative items (2.3a) had similar fit to the two-factor model.

**Step 3: Model Modification based on Fit Diagnostics**

Examination of modification indices, EPCs and residual variances in the two-factor model (2.2a) indicated a number of sources of poor fit. Similar patterns of localised poor fit were observed in the single-factor Model 2.3a.

Two items – 15 “I feel full of energy” and 19 “I feel that the future looks good for me” were associated with large modification indices, EPCs or residual variances. Conceptually, neither of these items is a specific measure of self-realisation or pleasure. Item 15 is likely to be closely related to age, health and capacity, while item 19 constitutes an overall evaluation of a person’s future life which may be much broader than self-realisation and pleasure. Both items were removed.

Item 16 “I choose to do things that I have never done before” was also associated with large modification indices, EPCs and residual variances. In particular, fit statistics suggested an association with item 18 “I feel that life is full of opportunities” (MI = 91.85, residual covariance = 0.12), reflecting the content overlap between these items. Fit diagnostics also suggested a strong association between item 14 “On balance, I look back on my life with a sense of happiness” and item 17 “I feel satisfied with the way my life has turned out” (MI = 110.29; residual covariance = 0.11), reflecting the high inter-item correlation (0.72). A similar association and content overlap was evident between item 5 “I can do the things that I want to do” and 7 “I feel that I can please myself what I do” (MI = 52.27; residual covariance = 0.12). Given the content overlap, it was decided to
remove items 16, 14 and 7, as removal of these items resulted in the greatest improvement in model fit.

Removal of all five items resulted in substantial improvement in model fit, for both the two-factor and single-factor structures (3.1a and 3.2a, Table 5).

**Model Cross-Validation**

Table 6 displays the results of a CFA in sub-sample B of the models developed in steps 2 to 3. Models tested at Step 2 had acceptable fit, while the models developed at Step 3 had excellent fit (e.g. Model 3.1b: RMSEA = 0.03, 90% CI 0.02-0.03).

Figure 1 displays the factor structure and completely standardised parameters for the two-factor model with residual covariances (Model 3.1b). In general, factor loadings are greater than or equal to 0.4. Items with lower loadings – 1, 8 and 9 – include content related to age, health and financial situation, and may be associated with factors other than QoL, but were deemed necessary for adequate conceptual coverage.

**Compatibility with CASP-12**

Repetition of Steps 2 and 3 for the 11 items available in CASP-12 (item 6 was initially excluded due to low inter-item correlations) in sub-sample A yielded similar results as for the 19-item scale. Step 2 (EFA followed by CFA) again indicated a two-factor model with residual covariances for negatively-worded items and a high correlation between the two factors. Similarly, results from Step 3 (fit diagnostics) supported the removal of items 19 and 15. As item 17 is not included in this scale, item 14 was retained.

The results of the cross-validation of these models in sub-sample B, using CFA, are displayed in Table 6. A two-factor model (3.4b) displayed good fit to the data, while a single-factor version (3.3b) exhibited marginally good fit.

**Discussion**

We evaluated two established factor structures for the CASP-19 measure of QoL with a large-scale, representative, sample of Irish adults aged 50+. Fit indices for these models were outside the boundaries of good fit. Two alternative factor structures were developed: a single-factor and a two-
factor model, each with 12 items and residual covariances for negatively-worded items. This item composition is referred to as CASP-R12 (R indicates "Revised"). Two 9-item versions of the scale were also derived for users of data sources including only 12 items from the scale (CASP-R9).

This study is the first, to our knowledge, to use EFA, CFA and a thorough examination of fit diagnostics to develop an interpretable, well-fitting measurement model for the CASP-19 scale.

Number of Dimensions

A major finding of this paper is that, in a large Irish community sample, the CASP scale appears to be best described using either a single- or two-factor structure. The control and autonomy, and self-realisation and pleasure factors, were not sufficiently distinct either empirically or theoretically, indicating that second-order three- or four-factor models are not appropriate for the scale. The distinctions as defined make theoretical sense – freedom to (control) is distinct from freedom from (autonomy), and living an enjoyable life (pleasure) is distinct from fulfilment of human potential (self-realisation). In practice, however, the generic, simply-worded items in the scale do not reflect these relatively subtle and complex distinctions.

These two clearly distinguishable constructs nevertheless capture the essential theoretical ideas in the original scale. Control-Autonomy focuses on individual capacity to initiate and achieve valued goals, including the extent to which life circumstances (such as health, finances) restrict this. This is consistent with Doyal & Gough's description of autonomy, and incorporates the control construct (6). The Self-realisation-Pleasure items capture the extent to which life is fulfilling, purposeful and involves connection to others. These are key elements of Gidden's concept of self-realisation (8), Ryff's concept of eudaimonic well-being (28) and Laslett's description of the Third Age (7). While three items from the Pleasure scale are retained, only one of these clearly relates to hedonic well-being – "I enjoy being in the company of others", indicating that this construct may not have been adequately captured initially.

Theoretically, the two factors are closely linked – in particular, Control-Autonomy can be seen as a key (though not necessary) pre-condition for Self-realisation-Pleasure, and can be viewed as two aspects of one overall QoL construct. This is supported by the good overall fit of the one-factor structure.
It is important to note that while the two factors are highly correlated (Fig. 1); this does not necessarily imply that a single-factor structure is preferable. A model with two highly correlated factors may be mis-specified if a single-factor structure is imposed (29). In this case, it is also conceptually useful to retain the option of a two-factor structure.

**Method Effect**

We found that adjustment for a method effect for the negatively-worded items improved model fit substantially. This method effect may also explain the low item-total correlations for negatively worded items noted by Sim and colleagues (10). Similar method effects have been found in scales measuring well-being and depression (30,31).

It is possible that the method effect arises from an asymmetry in CASP response options. To achieve a high QoL score on a negatively-worded item, the respondent reports that the statement is ‘Never’ true – whereas for a positively-worded item, the respondent merely indicates the statement is ‘Often’ true. ‘Often’ is an easier condition to fulfil than ‘Never’.

Researchers are increasingly recognising reliability and consistency problems with reverse worded items (32) and multiple response option scales more generally (33, 34), leading some to argue for alternatives such as reversal of response options (32), or for using shorter, simpler response categories (35).

**Implications for Users of the CASP-19**

Researchers undertaking structural equation modelling can make use of the well-fitting measurement model proposed here, including the adjustment for the method effect. Inclusion of method effects, where indicated, reduces bias in factor loadings (19). For researchers using less complex analytic strategies, the satisfactory fit of the uni-dimensional model suggests that it is possible to create and use a summary score of overall QoL. However, use of separate sub-scale scores for the original four dimensions is not supported by the evidence presented here. Combined sub-scale scores for Control and Autonomy, and for Self-realisation and Pleasure, are recommended where conceptually useful.

Summary scores based on the original 19 items compared with the 12 proposed here are highly correlated (0.97), and research results may not vary substantially depending on which score is used. Researchers may use summary scores based on the original 19 items in order to retain comparability
with previous work. In this case, it may be sensible to conduct sensitivity analysis to confirm that results would not be substantially altered if the scale version proposed here, which has improved psychometric validity, was used.

While the 9-item version may be preferable due to reduced respondent burden, the 12-item version provides more adequate conceptual coverage, and better overall fit to the data.

Limitations and Further Research

This proposed model for the CASP-19 was developed with one sample, albeit a large and representative sample of the Irish community-dwelling population aged 50+. Inclusion of participants not typically defined as “older” adults – i.e., those aged 50-65 years – is typical of research conducted with CASP to date (e.g., ELSA, SHARE, HRS). While it could be argued that this approach may limit applicability to the ‘older’ population, it is justified given the volume of CASP research with the 50+ age group (11-15). The measurement model may vary across the older and 50-65 year age groups, particularly given differences in life circumstances such as retirement. Further research examining measurement invariance by age, as well as sex, social position and time, would be worthwhile.

There is potential for further development of the CASP scale, particularly in improvements to the response format. A fifth response category “Always” could remedy the asymmetry of the response options. Alternatively, the response format could be simplified, particularly in view of an extensive psychometric literature suggesting that binary response formats are associated with less respondent fatigue, faster scale completion times and less response bias (33-35).

In conclusion, this study has developed and validated a well-fitting factor structure for the CASP-19 scale with a large population sample of older people. It has shown that while the established structure for the scale does not have acceptable psychometric properties, a psychometrically valid measurement model is possible. This is crucial given the large amount of longitudinal QoL data collected using this scale. Further evaluation with other samples will provide more evidence for the validity of this newly proposed structure.
Acknowledgements

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References


Table 1: Sample Demographic and Health-related Characteristics (n = 6,823)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (Mean (SD))</strong></td>
<td>63.6 (9.6)</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>3,121 (45.7)</td>
</tr>
<tr>
<td>Female</td>
<td>3,702 (54.3)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
</tr>
<tr>
<td>Primary / None</td>
<td>1,886 (27.7)</td>
</tr>
<tr>
<td>Secondary</td>
<td>2,799 (41.0)</td>
</tr>
<tr>
<td>Third Level</td>
<td>2,136 (31.3)</td>
</tr>
<tr>
<td><strong>Employment Status</strong></td>
<td></td>
</tr>
<tr>
<td>Employed (inc. Self-Employed)</td>
<td>2,507 (36.7)</td>
</tr>
<tr>
<td>Retired</td>
<td>2,551 (37.4)</td>
</tr>
<tr>
<td>Looking after home</td>
<td>1,020 (15.0)</td>
</tr>
<tr>
<td>Unemployed/Unable to Work</td>
<td>619 (9.1)</td>
</tr>
<tr>
<td>Other</td>
<td>126 (1.8)</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>4,862 (71.3)</td>
</tr>
<tr>
<td>Separated/Divorced</td>
<td>422 (6.2)</td>
</tr>
<tr>
<td>Never Married</td>
<td>631 (9.3)</td>
</tr>
<tr>
<td>Widowed</td>
<td>908 (13.3)</td>
</tr>
<tr>
<td><strong>Longstanding Illness</strong></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>4,204 (61.7)</td>
</tr>
<tr>
<td>Longstanding illness (not limiting)</td>
<td>1,074 (15.8)</td>
</tr>
<tr>
<td>Longstanding limiting illness</td>
<td>1,540 (22.6)</td>
</tr>
<tr>
<td><strong>Self-rated Health</strong></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>1,121 (16.4)</td>
</tr>
<tr>
<td>Very Good</td>
<td>1,992 (29.2)</td>
</tr>
<tr>
<td>Good</td>
<td>2,194 (32.2)</td>
</tr>
<tr>
<td>Fair</td>
<td>1,203 (17.6)</td>
</tr>
<tr>
<td>Poor</td>
<td>312 (4.6)</td>
</tr>
</tbody>
</table>
Table 2: Item Response Proportions and % of Missing Values for the CASP-19 Scale, n = 6,823

<table>
<thead>
<tr>
<th>Item</th>
<th>Question</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>% Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>My age prevents me from doing the things I would like to do (N)</td>
<td>8%</td>
<td>25%</td>
<td>28%</td>
<td>39%</td>
<td>0.8</td>
</tr>
<tr>
<td>C2</td>
<td>I feel that what happens to me is out of my control (N)</td>
<td>6%</td>
<td>24%</td>
<td>31%</td>
<td>40%</td>
<td>2.9</td>
</tr>
<tr>
<td>C3</td>
<td>I feel free to plan for the future (P)</td>
<td>6%</td>
<td>9%</td>
<td>30%</td>
<td>56%</td>
<td>3.6</td>
</tr>
<tr>
<td>C4</td>
<td>I feel left out of things (N)</td>
<td>4%</td>
<td>19%</td>
<td>29%</td>
<td>48%</td>
<td>2.6</td>
</tr>
</tbody>
</table>

**CONTROL**

**Autonomy**

<table>
<thead>
<tr>
<th>Item</th>
<th>Question</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>% Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5</td>
<td>I can do the things that I want to do (P)</td>
<td>3%</td>
<td>4%</td>
<td>26%</td>
<td>67%</td>
<td>1.9</td>
</tr>
<tr>
<td>C6</td>
<td>Family responsibilities prevent me from doing what I want to do (N)</td>
<td>6%</td>
<td>25%</td>
<td>26%</td>
<td>43%</td>
<td>2.0</td>
</tr>
<tr>
<td>C7</td>
<td>I feel that I can please myself what I do (P)</td>
<td>2%</td>
<td>4%</td>
<td>28%</td>
<td>66%</td>
<td>1.9</td>
</tr>
<tr>
<td>C8</td>
<td>My health stops me from doing the things I want to do (N)</td>
<td>11%</td>
<td>23%</td>
<td>22%</td>
<td>45%</td>
<td>1.8</td>
</tr>
<tr>
<td>C9</td>
<td>Shortage of money stops me from doing the things I want to do (N)</td>
<td>18%</td>
<td>36%</td>
<td>22%</td>
<td>23%</td>
<td>1.3</td>
</tr>
</tbody>
</table>

**Pleasure**

<table>
<thead>
<tr>
<th>Item</th>
<th>Question</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>% Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>C10</td>
<td>I look forward to each day (P)</td>
<td>1%</td>
<td>2%</td>
<td>17%</td>
<td>80%</td>
<td>0.8</td>
</tr>
<tr>
<td>C11</td>
<td>I feel that my life has meaning (P)</td>
<td>2%</td>
<td>3%</td>
<td>19%</td>
<td>77%</td>
<td>1.2</td>
</tr>
<tr>
<td>C12</td>
<td>I enjoy the things I do (P)</td>
<td>0%</td>
<td>1%</td>
<td>14%</td>
<td>85%</td>
<td>0.7</td>
</tr>
<tr>
<td>C13</td>
<td>I enjoy being in the company of others (P)</td>
<td>0%</td>
<td>2%</td>
<td>19%</td>
<td>79%</td>
<td>0.5</td>
</tr>
<tr>
<td>C14</td>
<td>On balance, I look back on my life with a sense of happiness (P)</td>
<td>1%</td>
<td>4%</td>
<td>27%</td>
<td>68%</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Self-Realisation**

<table>
<thead>
<tr>
<th>Item</th>
<th>Question</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>% Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>C15</td>
<td>I feel full of energy these days (P)</td>
<td>3%</td>
<td>13%</td>
<td>52%</td>
<td>33%</td>
<td>1.1</td>
</tr>
<tr>
<td>C16</td>
<td>I choose to do things that I have never done before (P)</td>
<td>12%</td>
<td>31%</td>
<td>42%</td>
<td>15%</td>
<td>2.0</td>
</tr>
<tr>
<td>C17</td>
<td>I feel satisfied with the way my life has turned (P)</td>
<td>2%</td>
<td>5%</td>
<td>33%</td>
<td>60%</td>
<td>1.2</td>
</tr>
<tr>
<td>C18</td>
<td>I feel that life is full of opportunities (P)</td>
<td>4%</td>
<td>14%</td>
<td>42%</td>
<td>40%</td>
<td>1.4</td>
</tr>
<tr>
<td>C19</td>
<td>I feel that the future looks good for me (P)</td>
<td>3%</td>
<td>9%</td>
<td>41%</td>
<td>47%</td>
<td>1.0</td>
</tr>
</tbody>
</table>

| All items | 5% | 13% | 29% | 53% |           |

* Included in CASP-12 (used in SHARE)

Table 3: Step 1: Overall Fit Statistics for the CASP-19 and CASP-12 Scale, n = 6,823

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
<th>WRMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Four factor, 19 item, 2nd Order Model (CASP-19)</td>
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<sup>b</sup>Compared with Model 2.3b  
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Table 6: Overall Fit Statistics for Modified CASP Models in Sub-Sample B, n = 4,101

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aCompared with Model 2.1b; bCompared with Model 2.3b; cCompared with Model 2.2b
Figure 1: Completely Standardised Loadings, Revised CASP Measurement Model (Model 2c)
CASP-19 Special Section: How does chronic disease status affect CASP quality of life at older ages? Examining the WHO ICF disability domains as mediators of this relationship

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Abstract

Objectives: The effect of chronic disease status on quality of life (QoL) has been well-established. However, less is known about how chronic diseases affect QoL. This paper examines impairment in three domains of the WHO International Classification of Functioning, Health and Disability (ICF) – body function, activity and participation, as well as affective well-being, – as potential mediators of the relationship between chronic disease and QoL.

Method: A cross-sectional sample (n = 4,961) of the general Irish community-dwelling population aged 50+ was obtained from the Irish Longitudinal Study of Ageing (TILDA). CASP was examined as two dimensions – control/autonomy and self-realisation/pleasure. Structural equation modelling was used to test the direct and indirect effects of chronic disease on QoL, via variables capturing body function, activity, participation and positive affect.

Results: A factor analysis showed that indicators of body function and activity loaded on to a single overall physical impairment factor. This physical impairment factor fully mediated the effect of chronic disease on positive affect and QoL. The total effect of chronic disease on control/autonomy (-0.160), was primarily composed of an indirect effect via physical impairment (-0.86), and via physical impairment and positive affect (-0.45). The decomposition of effects on self-realisation/pleasure was similar, although the direct effect of physical impairment was weaker. The model fit the data well (RMSEA = 0.02, TLI = 0.96, CFI = 0.96).

Conclusion: Chronic disease affects QoL through increased deficits in physical body function and activity. This overall physical impairment affects QoL both directly, and indirectly via reduced positive affect.

Keywords: Quality of life, older people, chronic disease, structural equation modelling, ICF, affect
Introduction

Chronic conditions and multi-morbidity are a feature of ageing (Marengoni et al., 2011), and are known to have a negative effect on quality of life (QoL) among older people (Fortin et al., 2004). However, less is known about how chronic diseases affect QoL. Many measures widely used to study QoL in older people, such as the SF-36, include indicators of physical health and function, making it difficult to disentangle the relationship between chronic disease and QoL. A more recently developed measure, the CASP-19, uses a broader definition of QoL, based on Maslow’s theory of needs satisfaction (Hyde, Wiggins, Higgs, & Blane, 2003; Maslow, 1968). This measure captures fulfilment of four needs - control, autonomy, self-realisation and pleasure. Fulfilment of these needs can be affected by multiple and diverse factors, including, but not limited to, health.

A small number of studies have investigated factors that mediate the relationship between disease and CASP-19. Blane and colleagues found that functional limitations and depression mediated the effect of physiological symptoms on CASP-19 (Blane, Netuveli, & Montgomery, 2008). Similarly, Netuveli et al found that the effect of functionally limiting longstanding illness on CASP-19 was three times the effect of longstanding illness on its own (Netuveli, Wiggins, Hildon, Montgomery, & Blane, 2005).

One model for identifying potential mediators of the chronic disease-QoL relationship is the WHO International Classification of Functioning, Disability and Health (ICF), which has been put forward as a standard framework for understanding the disabling consequences of illness (Jette, 2009). Disability is conceptualised as a deficit in any of three domains – body functions and structures, activity, and participation. Each domain is influenced by underlying pathology, environmental and person factors. Disablement process theory suggests that the three domains can be seen as a pathway between illness and QoL (Verbrugge, 1994). Underlying illness has a negative effect on the functions of the body, which in turn limits a person's activity capacity or performance, which then restricts participation in broader community life. Each of these deficits has a negative influence on QoL.

The ICF model has been used to examine how chronic disease affects health-related QoL and happiness (Tannenbaum, Ahmed, & Mayo, 2007; van Campen & Iedema, 2007). Both studies found that activity mediated the effect of chronic conditions on health-related QoL, happiness or both, while participation had a weak or no effect on health-related QoL, happiness, or both. Neither study examined indicators of body function or structure.

While participation may not affect health-related QoL or happiness, it may be relevant for eudaimonic well-being, which relates to a person's sense of purpose and fulfilment (Ryan & Deci, 2001; Ryff & Singer, 2008). The self-realisation dimension of CASP-19 captures this aspect of well-being, and may be more strongly affected by
participation restrictions. While the CASP-19 was initially proposed as a higher-order four dimension scale, psychometric analysis with the Irish population has shown that it can be measured as two distinct dimensions – control/autonomy and self-realisation/pleasure, using 12 items (CASP-R12, Sexton et al, 2013). Control/autonomy captures the extent to which a person can live the life they want, while self-realisation/pleasure captures the extent to which life is satisfying, purposeful and enjoyable.

Depressive symptoms, or affect, are an important predictor of CASP-19 (e.g. Layte, Sexton, & Savva, 2013), and strongly associated with poor physical health (Clarke & Currie, 2009; Scott et al., 2007). The ICF model classifies affect as a component of body function. However, current evidence suggests that depressive symptoms are a key consequence of physical disability (Stegenga et al., 2012), and may mediate the relationship between poor physical function and CASP (Blane, Netuveli, & Montgomery, 2008).

Control/autonomy and self-realisation/pleasure can be viewed as parallel outcomes of chronic conditions, disability and affect. However, it has been suggested that control and autonomy facilitate pursuit of an enjoyable and fulfilling life (Doyal & Gough, 1991; Higgs, Hyde, Wiggins, & Blane, 2003), and that perceived control mediates the effects of health on life satisfaction (Berg, Hassing, Thorvaldsson, & Johansson, 2011; Devins, 2010; George, 2010). Examining these two dimensions as a pathway may offer further insight into how chronic disease affects QoL.

The aim of this paper is to test the three ICF domains, and affective well-being, as mediators of the relationship between chronic disease and the two dimensions of CASP-R12, among older people. It extends previous research, by examining multiple indicators of all three ICF domains. Also, the measure used to capture QoL includes aspects of eudaimonic well-being, and is therefore broader than health-related QoL or happiness. Finally, like Tannenbaum et al (2007), it focuses on middle-aged and older people, allowing us to examine the unique effects of chronic disease in this age group. Illness may affect QoL differently in older people, as the ageing process leads to shifts in expectations and priorities in relation to health (e.g. Rothermund & Brandtstädter, 2003).

Our hypothesised model of chronic disease and QoL is displayed in Figure 1. We hypothesised that chronic disease affects QoL through loss of body function, reduced ability to perform activities, and restrictions in participation, and reduced affective well-being. We hypothesised that these relationships are characterised by partial rather than complete mediation, for example, impairment in body function affects control/autonomy both directly and indirectly via activity limitation and participation restrictions. Once we assessed the model in Figure 1, we also aimed to explore the extent to which control/autonomy mediated the effects of chronic conditions and disability on self-realisation/pleasure.

Method
Data

Data was obtained from the Irish Longitudinal Study of Ageing (TILDA), a population-representative sample of community-dwelling adults aged 50+ living in the Republic of Ireland. Geographical clusters were randomly selected, followed by households within each cluster. Any household members aged 50+ were invited to participate, along with their partners. 8,175 interviews were carried out with respondents aged 50+ between 2009 and 2011. Data collection comprised a computer-assisted home interview (n = 8,175), a self-completion questionnaire (n = 6,912) and a nurse-led health assessment (n = 6,154). Further sampling details are available in Kearney et al. (2011).

Participants aged 80+ were excluded as age was censored after 80 years in the publicly available data (n = 319). Respondents who completed the self-completion questionnaire, health assessment, at least half of the QoL items, and with complete data on exogenous independent variables, were included (n = 4,961).

Measures

Chronic Conditions

Chronic conditions were measured by number of self-reported doctor-diagnosed physical chronic conditions. These included high cholesterol, hypertension, arthritis, osteoporosis, asthma, stomach ulcer, heart arrhythmia, diabetes, cancer, heart murmur, angina, myocardial infarction, chronic lung disease, other heart condition, varicose ulcer, transient ischaemic attack, stroke, congestive heart failure, cirrhosis and Parkinson's disease. Self-reported doctor diagnoses have been shown to be a reasonable measure of disease burden relative to medical records (Frost et al., 2012; Kehoe, Wu, Leske, & Chylack, 1994).

A broad range of chronic conditions were included, based on the list of doctor-diagnosed conditions captured in the TILDA study. An inclusive list was used, rather than a weighted or un-weighted index, to avoid making a priori judgements regarding the relative severity of each condition. However, the analysis was repeated with a more restrictive definition, including only conditions associated with at least some functional limitation, based on their inclusion in the Functional Comorbidity Index (FCI) (Groll, To, Bombardier, & Wright, 2005). This excluded high cholesterol, hypertension, heart arrhythmia, heart murmur and varicose ulcer.

The ICF Domains – Body Function, Activity and Participation

The WHO browser tool [www.who.int/classifications/icfbrowser] was used as a guide to classify variables as indicators of body function, activity or participation. All indicators were treated as dichotomous.
Body function relates to the basic physical, cognitive and sensory functions of the body. Preliminary analysis found that cognitive function (Mini Mental State Examination) and objective measures of vision were not significantly related to chronic disease status, suggesting that cognitive and sensory domains of function were unlikely to mediate the effect of chronic conditions on QoL. Therefore, we focussed our analysis only on the physical domains of body function. Self-report measures included: pain reported as moderate or severe most of the time; steadiness as feeling slightly or very unsteady while walking, standing or getting up from a chair; and incontinence by the item "During the last 12 months, have you lost any amount of urine beyond your control?". Grip strength was measured objectively using a hydraulic hand dynamometer (Cronin et al, 2013), with poor grip strength defined as being in the lowest quintile for gender and age group (50-59; 60-69; 70-79).

Activity relates to the execution of both basic and more complex tasks and activities. Difficulties with basic mobility tasks (e.g. walking, sitting for a long period); basic activities of daily living (ADLS, e.g. dressing, eating); and more complex instrumental activities of daily living (IADLS, e.g. cooking, shopping) were measured via self-report. Each mobility activity was measured separately; however, the presence of IADL and ADL difficulties was low. Therefore, we simply measured presence or absence of any ADL, and any IADL. The Timed Up and Go (TUG) test measured activity objectively, as the time to get up from a chair and walk 3 meters, turn around and walk back to the chair (Cronin et al., 2013). A slow TUG was defined, similarly to weak grip, as being in the lowest quintile for gender and age group (50-59; 60-69; 70-79).

Participation has not been clearly distinguished from activity in the ICF framework. However, it has been defined as activities that take place in a social context (Eyssen et al, 2011) and can be divided into leisure and productive activities (Klumb & Maier, 2007). Three self-report indicators of participation were examined – socialising at least once a month, participating either in a community group or volunteering, and paid employment.

Quality of Life

The CASP-R12 was used, which has been shown to be psychometrically valid in TILDA, and comprises two dimensions – control/autonomy (CA) and self-realisation/pleasure (SP) (Sexton et al., 2013). It consists of 12 items, with four response options – Often, Sometimes, Rarely and Never. Example items include "I feel free to plan for the future" (CA) and "I feel satisfied with the way my life has turned out" (SP).

The CASP-R12 excludes seven items from the CASP-19, which displayed low inter-item correlations (item 6), ceiling effects (item 12), or overlap with other items in the scale (items 5, 14, 15, 16 and 19). In addition, the self-realisation (SR) and pleasure (P) items are combined, on the basis that these dimensions were insufficiently delineated conceptually – for example, the pleasure scale contained items which captured aspects of personal fulfilment, e.g. "I feel my life has meaning". The rationale for the revised version, including
the combination of self-realisation and pleasure, is set out in greater detail in a recent paper (Sexton, et al, 2013).

Affective Well-being

Affect was measured as a latent factor, using four positive affect items from the Centre for Epidemiological Studies – Depression (CES-D) scale, which is appropriate for use with the general population (Radloff, 1977). The CES-D comprises four dimensions: positive affect, depressed affect, somatic symptoms and interpersonal problems (Halloran, Kenny, & King-kallimanis, 2014; Shafer, 2006). The somatic and interpersonal dimensions overlapped with our measures of physical health and participation. The positive affect and depressed affect dimensions were highly correlated (0.8), and it was decided to use positive affect as a simple, uni-dimensional measure of affective well-being, to minimise the addition of complexity to an already complex model. The analysis was repeated using depressed affect, however, to ensure that the findings were not specific to positive affect.

Personal and Environmental Covariates

A number of person and environmental characteristics were included as covariates in the model. We adjusted for age and sex, along with a quadratic term for age to account for the non-linear relationship between age and CASP score (Layte, Sexton, & Savva, 2013); marital status (whether the person was living as married or not); three levels of education (primary/none, secondary and third level); current smoking and obesity (objectively measured BMI >=30).

A proxy measure of low income was available. Participants were asked whether they were part of the General Medical Services scheme (GMS status), which entitles holders to free medical care and is issued based on low income thresholds. However, this measure only functioned as a proxy measure of low income for participants aged under 70, as the income thresholds are considerably higher for those aged 70+. We therefore adjusted for this variable in stratified analysis with participants aged <=65 (we chose 65 as the cut-point for the stratified analysis, as we reasoned that the role of participation for most will change after retirement).

Statistical Analysis

The statistical analysis consisted of two broad steps. In step 1, confirmatory factor analysis (CFA) was used to test latent factors for body function, activity limitation, positive affect, control/autonomy and self-realisation/pleasure. This ensured that each of the measurement models had acceptable fit to the data prior to inclusion in a structural model. (Kline, 2011) In step 2, structural equation modelling was used to test the structural model outlined in Figure 1, incorporating the latent factors identified at Step 1. Estimation of the structural model allowed for the decomposition of the total effect of chronic conditions on the two QoL
dimensions into both direct effects, and a series of indirect effects via the ICF domains and positive affect.

MPlus version 6.0 was used for all analysis. The WLSMV estimator was used to account for the dichotomous and categorical nature of the indicators. Missing data was handled using a pairwise present approach, with the exogenous independent variables (covariates) used to predict missing values on the dependent variables (Asparouhov & Muthen, 2010). Cases with missing data on the covariates were excluded.

Overall model fit was assessed using the adjusted chi-square test statistic. This statistic is highly sensitive to sample size, however, and a range of alternative approximate fit indices were also examined. The root mean square error of approximation (RMSEA) and its 90% confidence interval were used, along with two comparative fit indices - the comparative fit index (CFI) and the Tucker-Lewis index (TLI). The following cut-offs have been used as indicators for good fit: RMSEA < 0.05; CFI > 0.95; TLI > 0.95 (Hu & Bentler, 1999; Kaplan, 2009; Kline, 2011; Yu, 2002). Measures of local fit were also examined, such as modification indices (MI), expected parameter change (EPC) and residual correlations (Kaplan, 2009; Kline, 2011). These indicate where a parameter should be omitted or included in order to improve the fit of the model.

Step 1: Measurement Models

Separate single-factor measurement models for body function, activity, positive affect, control/autonomy and self-realisation/pleasure were tested using CFA, to confirm unidimensionality for each factor. Following this, a measurement model including all five factors was tested. Overall and local fit statistics were examined, along with factor loadings, to evaluate the adequacy of the measurement model. We used this information in conjunction with theoretical considerations to revise the model, removing indicators, combining factors and/or adding residual covariances.

Step 2: Structural Equation Model

In this step, observed variables for chronic disease, social activity, community participation, paid work, and covariates, were added to the measurement model derived in Step 1, to form a structural model based on our hypothesised model (Figure 1). Model fit was evaluated using measures of overall fit and localised fit, and parameters were added or removed where conceptually sensible. Non-statistically significant parameters (p<0.05) were sequentially removed to ensure a parsimonious model. Statistically significant direct and indirect effects were identified using a Bonferroni adjusted level of significance (0.05/ 15= 0.003). This procedure was repeated for the more restrictive definition of chronic disease status, and using depressed affect in place of positive affect.

We explored the relationship between control/autonomy and self-realisation/pleasure by assessing two further models. The first included a direct effect of control/autonomy on
self-realisation/pleasure. In the second model, the direction of the effect was reversed, to assess whether any observed meditational effects arose from the close correlation between the two QoL domains, rather than any differential effects of physical health on control/autonomy and self-realisation/pleasure.

Step 1 and Step 2 were repeated separately for women aged under 65, men under 65, women aged 65+ and men aged 65+ to examine whether the relationships varied across age and sex groups. GMS status, as a proxy measure of low income, was added as a covariate to the analysis for the under 65s, to examine whether any of the effects in the model were confounded by socio-economic status. Stratifying the analysis at age 65 allowed comparison of the role of participation before and after retirement age.

Results

Descriptive Statistics

Descriptive statistics for the sample are displayed in Table 1. Socio-demographic characteristics are compared with the Irish census in 2011 (Central Statistics Office, 2011). The average age of the sample was 61.8 years. Over half (54%) were women, similar to the gender profile in the overall population aged 50-79. The majority of the sample had secondary or third level education, a higher proportion than in the general population. Sample participants were also more likely to be living as married (75.8%) than the overall population (67.4%). The majority had at least one chronic condition. High cholesterol, hypertension and arthritis were the most common conditions reported.

Step 1: Measurement Models

Separate single-factor models for body function, activity, positive affect, control/autonomy and self-realisation/pleasure displayed good fit to the data. These were then included in an overall measurement model comprising five latent factors (Model 1.1, Table 2). The correlation between the activity and body function factors in Model 2.1 was very high (0.989), suggesting that these indicators could load on to a single overall physical impairment factor. A measurement model with combined physical impairment was tested (Model 1.2). However, overall fit remained unsatisfactory, and examination of local fit statistics and factor loadings suggested further changes to the model.

The first change made related to two control/autonomy items, which were excluded due to overlap with the physical impairment factors – item 8 "My health stops me from doing what I want to do" and item 1 "My age prevents me from doing the things I would like to" (MI for cross-loading on physical impairment 1231.42 and 353.89 respectively). Two residual covariances were added between indicators of mobility impairment: one between "lifting and carrying weights" and "pushing and pulling large objects"; and one between "getting up from a chair" and "stooping/crouching". A residual covariance was added between two self-realisation/pleasure items "I feel my life has meaning" and "I look forward
Approximate fit indices suggested that the model (Model 1.3) fit the data well (RMSEA = 0.03; TLI = 0.98; CFI = 0.98), supporting the inclusion of these latent factors in a broader structural model.

The measurement model for CASP was re-tested with items 1 and 8 excluded, as both a two-factor (Model 1.4) and a single-factor (Model 1.5) model. Both models had acceptable and comparable fit. As neither version was preferable on the basis of model fit, it was decided to use the two-factor version on conceptual grounds, to allow the assessment of differential effects on the two domains.

**Step 2: Structural Models**

Overall fit statistics for structural models are displayed in Table 3. In Model 2.1, the structural relationships hypothesised in Figure 1 were tested, including latent factors for overall physical impairment, positive affect, control/autonomy and self-realisation, and observed variables for chronic disease, participation and covariates. Fit indices suggested good fit for Model 2.1. Modification indices, however, indicated the addition of a residual covariance between social activity and community participation. This model fit the data well (Model 2.2, RMSEA = 0.02, CFI = 0.96, TLI = 0.96). However, a number of structural parameters included in the model were not statistically significant, including the direct effects of chronic disease on control/autonomy and self-realisation/pleasure. In Model 2.3, any non-significant parameters (p<0.05) were excluded. This model also displayed good fit to the data (Model 2.3, Table 3), despite the significant chi-square value.

Given the significant chi-square value, residual correlations were inspected to examine whether the model mis-fit was trivial, or indicated that the model should be revised in a theoretically meaningful way. The majority of residuals were <0.1, and there were no patterns of residual correlations that suggested a theoretically relevant problem with the model, i.e. that the model was not a good description of the relationships between the variables in the data. Therefore, no additional changes were made to the model.

Parameter estimates and indirect effects for Model 2.3 are displayed in Table 4. The total effects of chronic disease on control/autonomy (T1), and self-realisation/pleasure (T2), were primarily composed of indirect effects via physical impairment (ID1, ID7) and physical impairment and positive affect (ID4, ID10). Wald's test of parameter constraints indicated that the direct effect of physical impairment on control/autonomy was significantly greater than its effect on self-realisation/pleasure (p<0.001). There were small, statistically significant indirect effects via participation. However, the standardised effects of participation on positive affect and QoL were generally small (<.01) (Cohen, 1992) relative to the effect of physical impairment. A simplified version of this model is displayed in Figure 2. Inclusion of a more restrictive definition of chronic conditions in Model 2.3 did not change the results substantially (parameter estimates available in Table A1, supplementary data), and nor did the use of depressed affect in place of positive affect.
In Model 2.4, a direct effect of control/autonomy on self-realisation/pleasure was included, and fit did not change with the inclusion of this parameter (Table 3). However, the effect of physical impairment on self-realisation was small (standardised estimate <0.1) and positive (ID1, Table 5), indicating that control/autonomy mediated the negative effect of physical impairment on self-realisation/pleasure (ID2). In Model 2.5, the contrary hypothesis was tested: that self-realisation/pleasure directly affected control/autonomy. Again, the model fit the data well (Table 3). While self-realisation/pleasure significantly mediated the effect of physical impairment on control/autonomy (ID6), this mediation was only partial, with physical impairment retaining a significant direct effect on control/autonomy (ID5, Table 5). On the other hand, self-realisation/pleasure fully mediated the effect of positive affect on control/autonomy (ID7, ID8).

Age and Sex Stratified Analysis

Across age and sex groups, the total effects of chronic disease on both domains of QoL were primarily composed of an effect via physical impairment (ID1, ID7), and physical impairment and positive affect (ID4, ID11). The only exception was among women aged 65+, for whom physical impairment did not directly affect self-realisation/pleasure. There were differences in the role of participation. Community participation only had a significant effect on QoL among women aged 65+. Paid work had a significant effect on positive affect and control/autonomy only among women aged <65.

GMS status had a significant negative effect on both physical impairment and control/autonomy for men and women aged <65. The effect of GMS on positive affect was not significant, while the effect of GMS on self-realisation/pleasure was only significant among men aged <65. The direct effects of physical impairment on self-realisation/pleasure (Table 6, ID1) and control/autonomy (ID6) remained significant, although the size of the effect was attenuated. Among men aged <65, the effect of physical impairment on self-realisation/pleasure was only significant at the 0.05 level (ID1).

Discussion

This study partially confirmed the WHO ICF framework as a model of the relationship between chronic disease and QoL. Impairments in physical body function and activity limitations almost fully mediated the effect of chronic disease on positive affect and QoL. Positive affect, in turn, partially mediated the effect of physical impairment on QoL. Small indirect effects via participation restrictions were also identified. These results were broadly similar across age and sex groups.

Body Functions and Activities

Impairments in body function and activity limitations reflected a single overall physical impairment latent factor, making it difficult to empirically distinguish the effects of these variables. This highlights that chronic disease does not reduce QoL solely through its effect
on activity. The effect of the illness on the body, through increased pain, reduced sense of balance and muscle strength can also directly reduce QoL. This supports the notion that "health is a state as well as a set of capacities" (Sullivan, Kempen, Van Sonderen, & Ormel, 2000) (p. 808). Sensory and cognitive aspects of function were not associated with chronic disease status, indicating that they did not mediate the effect of chronic conditions on QoL in this sample.

The direct positive effect for physical impairment on self-realisation/pleasure (Model 2.4) was unexpected, and worthy of further post-hoc exploration. Current evidence suggests that religious involvement may improve coping in poor physical heath, as well as encourage psychological growth as a result of illness (Koenig, Larson, & Larson, 2001). In this study, among participants who described religion as "very important" to them, the direct effect of physical impairment on self-realisation/pleasure (adjusting for an indirect effect via control/autonomy) was 0.14 (standardised parameter), compared with 0.001 among those who described it as somewhat or not important (p=0.01). Religious belief or engagement may "buffer" the effect of physical impairment on well-being, through greater social connectedness or group solidarity. Alternatively, more religious people may define QoL differently, de-emphasising physical health in favour of more spiritual or social dimensions of existence (Braam et al, 2006). Further research is required to confirm and explore this finding further.

**Participation Restrictions**

People with greater physical impairment were less likely to socialise, and to participate in volunteering and paid work. Community participation had a significant and positive direct effect on self-realisation/pleasure, consistent with the idea that participation affects eudaimonic aspects of well-being. Socialising and paid work were significantly associated with control/autonomy and positive affect. However, consistent with previous studies (Tannenbaum et al., 2007; van Campen & Iedema, 2007), the effect of each of these restrictions was small relative to the direct, negative effect of physical impairment.

The benefit of participation may be dependent on the level of contribution required (Heisler et al., 2012), the degree of choice or control involved in carrying out the activity (Wahrendorf, Ribet, Zins, & Siegrist, 2008), and levels of reward and reciprocity (McMunn et al., 2009; Sells et al., 2009), which we did not examine. In addition, we did not examine the dynamics of participation – whether people reduced or maintained participation in response to chronic disease. Further research is required to more thoroughly explore the role of participation restrictions in the relationship between chronic disease and QoL.

**Differential Effects on Control/Autonomy and Self-Realisation/Pleasure**

The effect of physical impairment on control/autonomy was stronger than the effect on self-realisation/pleasure. At a given level of control/autonomy, additional physical impairment did
not decrease self-realisation/pleasure (Model 2.4, Table 5). The reverse was true for positive affect, which did not directly affect control/autonomy once an indirect effect via self-realisation/pleasure estimated (Model 2.5 Table 5). This suggests that control/autonomy may be more sensitive to objective life circumstances, while self-realisation/pleasure is more influenced by psychological factors such as mood.

This is consistent with previous research and theory which has argued for the critical role of perceived control in mediating the effect of poor health on well-being (Barbareschi, Sanderman, Kempen, & Ranchor, 2008; Berg et al., 2011; Devins, 2010; George, 2010). The extent to which objective life circumstances, including health, affect subjective well-being has been the subject of debate (Berg et al., 2011; Diener, Suh, Lucas, & Smith, 1999; Diener, 2012), and control/autonomy may be a key pathway by which objective circumstances influence the extent to which people are satisfied and happy in their lives. Practical Implications

Policy makers are increasingly interested in not just the health, but the overall well-being of the general population (e.g. Department of Health (Ireland), 2013). The development and testing of interventions and services to improve well-being in those with chronic conditions requires specific hypotheses regarding how chronic conditions affect QoL, and how these effects could be modified. Researchers are increasingly encouraged to include patient-reported outcomes in randomised controlled trials, and to set out clear hypotheses for how their intervention is likely to affect QoL (Calvert et al., 2013). The empirically-validated model described here could form a useful conceptual framework for the generation of such hypotheses. For example, an intervention focused on better symptom management might reduce physical impairment, hence improving affective well-being and QoL. Psychological interventions may focus on improved mood management, which in turn improve QoL. Alternatively, the loss of control associated with increasing physical impairment could be directly tackled by greater provision of instrumental help.

Limitations and Further Research

This study had a number of limitations. The data was cross-sectional, and further longitudinal research is required to examine causal pathways across chronic conditions, physical impairment, affective well-being, and QoL. Our reliance on self-reported doctor diagnosed conditions as a measure of chronic disease may have resulted in classification bias, as participants may have failed to recall certain illnesses, or may have had undiagnosed conditions. Capturing chronic illness as such is commonly used in these types of studies, however, and has reasonable validity relative to medical records. Only one aspect of psychological functioning was examined (affective well-being): further research could examine other aspects such as anxiety and stress. Finally, we examined person and environmental characteristics as confounding variables, but not as moderators of the relationships in the model. Initial exploratory examination of the role of religious belief
indicated that the influences of moderating variables may be important, and should be investigated further.

In conclusion, this study has broadly supported the role of the ICF domains in mediating the relationship between chronic disease and QoL, while also highlighting some of the complexities in this relationship. Chronic conditions were associated with increased physical impairment, which led to a reduced positive affect, reduced control/autonomy, and less enjoyment and fulfilment in life. A strength of the study was the wide range of personal and environmental covariates included, and the use of objective measures of physical impairment in combination with self-report. Further research with the TILDA dataset will examine these relationships longitudinally, and provide a more in-depth analysis of the moderating role of person and environmental variables.

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References


Table 1: Descriptive Statistics for Socio-demographic, Health, Disability and Participation Variables (n = 4,961)

<table>
<thead>
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<td>2,678</td>
<td>54.0</td>
<td>50.6</td>
</tr>
<tr>
<td>Living as married</td>
<td>3,761</td>
<td>75.8</td>
<td>67.4</td>
</tr>
<tr>
<td>Primary / None</td>
<td>1,151</td>
<td>23.2</td>
<td>29.4</td>
</tr>
<tr>
<td>Secondary</td>
<td>2,089</td>
<td>42.1</td>
<td>51.1</td>
</tr>
<tr>
<td>Third Level</td>
<td>1,721</td>
<td>34.7</td>
<td>19.5</td>
</tr>
<tr>
<td>Aged Under 65</td>
<td>3,149</td>
<td>63.5</td>
<td>64.5</td>
</tr>
<tr>
<td>Aged 65-80</td>
<td>1,812</td>
<td>36.6</td>
<td>35.5</td>
</tr>
<tr>
<td><strong>Behavioural Health</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoker</td>
<td>772</td>
<td>15.6</td>
<td></td>
</tr>
<tr>
<td>Obese (bmi &gt;=30)</td>
<td>1,711</td>
<td>34.5</td>
<td></td>
</tr>
<tr>
<td><strong>Chronic Disease Status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1,093</td>
<td>22.0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1,387</td>
<td>28.0</td>
<td></td>
</tr>
<tr>
<td>2 or more</td>
<td>2,481</td>
<td>49.9</td>
<td></td>
</tr>
<tr>
<td><strong>Body Function</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weak Grip</td>
<td>1,006</td>
<td>20.5</td>
<td></td>
</tr>
<tr>
<td>Moderate or Severe Pain</td>
<td>1,239</td>
<td>25.0</td>
<td></td>
</tr>
<tr>
<td>Poor balance</td>
<td>1,298</td>
<td>26.2</td>
<td></td>
</tr>
<tr>
<td>Incontinent</td>
<td>629</td>
<td>12.7</td>
<td></td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking 100m</td>
<td>245</td>
<td>4.9</td>
<td></td>
</tr>
<tr>
<td>Sitting for 2 hours</td>
<td>513</td>
<td>10.3</td>
<td></td>
</tr>
<tr>
<td>Getting up from a chair</td>
<td>834</td>
<td>16.8</td>
<td></td>
</tr>
<tr>
<td>Climbing stairs</td>
<td>244</td>
<td>4.9</td>
<td></td>
</tr>
<tr>
<td>Stooping/kneeling</td>
<td>1,283</td>
<td>25.9</td>
<td></td>
</tr>
<tr>
<td>Reaching</td>
<td>346</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>Pulling or pushing large objects</td>
<td>509</td>
<td>10.3</td>
<td></td>
</tr>
<tr>
<td>Lifting or carrying weights</td>
<td>768</td>
<td>15.5</td>
<td></td>
</tr>
<tr>
<td>Picking up small objects</td>
<td>153</td>
<td>3.1</td>
<td></td>
</tr>
<tr>
<td>Any ADLs</td>
<td>354</td>
<td>7.1</td>
<td></td>
</tr>
<tr>
<td>Any IADLs</td>
<td>236</td>
<td>4.8</td>
<td></td>
</tr>
<tr>
<td>Slow Timed Up and Go</td>
<td>304</td>
<td>6.2</td>
<td></td>
</tr>
<tr>
<td><strong>Participation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Activity</td>
<td>3,373</td>
<td>74.2</td>
<td></td>
</tr>
<tr>
<td>Participates in Community or</td>
<td>2,903</td>
<td>60.1</td>
<td></td>
</tr>
<tr>
<td>Volunteers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paid Work</td>
<td>2,014</td>
<td>40.6</td>
<td></td>
</tr>
</tbody>
</table>

Source for Census 2011: www.cso.ie
Table 2: Overall Fit Statistics for Measurement Models of Body Function, Activity, Positive Affect, Control/Autonomy and Self-Realisation/Pleasure (n = 4,961)

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Five latent factors for Body Function, Activity, PA, CA and SP</td>
<td>4972.45*</td>
<td>444</td>
<td>0.045</td>
<td>0.044</td>
<td>0.046</td>
<td>0.921</td>
</tr>
<tr>
<td>2.2</td>
<td>Four latent factors – PA, CA, SP, PhysImp</td>
<td>4028.56*</td>
<td>448</td>
<td>0.040</td>
<td>0.039</td>
<td>0.041</td>
<td>0.926</td>
</tr>
<tr>
<td>2.3</td>
<td>Four latent factors – PA, CA, SP, PhysImp items C1 and C8 removed, Residual covariance for A6 and A8, for A10 and A11; for C10 and C11</td>
<td>1598.48*</td>
<td>393</td>
<td>0.025</td>
<td>0.024</td>
<td>0.026</td>
<td>0.975</td>
</tr>
<tr>
<td>2.4</td>
<td>10 item CA and SP, two factors</td>
<td>290.62*</td>
<td>30</td>
<td>0.042</td>
<td>0.038</td>
<td>0.046</td>
<td>0.989</td>
</tr>
<tr>
<td>2.5</td>
<td>10 item CASP, single factor</td>
<td>384.73*</td>
<td>31</td>
<td>0.048</td>
<td>0.044</td>
<td>0.052</td>
<td>0.985</td>
</tr>
</tbody>
</table>

*p<0.01

Legend: df = degrees of freedom, RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index; PA = Positive Affect; CA = Control/Autonomy; SP = Self-Realisation/Pleasure; PhysImp = Physical Impairment
Table 3: Overall Fit Statistics for Structural Equation Model of the Relationship between Chronic Disease and QoL (n = 4,961)

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Chi-Square</th>
<th>df</th>
<th>RMSEA</th>
<th>90% CI</th>
<th>CFI</th>
<th>TLI</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Structural Model (Fig 1)</td>
<td>2636.88*</td>
<td>708</td>
<td>0.02</td>
<td>0.023</td>
<td>0.024</td>
<td>0.960</td>
</tr>
<tr>
<td>2.2</td>
<td>Model 2.1 with residual covariance added between Social Activity and Participation</td>
<td>2555.67*</td>
<td>707</td>
<td>0.02</td>
<td>0.022</td>
<td>0.024</td>
<td>0.962</td>
</tr>
<tr>
<td>2.3</td>
<td>Model 2.2 with non-significant parameters removed</td>
<td>2512.43*</td>
<td>740</td>
<td>0.02</td>
<td>0.021</td>
<td>0.023</td>
<td>0.964</td>
</tr>
<tr>
<td>2.4</td>
<td>Model 2.3 with sp ON ca</td>
<td>2533.97*</td>
<td>740</td>
<td>0.02</td>
<td>0.021</td>
<td>0.023</td>
<td>0.963</td>
</tr>
<tr>
<td>2.5</td>
<td>Model 2.3 with ca ON sp</td>
<td>2551.72*</td>
<td>740</td>
<td>0.02</td>
<td>0.021</td>
<td>0.023</td>
<td>0.963</td>
</tr>
</tbody>
</table>

*p<0.01

Legend: df = degrees of freedom, RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index
Table 4: Parameter estimates for structural relationships and indirect effects in Model 2.3

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Est.</th>
<th>P</th>
<th>Standardised Est.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chron → PhysImp</td>
<td>0.306</td>
<td>&lt;0.001</td>
<td>0.389</td>
</tr>
<tr>
<td>Chron→ Emp</td>
<td>-0.042</td>
<td>0.015</td>
<td>-0.062</td>
</tr>
<tr>
<td>PhysImp→Emp</td>
<td>-0.213</td>
<td>&lt;0.001</td>
<td>-0.248</td>
</tr>
<tr>
<td>PhysImp→SocAct</td>
<td>-0.126</td>
<td>&lt;0.001</td>
<td>-0.149</td>
</tr>
<tr>
<td>PhysImp→Partic</td>
<td>-0.141</td>
<td>&lt;0.001</td>
<td>-0.139</td>
</tr>
<tr>
<td>PhysImp→PA</td>
<td>-0.293</td>
<td>&lt;0.001</td>
<td>-0.326</td>
</tr>
<tr>
<td>PhysImp→CA</td>
<td>-0.279</td>
<td>&lt;0.001</td>
<td>-0.248</td>
</tr>
<tr>
<td>PhysImp→SP</td>
<td>-0.146</td>
<td>&lt;0.001</td>
<td>-0.109</td>
</tr>
<tr>
<td>Emp → PA</td>
<td>0.072</td>
<td>0.006</td>
<td>0.069</td>
</tr>
<tr>
<td>SocAct → PA</td>
<td>0.093</td>
<td>&lt;0.001</td>
<td>0.088</td>
</tr>
<tr>
<td>Emp → CA</td>
<td>0.108</td>
<td>&lt;0.001</td>
<td>0.082</td>
</tr>
<tr>
<td>SocAct → CA</td>
<td>0.187</td>
<td>&lt;0.001</td>
<td>0.140</td>
</tr>
<tr>
<td>SocAct → SP</td>
<td>0.104</td>
<td>&lt;0.001</td>
<td>0.066</td>
</tr>
<tr>
<td>Partic → SP</td>
<td>0.108</td>
<td>0.001</td>
<td>0.069</td>
</tr>
<tr>
<td>PA → CA</td>
<td>0.555</td>
<td>&lt;0.001</td>
<td>0.442</td>
</tr>
<tr>
<td>PA → SP</td>
<td>0.622</td>
<td>&lt;0.001</td>
<td>0.418</td>
</tr>
<tr>
<td>CA WITH SP</td>
<td>0.824</td>
<td>&lt;0.001</td>
<td>0.824</td>
</tr>
</tbody>
</table>

T1: Total Effect: Chron → SP
-0.115 <0.001 -0.110

Indirect Effects

| ID1: Chron → PhysImp → SP        | -0.045 <0.001 -0.042 |
| ID2: Chron → PhysImp → SocAct → SP | -0.004 0.003 -0.004 |
| ID3: Chron → PhysImp → ParticVol → SP | -0.004 0.003 -0.004 |
| ID4: Chron → PhysImp → PA → SP    | -0.056 <0.001 -0.053 |
| ID5: Chron → PhysImp → Emp → PA → SP | -0.003 0.008 -0.003 |
| ID6: Chron → PhysImp → SocAct → CA | -0.002 0.003 -0.002 |

T2: Total Effect: Chron → CA
-0.160 <0.001 -0.181

Indirect Effects

| ID7: Chron → PhysImp → CA        | -0.086 <0.001 -0.097 |
| ID8: Chron → PhysImp → Emp → CA  | -0.007 0.001 -0.008 |
| ID9: Chron → PhysImp → SocAct → CA | -0.007 <0.001 -0.008 |
| ID10: Chron → PhysImp → PA → CA   | -0.050 <0.001 -0.056 |
| ID11: Chron → PhysImp → Emp → PA → CA | -0.003 0.008 -0.003 |
| ID12: Chron → PhysImp → SocAct → PA → CA | -0.002 0.002 -0.002 |

Note: Direct effects of covariates (age, age2, sex, education, marital status, obesity, smoker) on each of the ICF domains, positive affect and QoL variables are also included in the model, but excluded from the table for ease of presentation. Only statistically significant indirect effects are displayed.

Legend: Chron = Number of Chronic Diseases; PhysImp = Physical Impairment; Emp = Paid Work; SocAct = Social Activity; ParticVol = Community Participation; PA = Positive Affect; CA = control/autonomy; SP = self-realisation/pleasure
### Table 5: Parameter estimates for direct and indirect effects on self-realisation/pleasure and control/autonomy in Model 2.4 and Model 2.5

<table>
<thead>
<tr>
<th></th>
<th>Model 2.4</th>
<th></th>
<th>Model 2.5</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PhysImp → CA</td>
<td>-0.284</td>
<td>&lt;0.001</td>
<td>-0.224</td>
<td></td>
</tr>
<tr>
<td>PhysImp → SP</td>
<td>0.177</td>
<td>0.001</td>
<td>0.096</td>
<td></td>
</tr>
<tr>
<td>PA → CA</td>
<td>0.554</td>
<td>&lt;0.001</td>
<td>0.392</td>
<td></td>
</tr>
<tr>
<td>PA → SP</td>
<td>0.292</td>
<td>&lt;0.001</td>
<td>0.142</td>
<td></td>
</tr>
<tr>
<td>CA → SP</td>
<td>1.400</td>
<td>&lt;0.001</td>
<td>0.967</td>
<td></td>
</tr>
<tr>
<td>SP → CA</td>
<td></td>
<td></td>
<td>1.394</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>T1: Total Effect: Chron → SP</strong></td>
<td>-0.200</td>
<td>&lt;0.001</td>
<td>-0.138</td>
<td></td>
</tr>
<tr>
<td><strong>T2: Total Effect: Chron → CA</strong></td>
<td></td>
<td></td>
<td>-0.274</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Indirect Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID1: Chron → PhysImp → SP</td>
<td>0.054</td>
<td>0.001</td>
<td>0.037</td>
<td></td>
</tr>
<tr>
<td>ID2: Chron → PhysImp → CA → SP</td>
<td>-0.122</td>
<td>&lt;0.001</td>
<td>-0.084</td>
<td></td>
</tr>
<tr>
<td>ID3: Chron → PhysImp → PA → SP</td>
<td>-0.027</td>
<td>&lt;0.001</td>
<td>-0.018</td>
<td></td>
</tr>
<tr>
<td>ID4: Chron → PhysImp → PA → CA → SP</td>
<td>-0.071</td>
<td>&lt;0.001</td>
<td>-0.049</td>
<td></td>
</tr>
<tr>
<td>ID5: Chron → PhysImp → CA</td>
<td></td>
<td></td>
<td>-0.079</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ID6: Chron → PhysImp → SP → CA</td>
<td></td>
<td></td>
<td>-0.063</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ID7: Chron → PhysImp → PA → CA</td>
<td></td>
<td></td>
<td>-0.007</td>
<td>0.147</td>
</tr>
<tr>
<td>ID8: Chron → PhysImp → PA → SP → CA</td>
<td></td>
<td></td>
<td>-0.078</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Note: Only indirect effects via physical impairment and positive affect are displayed in the Table. Small indirect effects via participation variables are not shown.

Legend: Chron = Number of Chronic Diseases; PhysImp = Physical Impairment; PA = Positive Affect; CA = control/autonomy; SP = self-realisation/pleasure
Table 6: Unstandardised estimates for indirect effects, Model 3.3, across age and sex groups

<table>
<thead>
<tr>
<th></th>
<th>Women &lt;65</th>
<th>Men &lt;65</th>
<th>Women &lt;65</th>
<th>Men &lt; 65</th>
<th>Women &gt;=65</th>
<th>Men &gt;= 65</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adj for GMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1: Total Effect: Chron → SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indirect Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID1: Chron → PhysImp → SP</td>
<td>-0.154</td>
<td>-0.103</td>
<td>-0.143</td>
<td>-0.078</td>
<td>-0.093</td>
<td>-0.96</td>
</tr>
<tr>
<td>ID2: Chron → PhysImp → SocAct → SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID3: Chron → PhysImp → ParticVol → SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID4: Chron → PhysImp → PA → SP</td>
<td>-0.079</td>
<td>-0.039</td>
<td>-0.074</td>
<td>-0.028</td>
<td></td>
<td>-0.49</td>
</tr>
<tr>
<td>ID5: Chron → PhysImp → Emp → PA → SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID6: Chron → PhysImp → SocAct → PA → SP</td>
<td>-0.064</td>
<td>-0.056</td>
<td>-0.061</td>
<td>-0.045</td>
<td>-0.078</td>
<td>-0.35</td>
</tr>
<tr>
<td>T2: Total Effect: Chron → CA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indirect Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID7: Chron → PhysImp → CA</td>
<td>-0.184</td>
<td>-0.133</td>
<td>-0.161</td>
<td>-0.091</td>
<td>-0.215</td>
<td>-0.134</td>
</tr>
<tr>
<td>ID8: Chron → PhysImp → ParticVol → CA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID9: Chron → PhysImp → Emp → CA</td>
<td>-0.093</td>
<td>-0.062</td>
<td>-0.083</td>
<td>-0.048</td>
<td>-0.123</td>
<td>-0.086</td>
</tr>
<tr>
<td>ID10: Chron → PhysImp → SocAct → CA</td>
<td>.014</td>
<td>-0.009</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID11: Chron → PhysImp → PA → CA</td>
<td>-0.008</td>
<td>0.008</td>
<td>-0.005</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID12: Chron → PhysImp → Emp → PA → CA</td>
<td>-0.059</td>
<td>-0.048</td>
<td>-0.056</td>
<td>-0.038</td>
<td>-0.069</td>
<td>-0.038</td>
</tr>
<tr>
<td>ID13: Chron → PhysImp → SocAct → PA → CA</td>
<td>-0.006</td>
<td>-0.004</td>
<td>-0.003</td>
<td>-0.003</td>
<td>-0.006</td>
<td></td>
</tr>
</tbody>
</table>

Bold < 0.001, Italics, <0.01, Normal Type <0.05

Legend: Chron = Number of Chronic Diseases; PhysImp = Physical Impairment; Emp = Paid Work; SocAct = Social Activity; ParticVol = Community Participation; PA = Positive Affect; CA = control/autonomy; SP = self-realisation/pleasure; Adj for = Adjusted for; GMS = General Medical Services
Figure 1: Hypothesised Model of the Relationship between Chronic Disease and Quality of Life
Note: Direct effects of covariates (age, age2, sex, education, marital status, smoking and obesity) on each of the ICF domains, positive affect, and QoL variables are also included in the model, but excluded from the figure for ease of presentation.

Figure 2: Structure of Model 2.3
Note: Direct effects of covariates (age, age2, sex, education, marital status, obesity, smoker) on each of the ICF domains, positive affect and QoL variables are also included in the model, but excluded from the figure for ease of presentation. While participation indicators were included separately in the model, they are shown as a single variable for ease of presentation.
### Appendix 4: Supplementary Tables for Chapter 6

#### Table A4-1: Inter-item correlations for Items 1 – 19 of the CASP-19 Scale, n = 6,823

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cov = covariances; RMSEA = Root Mean Square Error of Approximation, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index. Final models (1g and 2i) shown in bold.
### Appendix 5: Supplementary Tables for Chapter 7

Table A5-1: Direct effects of covariates on each of the endogenous dependent variables or factors in Model 3.3 (n = 4,961)

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<td>0.20</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Edu3 → Partic</td>
<td>0.56</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Smoker → Partic</td>
<td>-0.32</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Obese → PA</td>
<td>0.15</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Smoker → PA</td>
<td>-0.13</td>
<td>0.02</td>
</tr>
<tr>
<td>Married → PA</td>
<td>0.23</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Age → CA</td>
<td>0.23</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Age² → CA</td>
<td>-0.002</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Edu2 → CA</td>
<td>0.12</td>
<td>0.04</td>
</tr>
<tr>
<td>Edu3 → CA</td>
<td>0.16</td>
<td>0.02</td>
</tr>
<tr>
<td>Sex → CA</td>
<td>0.18</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Age → SP</td>
<td>0.10</td>
<td>0.02</td>
</tr>
<tr>
<td>Married → SP</td>
<td>0.29</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Sex → SP</td>
<td>0.24</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Legend: Est. = Parameter estimate; Std. Est. = Standardised parameter estimate; PhysImp = Physical Impairment; Emp = Paid Work; SocAct = Social Activity; Partic = Community Participation; PA = Positive Affect; CA = control/autonomy; SP = self-realisation/pleasure; Edu2 = secondary education; Edu3 = third level education
Appendix 6: Incident Diagnoses and Objective Disease Indicators

Throughout this thesis, chronic disease status has been measured using self-reported doctor diagnosis. Objective data on hypertension, high cholesterol and osteoporosis was available from the W1 health assessment (HA). For many of the participants who reported an incident diagnosis of one of these conditions at W2, clinical indicators had been detected at the HA and reported to the participant.

Figure A6.1 displays the number of participants who had both normal and high blood pressure at W1, and went on to report an incident hypertension diagnosis at W2. One in five participants who had high blood pressure in the HA went on to report a doctor-diagnosis of hypertension. Approximately one third of participants who reported an incident diagnosis of hypertension actually had normal blood pressure at the HA (n = 46).

![Figure A6.1: Incidence of Hypertension Diagnosis by Blood Pressure at Health Assessment, participants with no baseline hypertension diagnosis (n = 1,770)](image)

The picture was similar for participants with no high cholesterol diagnosis at baseline (see Figure A6-2). Over half of participants who had no diagnosis of high cholesterol at baseline had high cholesterol, based on >= 5 mmol/L total cholesterol in their blood. Just over a fifth of these reported an incident diagnosis of high cholesterol by W2. However, a quarter (24.9%) of participants who reported an incident diagnosis of high cholesterol had normal levels of cholesterol at baseline.
Similar patterns of incident diagnosis were observed for participants with no osteoporosis diagnosis at baseline, displayed in Figure A6.3. Nearly half had indicators of osteoporosis (bone density T score < -2.5, stiffness < 65) or osteopenia (bone density T score < -1, stiffness < 88). Approximately 15% went on to receive a diagnosis from a doctor at W2. Most of those who reported an incident diagnosis had bone density and stiffness that was indicative of osteopenia, rather than osteoporosis. Approximately 3% of participants who had normal reading for bone density and stiffness went on to report an incident diagnosis. This represented 20% of total participants with an incident osteoporosis diagnosis.

Approximately two-thirds of participants who had indicators of high cholesterol (63%), hypertension (63%) or osteoporosis (68%), and still did not report a diagnosis by W2, had visited a GP at least twice between waves. This makes it difficult to conclude that these participants were suffering from un-diagnosed illnesses. For that reason, the definition of baseline and incident condition based on self-reported doctor diagnosis was retained.
**Figure A6-3: Incidence of Osteoporosis Diagnosis by Bone Density and Stiffness at health assessment, participants with no baseline osteoporosis diagnosis (n = 2,199)**

Note: Definition of low density and high stiffness includes pre-osteoporotic indicators.

**Appendix 7: Supplementary Tables for Chapter 8**

**Table A7-1: Covariates used in estimation model for multiple imputations**

<table>
<thead>
<tr>
<th>Covariates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, age², sex, education, number of baseline chronic conditions, any incident condition, smoker (w1, w2), obesity, retirement status (w1 w2), physical impairment (w1, w2), supportive partner (w1, w2), supportive relatives (w1, w2), supportive friends (w1, w2), community participation (w1, w2), weekly social activity (w1, w2), monthly social activity (w1, w2), importance of religion (w1, w2), church attendance (w1, w2), medical card status (w1, w2), private health insurance (w1, w2), household, cluster</td>
</tr>
</tbody>
</table>

Interactions with physical impairment:

- age*physical impairment, sex*physical impairment, supportive partner*physical impairment, supportive relatives*physical impairment, supportive friends*physical impairment, weekly social activity*physical impairment, monthly social activity*physical impairment, community participation*physical impairment, importance of religion*physical impairment, church attendance*physical impairment, education*physical impairment, medical card*physical impairment, private health insurance*physical impairment

Interactions with incident condition:

- age*new condition, sex*new condition, supportive partner*new condition, supportive relatives*new condition, supportive friends*new condition, weekly social activity*new condition, monthly social activity*new condition, community participation*new condition, importance of religion*new condition, church attendance*new condition, education*new condition, medical card*new condition, private health insurance*new condition
In analysis with the fully imputed dataset, \( n = 4,547 \) there were no significant interactions \((p<0.01)\) detected for the effect of incident conditions on change in physical impairment.

**Table A7-2: Interactions with the effect of incident chronic conditions on physical impairment, imputed data \((n = 4,547)\)**

<table>
<thead>
<tr>
<th>Interaction</th>
<th>Coef.</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incident condition*Age</td>
<td>-0.004</td>
<td>0.003</td>
<td>0.24</td>
</tr>
<tr>
<td>Incident condition*Sex</td>
<td>-0.02</td>
<td>0.06</td>
<td>0.78</td>
</tr>
<tr>
<td>Incident condition*Religion very important [ref = not important]</td>
<td>0.01</td>
<td>0.06</td>
<td>0.81</td>
</tr>
<tr>
<td>Incident condition*Neuroticism</td>
<td>-0.01</td>
<td>0.03</td>
<td>0.17</td>
</tr>
<tr>
<td>Incident condition*Extraversion</td>
<td>-0.001</td>
<td>0.01</td>
<td>0.79</td>
</tr>
<tr>
<td>Incident condition*Living as married</td>
<td>0.12</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>Incident condition*Supportive marriage [ref = not married]</td>
<td>0.12</td>
<td>0.07</td>
<td>0.09</td>
</tr>
<tr>
<td>Incident condition*Supportive friends</td>
<td>0.004</td>
<td>0.06</td>
<td>0.95</td>
</tr>
<tr>
<td>Incident condition*Supportive relatives</td>
<td>-0.03</td>
<td>0.06</td>
<td>0.68</td>
</tr>
<tr>
<td>Incident condition*Weekly social activity</td>
<td>0.01</td>
<td>0.06</td>
<td>0.85</td>
</tr>
<tr>
<td>Incident condition*Monthly social activity</td>
<td>0.12</td>
<td>0.09</td>
<td>0.15</td>
</tr>
<tr>
<td>Incident condition*Community participation</td>
<td>-0.05</td>
<td>0.06</td>
<td>0.40</td>
</tr>
<tr>
<td>Incident condition*Medical card</td>
<td>-0.15</td>
<td>0.08</td>
<td>0.07</td>
</tr>
<tr>
<td>Incident condition*Private insurance</td>
<td>0.03</td>
<td>0.06</td>
<td>0.63</td>
</tr>
<tr>
<td>Incident condition*Secondary education (ref = primary)</td>
<td>0.06</td>
<td>0.07</td>
<td>0.40</td>
</tr>
<tr>
<td>Incident condition*Third level (ref = primary)</td>
<td>0.09</td>
<td>0.08</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Note: The coefficient is equivalent to the difference in the log of expected counts of numbers of deficits. Effects with \( p \)-values <0.05 are shown in **bold**.

Each interaction effect was adjusted for age, sex, education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)
In analysis of the effect of physical impairment on positive affect with the fully imputed dataset (n = 4,547), the protective effect of extraversion was significant (p<0.01), while there were marginally statistically significant protective effects of age (p=0.02) and not having a medical card (p=0.05).

Table A7-3: Interactions with the effect of physical impairment on positive affect, imputed data (n = 4,547)

<table>
<thead>
<tr>
<th>Interaction effect</th>
<th>Coef.</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical impairment*Age</td>
<td>0.003</td>
<td>0.001</td>
<td>0.02</td>
</tr>
<tr>
<td>Physical impairment*Sex</td>
<td>-0.03</td>
<td>0.03</td>
<td>0.18</td>
</tr>
<tr>
<td>Physical impairment*Neuroticism</td>
<td>-0.002</td>
<td>0.002</td>
<td>0.32</td>
</tr>
<tr>
<td><strong>Physical impairment*Extraversion</strong></td>
<td><strong>0.01</strong></td>
<td><strong>0.002</strong></td>
<td><strong>&lt;0.01</strong></td>
</tr>
<tr>
<td>Physical impairment*Religion Very Imp</td>
<td>0.03</td>
<td>0.03</td>
<td>0.30</td>
</tr>
<tr>
<td>(Ref = not important)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical impairment*Living as Married</td>
<td>0.03</td>
<td>0.03</td>
<td>0.26</td>
</tr>
<tr>
<td>Physical impairment*Supportive Marriage [Ref = not married]</td>
<td>0.01</td>
<td>0.03</td>
<td>0.59</td>
</tr>
<tr>
<td>Physical impairment*Supportive Friends</td>
<td>0.04</td>
<td>0.03</td>
<td>0.17</td>
</tr>
<tr>
<td>Physical impairment*Supportive Relatives</td>
<td>-0.005</td>
<td>0.03</td>
<td>0.85</td>
</tr>
<tr>
<td>Physical impairment*Weekly social activity</td>
<td>0.0004</td>
<td>0.03</td>
<td>0.99</td>
</tr>
<tr>
<td>Physical impairment*Monthly social activity</td>
<td>0.03</td>
<td>0.03</td>
<td>0.39</td>
</tr>
<tr>
<td>Physical impairment*Community participation</td>
<td>-0.003</td>
<td>0.03</td>
<td>0.89</td>
</tr>
<tr>
<td><strong>Physical impairment*Medical Card (low income)</strong></td>
<td><strong>-0.07</strong></td>
<td><strong>0.03</strong></td>
<td><strong>0.05</strong></td>
</tr>
<tr>
<td>Physical impairment*Private insurance</td>
<td>0.02</td>
<td>0.03</td>
<td>0.35</td>
</tr>
<tr>
<td>Physical impairment*Secondary education (ref = primary)</td>
<td>0.01</td>
<td>0.03</td>
<td>0.84</td>
</tr>
<tr>
<td>Physical impairment*Third level education</td>
<td>-0.02</td>
<td>0.03</td>
<td>0.47</td>
</tr>
</tbody>
</table>

Adjusted for age, sex, education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2) 

* n = 3,202
In analysis of the effect of physical impairment on control/autonomy with the fully imputed dataset (n = 4,547), supportive marriage was only significantly protective at the p<0.05 level, while supportive relatives were significantly protective (p=0.01). Male sex was no longer protective, and monthly social activity was protective at the p<0.05 level, consistent with hypothesis 3.6c.

Table A7-4: Interactions with the effect of physical impairment on control/autonomy, imputed data (n = 4,547)

<table>
<thead>
<tr>
<th>Interaction</th>
<th>Coef.</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical impairment*Age</td>
<td>-0.001</td>
<td>0.001</td>
<td>0.39</td>
</tr>
<tr>
<td>Physical impairment*Sex</td>
<td>-0.05</td>
<td>0.03</td>
<td>0.07</td>
</tr>
<tr>
<td>Physical impairment*Religion Very Important</td>
<td>-0.01</td>
<td>0.03</td>
<td>0.64</td>
</tr>
<tr>
<td>Physical impairment*Neuroticism</td>
<td>-0.001</td>
<td>0.02</td>
<td>0.77</td>
</tr>
<tr>
<td>Physical impairment*Extraversion</td>
<td>0.003</td>
<td>0.002</td>
<td>0.26</td>
</tr>
<tr>
<td>Physical impairment*Living as Married</td>
<td>0.05</td>
<td>0.03</td>
<td>0.10</td>
</tr>
<tr>
<td>Physical impairment*Supportive marriage</td>
<td>0.06</td>
<td>0.03</td>
<td>0.046</td>
</tr>
<tr>
<td>Physical impairment*Supportive friends</td>
<td>-0.01</td>
<td>0.03</td>
<td>0.70</td>
</tr>
<tr>
<td>Physical impairment*Supportive relatives</td>
<td>0.07</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>Physical impairment*Weekly social activity</td>
<td>0.03</td>
<td>0.03</td>
<td>0.24</td>
</tr>
<tr>
<td>Physical impairment*Monthly social activity</td>
<td>0.07</td>
<td>0.03</td>
<td>0.047</td>
</tr>
<tr>
<td>Physical impairment*Community participation</td>
<td>0.04</td>
<td>0.03</td>
<td>0.18</td>
</tr>
<tr>
<td>Physical impairment*Medical Card (low income)(^a)</td>
<td>0.02</td>
<td>0.03</td>
<td>0.49</td>
</tr>
<tr>
<td>Physical impairment*Private health insurance</td>
<td>0.02</td>
<td>0.03</td>
<td>0.48</td>
</tr>
<tr>
<td>Physical impairment*Secondary education</td>
<td>0.04</td>
<td>0.03</td>
<td>0.28</td>
</tr>
<tr>
<td>Physical impairment*Third level</td>
<td>0.005</td>
<td>0.04</td>
<td>0.90</td>
</tr>
</tbody>
</table>

Adjusted for age, age\(^2\), sex, education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W1), retired (W1), retired (W2)
\(^a\)n = 3,202
In analysis of the effect of physical impairment on self-realisation/pleasure with the fully imputed dataset (n = 4,547), effects of age and religion remained significantly protective at the p<0.01 level. However, higher levels of extraversion were also protective, consistent with hypothesis 3.1d. This effect was significant at the p<0.05 level.

Table A7-5: Interactions with the effect of physical impairment on self-realisation/pleasure, imputed data (n = 4,547)

<table>
<thead>
<tr>
<th>Interaction</th>
<th>Coef.</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical impairment*Age</td>
<td>0.003</td>
<td>0.001</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Physical impairment*Sex</td>
<td>0.003</td>
<td>0.02</td>
<td>0.92</td>
</tr>
<tr>
<td>Physical impairment*Neuroticism</td>
<td>-0.0004</td>
<td>0.002</td>
<td>0.83</td>
</tr>
<tr>
<td>Physical impairment*Extraversion</td>
<td>0.01</td>
<td>0.00</td>
<td>0.02</td>
</tr>
<tr>
<td>Physical impairment*Religion very important</td>
<td>0.09</td>
<td>0.02</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Physical impairment*Living as Married</td>
<td>-0.002</td>
<td>0.03</td>
<td>0.93</td>
</tr>
<tr>
<td>Physical impairment*Supportive friends</td>
<td>0.02</td>
<td>0.03</td>
<td>0.47</td>
</tr>
<tr>
<td>Physical impairment*Supportive relatives</td>
<td>-0.01</td>
<td>0.02</td>
<td>0.69</td>
</tr>
<tr>
<td>Physical impairment*Weekly social activity</td>
<td>0.01</td>
<td>0.02</td>
<td>0.69</td>
</tr>
<tr>
<td>Physical impairment*Monthly social activity</td>
<td>-0.01</td>
<td>0.03</td>
<td>0.80</td>
</tr>
<tr>
<td>Physical impairment*Community participation</td>
<td>-0.01</td>
<td>0.02</td>
<td>0.77</td>
</tr>
<tr>
<td>Physical impairment*Medical card(^a)</td>
<td>0.01</td>
<td>0.03</td>
<td>0.86</td>
</tr>
<tr>
<td>Physical impairment*Private health insurance</td>
<td>-0.002</td>
<td>0.02</td>
<td>0.95</td>
</tr>
<tr>
<td>Physical impairment*Secondary education (Ref = primary)</td>
<td>0.03</td>
<td>0.03</td>
<td>0.35</td>
</tr>
<tr>
<td>Physical impairment*Third level (Ref = primary)</td>
<td>-0.01</td>
<td>0.03</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Adjusted for age, sex, education, obesity (W1), smoker (W1), smoker (W2), extraversion, neuroticism, married (W2), retired (W1), retired (W2)
\(^a\)n = 3,202