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Social Relationships, Depression and BMI in Older Irish Adults

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Social relationships, depression and BMI in older Irish adults

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A thesis submitted to the School of Postgraduate Studies, Faculty of Medicine and Health Sciences, Royal College of Surgeons in Ireland, in fulfilment of the degree of Master of Science

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November 2016
Candidate Thesis Declaration

I declare that this thesis, which I submit to RCSI for examination in consideration of the award of a higher degree MSc Psychology 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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List of Abbreviations

ADL Activities of daily living
AMSTEL Amsterdam Study of the Elderly
BAPEN British Association for Parenteral and Enteral Nutrition
BMI Body Mass Index
CES-D Centre for Epidemiologic Studies Depression Scale
CHD Coronary Heart Disease
CVD Cardiovascular Disease
DALY Disability-Adjusted Life Years
DSM-IV Diagnostic and Statistical Manual of Mental Disorders
ELSA English Longitudinal Study on Ageing
ESRC Economic and Social Research Council
HIV Human Immunodeficiency Virus
HRQOL Health-Related Quality of Life
IADL Instrumental Activities of Daily Living
MDD Major Depressive Disorder
MIDUS Midlife Development in the United States
MNLM Multinomial Logistic Modelling
MUST Malnutrition Universal Screening Tool
NANS National Adult Nutrition Survey
NCAOP National Council on Ageing and Older People
NHANES National Health and Nutrition Examination Survey
NILS       Northern Ireland Longitudinal Study
NCS-R      National Comorbidity Survey Replication
PATH       Personality and Total Health Through Life Study
QoL        Quality of Life
RRR        Relative Risk Ratio
SAGE       Successful Aging Evaluation study
SES        Socio Economic Status
SF-36      36-Item Short Form Health Survey
SHARE      Survey of Health, Ageing and Retirement in Europe
SLÁN       Survey of Lifestyle, Attitudes and Nutrition
SOC        Selection, Optimization, and Compensation
SRH        Self-rated health
SWEOLD     Swedish Panel Study of Living Conditions of the Oldest Old
TILDA      The Irish Longitudinal Study on Ageing
UCLA       University of California, Los Angeles
UK         United Kingdom
ULS        UCLA Loneliness Scale
UN         United Nations
USA        United States of America
VIF        Variance inflation factor
WHO        World Health Organization
WHR        Waist-Hip Ratio
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Summary

Introduction:

Older adults’ social relationships influence both mental and physical health outcomes, and reciprocal influences between loneliness and depression have been demonstrated over time. Social and mental health are both important considerations for Ireland’s ageing population. Obesity represents another public health concern among the ageing population, and is also associated with depression. ‘Social relationships’ is an umbrella term that encompasses both subjective relationship measures such as loneliness and relationship quality, and objective relationship measures such as participation and social network connectedness. This thesis aims to describe the prevalence of social relationships, depression and BMI in older Irish adults, and to investigate the interactions and reciprocal influences between these variables. Analysis includes comparison of influences of subjective and objective social relationship measures on depression and BMI, and uses multiple measures from wave 1 and wave 2 of the Irish Longitudinal Study of Ageing (TILDA).

Methods:

The study population included community dwelling adults aged 65 years and older living in Ireland. Associations between four relationship measures (loneliness, relationship quality, participation and social network connectedness) and their associations with depression and BMI were investigated using correlations and regression modelling. Multinomial logistic modelling (MNLM) was employed to assess the impact of loneliness and other independent variables on depression as the dependent variable, and on BMI as the dependent variable. Hierarchical logistic regression was used to assess the influence of independent variables on continuous depression and BMI scores. Covariates controlled for throughout included socio-demographic variables and self-rated health (SRH). Statistical analysis was conducted using STATA version 13.

Results:

Depression is a significant concern in this population with over a quarter of respondents reporting moderate or severe depressive symptoms. One in five respondents reported loneliness and the links between loneliness and depression were clear. Of the social relationship measures assessed, loneliness had the most important association with depression, accounting for 21.0% of the variance in depression scores in cross sectional data. Subjective social relationship measures (loneliness and relationship quality) significantly increased the risk of depression, while objective measures
(participation and social network connectedness) had no significant effect. Associations between subjective and objective relationship measures were weak. Reciprocal relationships between loneliness and depression were supported by longitudinal analysis.

While there was an overall decrease in both depression and loneliness between waves 1 and 2, one respondent in ten moved from not being lonely at wave 1 to experiencing loneliness at wave 2, and a similar proportion developed depression in this time frame. In addition to socio-economic variables, the variables of depression, loneliness, social network connectedness and relationship quality were all significant in accounting for change in depression and loneliness, showing the mutual influence of depression and social relationships over time.

Raised BMI was prevalent (77.37%), but after adjusting for known covariates the relationships between BMI and depression and loneliness were not significant.

Discussion:

Risk of loneliness increased considerably among those with concurrent severe depression. Of all the social relationship variables assessed, loneliness was the only one to correlate strongly with or to account for a large amount of variance in depression scores. This study provides evidence that loneliness is strongly associated with depression in older adults and that subjective measures of loneliness and relationship quality are of greater consequence than objective measures of participation or social network connectedness in relation to depression.

The lack of association found between BMI and loneliness or depression after other covariates were adjusted for, suggests that although raised BMI is of concern from a population health perspective in Ireland, current BMI is not associated with loneliness or depression.

These findings suggest that loneliness and depression should each be considered in the aetiology and management of the other. The influences of subjective and objective social relationships on health differ, with loneliness having a stronger association with depression than other more objective measures. This underlines the importance of older adults’ perceptions and experience of their social interactions, and the potential limitations of relying on easily measurable constructs to assess these experiences. The links between depression and loneliness, and their position as risk factors for other conditions, place them at the heart of the concept of successful ageing. Understanding this bidirectional relationship allows for the development of informed interventions that address both the psychological distress of perceived isolation and the isolating effect of depressed mood.
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Chapter 1: Introduction

1.0 Overview

As the world ages, the physical and mental health of older adults is an increasing focus for health and social research. Successful ageing and the attainment of good quality of life (QoL) in older age are universal targets for ageing populations. Achievement of these goals is influenced by multiple aspects of health from functional status to mental wellbeing, as well as the environment in which one ages, and the individual’s role in it. The interactions between health and environment are complex, and the ways in which older adults interact with their environment further influence these experiences. This thesis considers the variety of social relationships that older people encounter, and how these are entwined with aspects of mental and physical health. It will examine the links between four different types of social relationships - two subjective: loneliness and relationship quality; and two objective: participation and social network connectedness - and both mental and physical health indices, specifically depression and BMI, and seek to determine their mutual influences after traditional covariates have been considered.

The psychological impact of building and maintaining adequate social relationships is wide reaching, and influences health and well-being. In turn, mental and physical health both play a role in determining social relationships over time. This intricate system of mutual influences is not fully understood, partially due to the broad array of social relationships, as well as mental and physical health parameters to be considered. This thesis explores the interplay between subjective and objective aspects of social relationships, depression, and body mass index (BMI), expanding our understanding of the role of social relationships in determining the mental and physical health of older adults.

Chapter two will provide an overview of the relevant literature in the area of social relationships, outlining the selection of social relationship definitions and measures used in this research. Patterns and determinants of these relationships are considered within the Irish context, and their influence on health is discussed. Chapter three will provide a further review of the relevant literature addressing BMI and depression. Prevalence of obesity and the physical and psychological health effects of raised BMI, including associations with depression, are reviewed. The effects of depression and the known associations and interactions of both BMI and depression with social relationships are also discussed. The research aims and objectives of the current thesis will be described in chapter four, where the study hypotheses are outlined. The methodology employed in the study will be presented in chapter five. Chapter six will describe the results of the study, and these findings and their implications will be discussed in chapter seven.
1.1 Research Context

This research is conducted in the context of The Irish Longitudinal Study on Ageing (TILDA) (http://tilda.tcd.ie/), a longitudinal study of over 8,500 people aged 50 years and over, and living in Ireland. TILDA is gathering waves of data on a wide variety of areas including health, economic and social behaviours over a span of ten years (2009 – 2020). TILDA is providing information that will allow us to gain a better understanding of the impact of economic and policy changes on the lives of older people. The overarching aim of TILDA is to make Ireland the best place in the world to grow old. To date three waves of data collection have been conducted. This thesis examines the complex associations between social relationships, depression and BMI in older people by examining the data gathered in the first and second waves of TILDA in 2010 and 2012 (wave 3 data is not available currently).

By examining these relationships, the theoretical and practical significance of social relationships within the context of mental and physical health will be further clarified. This study extends previous work on social relationships in several ways. While previous research has demonstrated reciprocal influences over time between loneliness and depressive symptomatology (1), few have separately examined the associations of other objective and subjective social relationships, namely relationship quality, participation and social networks, with depression. Furthermore, although links have been established between social relationships and mental and physical health indices, there have been calls for research to include a wider range of measures concurrently (2) in investigating these relationships, as individual variables vary in the strength of their relationships with health. Hence the inclusion of BMI and depression in this research will add to knowledge in this area.

1.2 Ageing Populations

The world’s population is growing older - living to older age has become a new world norm (3). As older populations increase worldwide, so too does the relevance of ageing research in terms of economic and health policy and planning.

There are increasingly large proportions of older people in populations throughout the world. This is a result of increased longevity, reduced fertility and the ageing of the ‘baby boom’ generation. According to the World Health Organization (WHO) global figures indicate that we will soon be in the unprecedented position of having more people aged over 65 years in the world than children under 5 years (4). The United Nations Population Division projections suggest that the number of those aged over 60 years is to increase from just under 800 million in 2011 (representing 11% of world population) to just over 2 billion in 2050 (representing 22% of world population) (5). In Ireland, the
The total number of people aged 65 years and over is projected to increase from 535,716, or 11.4% of the total population in 2011 to 796,484, or 14.1% of the total population in 2021, and to double by 2031 (6). The numbers of older men in Ireland have been predicted to increase by up to 79% and older women by 58% between 2002 and 2021 (7). The group that is projected to see the largest increase is the ‘younger old’, people aged 65 to 74 years, however there will also be a substantial increase in numbers of ‘older old’ people, those aged 75 years and over (7). These growing older populations are facing a changing environment, within which the social norms and demographic patterns are shifting to a landscape of older age that poses new challenges in maintaining social relationships.

1.3 Challenges for Ageing Populations in Ireland

Considering the significant projected increases in the population of older adults in Ireland a focus on the identification of heretofore overlooked modifiable factors that may positively influence biological and mental health outcomes is judicious. This thesis investigates how indices of mental health, such as depression, and of physical health, such as BMI, relate to subjective and objective social relationships. Adequate mental and physical health are required to engage in social relationships, and these relationships in turn influence mental and physical health.

The influence of social relationships can be seen across health, social and fiscal domains of wellbeing, and should be considered an important factor in determining requirements for Ireland’s ageing population. Concerns regarding the allocation of resources and increased demands on pension, healthcare and long term care systems are common in the context of an ageing population. The projected increase in costs associated with caring for the elderly has been described in the media as ‘a financial time bomb with no plan in place to cope with the increase in older people’ (8), and health economists have demonstrated that both age and proximity to death significantly influence health care costs (9).

The established health effects of loneliness and social integration will influence the needs of the ageing Irish population and are key components of older people’s well-being. Social relationships facilitate the provision of a range of supports to older people, from practical caregiving, living arrangements and financial contributions, to the mental support of a meaningful friendship. The presence or absence of these supports is likely to impact on the magnitude of the older population’s needs.

In addition to considering the needs of Ireland’s ageing population it is important to take into account their significant contribution to society. Ireland’s older people contribute a great deal to the
provision of social support and care in their communities. Nearly one-quarter of older people in Ireland provide some form of help to their neighbours and friends, and they account for a significant proportion of carers, both in child care and care for other adults, with nearly half of older people in Ireland providing care to grandchildren (6). WHO has acknowledged healthy older people as a resource for their families, their communities and the economy (10). The wide range of experiences that can present in older age highlights the relevance of the successful ageing concept. This advocates the potential for individual and societal burden to be reduced and personal fulfilment, satisfaction and societal contribution to be enhanced in later years.

1.4 Supporting Successful Ageing

To address the challenges outlined above it is necessary to consider the social environments within which people live and grow old. The impact of social relationships is wide reaching and encompasses mental and physical health parameters such as depression and BMI, addressed in this thesis. A greater understanding of how social relationships and health intertwine will allow policy and society to support successful ageing in a holistic manner.

Successful ageing is described as a dynamic, multidimensional process building from earlier life experiences aiming to minimise physical and cognitive functional loss in later years, while maintaining and achieving high social activity (11). Successful ageing signifies a time of potential health and well-being, and is measured by objective indicators, including the absence of disease, high physical and cognitive functioning, and active social engagement (12), representing a balance of both qualitative and quantitative measures of well-being. With increasing life expectancy ageing societies are experiencing the relatively new social phenomenon of an older generation which is retired yet are entering a phase of their lives in which they have the opportunity to actively engage in and contribute to society on many levels without the responsibilities of earlier adulthood. This time of opportunity and potential is central in the theme of successful ageing and may be optimised through the fostering and maintenance of social relationships.

To explore the associations between these subjective and objective components of social relationships, this thesis will utilise the variables from waves 1 and 2 of TILDA, described in detail in Chapter 5. While there are established associations between social relationships and morbidity and mortality, it is thought that various components of these relationships may influence health in different ways (13), and important differences have been highlighted between objective and subjective perspectives on social involvement (14). This thesis aims to investigate these relationships, addressing separately the objective and subjective components of social relationships, and also to investigate the interactions between BMI, depression and social relationships.
Chapter 2: Literature Review: Social Relationships

2.0 Introduction

The following chapter will review the multiple aspects and definitions of social relationships relevant to this study, including objective and subjective components. It will discuss factors influencing social relationships in Ireland, and consider known risk factors and interventions. Finally, it will review the physiological, psychological and psychosocial outcomes associated with social integration and loneliness in the older adult.

Many terms relating to social relationships are used loosely and interchangeably (15). These terms can be variously interpreted, for example social participation can be conceptualised as an objective assessment of an individual’s capacity to be involved in social activities, such as visiting friends, attending clubs and meetings, going to parties (16); or the psychosocial aspects of role participation including being involved in close relationships such as parenting, social and community interactions, being a student or employee, as well as participation in leisure pursuits (17). Social integration has also varying definitions, as either a technical term indicating the number of interpersonal ties a person has, or as a broader descriptor of the degree to which an individual is embedded in a wider network of social relations, or the entire set of an individual’s connections to others in his or her environment (18).

The need for social connection is central to human nature and the failure to fulfil this need has been shown to be detrimental to mental and physical health (19). Physical health and illness are a function of social, psychological, and behavioural factors in addition to the physiological effects of biological processes and medical care received.

Research has documented that social isolation and persistent loneliness present potential risks for both emotional and physical disorders among a range of populations and situations. Social support is also a well-documented influencing factor on physical health outcomes, with socially integrated, supported individuals leading healthier, happier and longer lives, in contrast with the increased health risk suffered by those who are lonely (20-22).

The role of social relationships in health and wellbeing is wide ranging and they have been established as an important correlate of many aspects of health. A significant body of research has identified strong associations between social relationships and morbidity and mortality. For example, social relationships have been associated with lung function (23), cardiac measures such as blood pressure, C-reactive protein, and fibrinogen levels (24), chronic heart failure mortality (25), and health-related quality of life of older people (26). They have also been identified as protective
against cognitive decline (27) and a determinant of self-reported health (28). Social integration is reported to have highly beneficial effects on functioning and longevity post-myocardial infarction (20), and to be protective against dementia and Alzheimer’s disease (29).

Older age is a transitional period when people experience changes not only in physical health, but also in social roles, which can influence opportunities for social participation. Changes in community roles such as at retirement and in family roles such as when grown children leave the family home, all affect the usual interactions an individual engages in day to day. Loneliness has been described as a major risk factor for health problems in later life and a predictor of functional decline and death (30). The importance, medical impact and biological effects of loneliness on the health of older people are well acknowledged, and loneliness has been advocated as a legitimate therapeutic target (31). Statistically significant improvements in loneliness, social isolation, structural and functional social support, and mental and physical health have been reported in a variety of group-based and one-to-one interventions. The development of strategies to increase older people’s participation in society is increasingly addressed as a component of government policies regarding the delivery of health and social care, social cohesion and the tackling of social inequalities (32). Subjective and objective aspects of relationships have been shown to affect loneliness independently (14). It is likely that subjective and objective aspects of social relationships might also independently influence other aspects of mental and physical health. Hence, gaining a better understanding of the various types of social relationships and their association with health will signpost future policy makers towards appropriate intervention strategies.

The social relationships explored in this chapter will be examined in relation to BMI and depression throughout this thesis. Patterns and known associations between social relationships and BMI will be reviewed in subsequent chapters, as will the existing evidence for an association between social relationships and depression. There are complex mutual influences between social interactions, excess body weight, and poor mental health. Mood influences health behaviour choices, which in turn influence physical health, and has a ripple effect on one’s social relationships. The degree and quality of social relationships are also likely to affect mood and lifestyle choices and health. These inter-relationships are complex, not least because of the multiplicity of pathways involved, but also due to the variety of social relationships at play. In order to address social relationships in the context of BMI and depression, and in an Irish context, it is important to clarify the measures being used in this study, listed in figure 2.1.
The next section of this chapter will provide an overview of several types of social relationship and will seek to clarify the distinguishing features and areas of overlap between them. Section three will discuss patterns of social relationships in Ireland, and section four the factors that influence the development and maintenance of these relationships and how interventions may target their support.

2.1 Defining Social Relationships: Social Networks, Loneliness, and Related Concepts - Associations and Differences

The concepts of loneliness, relationship quality, participation and social network connectedness are undoubtedly closely linked but the subtle differences in their definition warrant attention when attempting to quantify their influence. To view social relationships as a uni-dimensional concept referring to the lack of social integration assumes that all social contacts have the same social value or importance and disregards the importance of close relationships, attachments and companionship (32). To better understand how these concepts relate to each other it is necessary to review how they are defined in the literature.

Definitions of loneliness and social isolation are not synonymous - the heart of the distinction is that people can be socially isolated without feeling lonely, or feel lonely amongst others. This was demonstrated by Golden’s study on loneliness, social networks, mood and well-being in older people in Ireland, which reported significant overlap between loneliness and social isolation but still found 32% of participants with an integrated social network to be lonely, underlining the distinctness of the constructs (33). Loneliness and social isolation represent subjective and objective views of the adequacy of social relationships.
However, research has indicated that there are common factors associated with both, including socio-economic characteristics (age, marital status, socioeconomic status and education) and life events or transition times (e.g., bereavement or retirement) (34). Holt-Lunstad highlights the degree of integration in social networks, received and perceived social support – components of relationship quality, as major components of social relationships which are consistently evaluated (13). In addition to these, the concepts of social networks and loneliness should be clarified.

2.1.1 Social Networks - Social Integration and Isolation

One of the social relationship variables addressed in this study is social networks. The closely related concepts of social networks, social isolation and social integration are all connected to social engagement, describing the “connectedness” that arises from social networks (35). Social integration in older people has been defined as an objective state relating to the number of contacts and interaction between older persons and their wider social network (36). In this definition integration refers to the structural element of social relationships and can therefore be measured objectively using quantitative properties such as the extent and frequency of engagement in social activities (37). Integration can be viewed as the extent of an individual’s participation in a range of social relationships within their social network (38).

Durkheim described the social network as the means through which people interact, connect, and validate each other within a community (39). The concept of social network is often referred to as an ego-centred network or a personal network, which consists of one particular individual and everyone that he or she knows or interacts with (40). The degree to which members of the network know each other, can communicate with each other, and have reciprocal relationships varies. These interactions are also important in their influence on the person at the centre of the network (41). Network analysis focuses on the structure and composition of these networks, but also on the contents or specific resources which flow through those networks (15). An individual’s social network includes various types of relationship ranging from family to work colleagues and neighbours, each fulfilling specific functions. Achieving a heterogeneous network will afford an individual a broad range of resources and is thought to be a first step in guaranteeing individuals the benefits of belonging to a set of interlocking social structures (42). These benefits include emotional and/or instrumental support – these constructs will be further discussed below. Estimates from previous studies suggest that the average person in the United States has a social circle of about 290 people (40), although it is likely that the number of intimate contacts is far less than this.

Contrary to integration within a large social network, social isolation has been objectively described as living alone, unmarried or no longer married and without social support (43), with a more formal
definition of ‘disengagement from social ties, institutional connections, or community participation’ put forward by Seeman (20). Social isolation can be distinguished from social exclusion. Social isolation is the phenomenon of non-participation (of an individual or group) in a society's mainstream institutions and may be driven by location, education and income factors (44). 'Social exclusion' on the other hand, can be applied to the subset of cases in which social isolation occurs for reasons that are beyond the control of the individual (45), for example those living in institutions (46). Social exclusion is not within the scope of this research and will not be further considered in this thesis.

As a measure of the human contacts a person has, their social network becomes a function of what Rosow describes as ‘an atrophy of social roles and a shrinkage of primary groups’ as ageing happens (47), and is therefore fundamentally linked to loneliness. However, while those with a very small number of relationships may be considered to be socially isolated they are not always necessarily lonely, and vice versa (42).

2.1.2 Loneliness
The important distinction between the size of one’s social network and its perceived adequacy is at the heart of what constitutes loneliness. Loneliness has been defined as ‘a discrepancy between one’s desired and achieved levels of social relations’ (48), or a distressed feeling that accompanies the perception that one’s social needs are not being met by the quantity or quality of one’s social relationships (49). It is the subjective feeling of isolation, not belonging, or lacking companionship (30) synonymous with perceived isolation, not with objective social isolation (49), and so is a more subjective measure than that of social networks, isolation or integration.

The 2007 SLÁN report on Mental Health and Social Well-being in Ireland stated that 14% of respondents reported being often lonely in the last 4 weeks, with women, older people and respondents in lower social class groups reporting higher levels of loneliness. Figures from that report show that 19% of women aged 65 years and over, and 11% of men in the same age group reported being lonely in the last four weeks (50). The NCAOP (National Council on Ageing and Older People) report on loneliness in older people in Ireland was published in 2004 (34). They assessed three types of loneliness: social loneliness; family loneliness; and romantic loneliness (absence of close friend or partner). Overall scores for loneliness were low. The highest percentage of loneliness was identified in the romantically lonely category, a finding supported by other work on experience of social and emotional loneliness among older people in Ireland (51), with almost 50% identifying themselves as moderately romantically lonely, and within this figure reports were significantly higher in females. Moderate social loneliness was reported by 10% with less than 2 per
cent reporting being very lonely in this category. Reported loneliness was lowest in the family category, with 7.2% of respondents indicating that they were moderately lonely. Reports of being very lonely were infrequent. As might be expected, marital status had an effect on family loneliness with those who were married or widowed reporting lower levels of loneliness than single respondents (34).

The report on the initial analysis of the TILDA data showed low overall levels of loneliness, with an average score for older adults of 2, on a scale from 0 (not lonely) to 10 (extremely lonely). The intricate relationship between loneliness and social isolation was highlighted as not all persons who were less socially engaged reported experiencing loneliness. Even out of those who were ‘objectively’ socially isolated, 60% stated they never feel isolated from others (6), a finding which brings into focus the essential subjectivity within the concept of loneliness.

Hawkley and Cacioppo compare loneliness to physical pain, hunger, and thirst, describing it in terms of the pain of social disconnection and the hunger and thirst for social connection (49). This brings to mind Maslow’s Hierarchy of Needs and its five levels of need: physiological, safety–security, belongingness, esteem, and self-actualization. When examining Maslow’s Hierarchy of Needs, social relationships can be considered integral to the first four levels of needs—physiological, safety, belongingness and esteem. Many older people, especially those who are less physically able, rely on others to provide or help them to access the requirements for physiological and safety needs. The practical provision for these needs may include provision of appropriate safe and secure housing, assistance with shopping and potentially hazardous tasks such as cooking, and the provision of companionship. Belongingness is clearly concerned with social relationships, as it describes a requirement for relations with family, friends, lovers and people in general to be satisfied (52). Social relationships are also recognized as contributing to an individual’s self-esteem across the life stages (53-55). These observations begin to identify loneliness as more than a psychological phenomenon and suggest its involvement in broader aspects of life.

Loneliness is a dynamic state and changes over time (56), and through interactions between individual level characteristics and contextual characteristics such as socio-structural aspects of the individual’s environment (57). Loneliness has been described as a process with temporal changes, or something to be experienced over a period of time, not a static event (58). The life-course perspective on loneliness considers whether an individual has always been lonely or has become lonely upon reaching a certain time of life.
The experience of any emotion is influenced by the context in which it is felt – compounding negative factors such as ill-health or concurrent significant life events such as the loss of a partner will influence the intensity of feelings of loneliness, and will inevitably change over time. Acute or sudden changes in life circumstances may lead to a sudden onset of loneliness or the gradual build-up of losses over time may precipitate chronic loneliness. This flux has also been noted in the measurement of detachment in the English Longitudinal Study of Ageing (ELSA), with people moving into and out of different domains of social detachment as years pass (59). Three possible pathways of loneliness in later life have been proposed - continuation of a long-established attribute, late-onset loneliness, and decreasing loneliness (60). Earlier life events should not be discounted in the development of later life loneliness and its impact on health. The influence on health of antecedent processes and mechanisms related to measures of support over time has been noted by Unhino (61). Research on potential lifetime traumatic events has also shown that such earlier life events are associated with loneliness in the second half of life (62).

The subjective nature of loneliness was captured in the UK Economic and Social Research Council (ESRC) report where three distinct definitional categories of loneliness were identified by respondents (58). These categories were (a) functional, (b) a state of mind and (c) family and friends network related, and were used either singularly or in combination. Functional loneliness was articulated in terms of the loss of a range of abilities and the loss of practical aspects of daily life. Loneliness as a state of mind reflected an individual’s ability to find ways of filling time, happiness at spending time alone or the ability to motivate oneself to do things or meet new people. Network loneliness reflected the size of the social network and the closeness of others and a confidant to the respondent (58). The use of a separate ‘network’ category to capture this specific strand of the concept is interesting, as the quality of relationships appears to be more important than the quantity, with the presence of at least one close relationship being key in prevention of loneliness (63). This subjective aspect of relationship quality will be discussed further below.

Addressing loneliness as a separate entity to quantitative measures of relationships is important as indices such as number of social contacts and the amount of social engagement may not adequately capture the distress that an individual may subjectively feel (30). Weiss described loneliness as a natural response of the individual to certain situations and not as a form of weakness (64), in contrast with Rokach’s work in which respondents describe loneliness as a weakness (65) and the stigma of loneliness is explored. The construct of loneliness can be sub-divided into social loneliness, referring to negative feelings resulting from the absence of meaningful relationships and social integration, and emotional loneliness referring to the perceived lack of an attachment figure or
confidant, as well as feelings of emptiness, anxiety, restlessness, and marginality (64). Similar to the network category employed in the UK ERSC report, social loneliness is concerned more with a person’s wider connections and refers to the absence of a wider circle of friends and acquaintances that can provide a sense of belonging, of companionship, and of being a member of a community; and emotional loneliness refers to the absence of an attachment figure in one’s life and someone to turn to (48). This distinction between the social and emotional dimensions of loneliness highlights the potential overlap of loneliness and more objective social isolation measurements. Throughout this thesis loneliness will refer to the subjective sensation of lacking companionship, feeling left out or isolated from others, or not feeling in tune with others. All of the items used in TILDA to capture the concept specifically deal with feelings, irrespective of the individual’s actual circumstances.

2.1.3 Social Support and Relationship Quality

There is an important distinction between the objective measurement of social networks and subjective measurement of loneliness, and disparity often exists between practitioner and client definitions of social isolation and loneliness (36). Social support can be viewed as the bridge between these separate concepts, representing the quality element of social relationships. Social support is a multidimensional concept, it has been conceptualized both as an objective phenomenon – something that can be independently measured against agreed parameters (66), and as a subjective phenomenon - something that is perceived by the recipient (41), and encompasses both the perception that and the actual extent to which the basic social needs of individuals are met by assistance from others. Social support as a subjective phenomenon can also be measured, for example, the perceptions of support from family and friends and the extent to which an individual feels a sense of belonging and satisfaction, and is more than a measure of social network size (67). Support and its mirror – strain - form the measure of relationship quality used in this study.

Social relationships can be categorised as structural (e.g., number of friends, or network size) or functional (e.g., having someone you can talk to about personal problems, or how they can provide benefit), which helps to distinguish between similar but disparate concepts, and their roles (68). Measures of structural support focus on an individual’s social network and the number of ties they have. They assess primary social relationships (being married, having children), contacts with friends and neighbours, and defined social roles such as belonging to an organisation. This approach assumes that regular social connections are important and suggests that the diversity of relationships may also be important.
Functional aspects of social relationships refer to the ‘resources’ afforded by a relationship. Various typologies of support functions have been suggested but the frequently cited defining attributes of social support are emotional, instrumental, informational, appraisal support (69) and companionship or belonging support (70). In line with these, Cohen proposed four categories of support – tangible, appraisal, self-esteem support and belonging support (68). Social support concepts generally include and distinguish at least two functional aspects, namely practical or instrumental support (i.e., help or guidance) in contrast to psychological or emotional support (21).

Emotional support includes the expression of empathy, acceptance, understanding, reassurance, encouragement and emotions such as concern, affection and love, as well as letting the individual know they are valued (69, 71). Instrumental or tangible support encompasses the concrete, direct ways people assist others, such as the provision of financial assistance, material goods, or physical help with tangible needs, such as getting groceries or doing laundry, while informational support is the provision of advice, guidance or useful information (69). Appraisal support seeks to promote the individual’s self-esteem and foster empowerment, and involves the communication of information relevant for the individual’s self-evaluation.

The degree to which one’s social network can be counted on for emotional, material, or informational assistance is captured in the term ‘social support’ (72). This has also been termed ‘coping assistance’ or the active participation of significant others in an individual’s stress management (73). The significance of this is highlighted by Fiorillo et al. (74) in their observation that when quality of relationships is accounted for, their quantity becomes less significant in predicting health. Holt-Lunstad’s description of both social support and perceived social support as functional aspects of social relationships would seem to endorse this observation (13).

Cohen used a broad definition of social support as ‘the resources provided by other persons, potentially useful information or things’ (75) (page 4). This definition was adopted in order to allow for the fact that ‘support’ may have negative as well as positive effects on health and well-being. Those who provide support and those who are in receipt of support may not necessarily agree on which behaviours are supportive and which are not. For example, well-meant advice that may not be appreciated but rather perceived as interfering, or efforts to provide emotional support may be perceived as infringements on privacy. This explains the strain component of the relationship quality measure. Often negative results of ‘social support’ are interpreted as evidence for the hypothesis that individuals under stress more often seek and receive support (76), although the possibility of a direct negative effect of misdirected or situation inappropriate support cannot be discounted. The concept of social control, direct attempts by others to influence participants' health practices and
The existence of significant role obligations to others (77) are examples of how social support can be experienced as both positive and negative.

2.1.3.1 Perceived and Received Support:
Perceived support refers to the perception of social support believed to be available and/or global satisfaction with support (78, 79). The perception of support has been described as an expectation which remains relatively stable over several years in the same way as a personality trait, irrespective of changes to the actual availability of support over that time (21). It is also influenced by family norms and is associated with other positive profiles (61). Received support refers to the specific supportive behaviours that are provided to recipients by their support networks (79). It is more of a situational factor that arises in response to stressful circumstances and so is less linked to the individual’s long term support network – which itself comprises antecedent conditions and mediators of health in the long term (61). Further differentiation can be drawn between support that is received and noticed - visible support and that which is received but not recognised by the recipient - invisible support (21).

The discrepancy between perceived and received support is highlighted by a meta-analytic review comparing effect sizes of the two, finding only a relatively low correlation of $r = .35$, $p < .001$ (79). They also highlight that only perceived support is consistently associated with self-reported general health. Furthermore, McDowell’s study on HIV positive persons suggests that there are significant differences in the relationship of perceived and actual social support to mental health (80). In this study women, gay men and straight/bisexual mens’ perceived social support was significantly more predictive of mental health compared to actual social support. Perceived social support has also been shown to predict health-related quality of life in other population groups (81).

It is possible that the perception of social support, as it remains relatively stable over time, influences an individual’s sense of their capability to tackle challenges in life. Having a sense that support will be available should it be required may increase confidence and improve coping in the face of difficulties. Received support, on the other hand, although more tangible when provided, may also be more transient and less evident on a day-to-day basis, and so not offer the same bolstering of confidence. The relationship quality measure used in this study captured respondents’ subjective perceptions of positive and negative interactions provided by a spouse, children, relatives and friends, and so encompasses perceived support and strain.

The social relationships described here are all influenced by the individuals’ environment and their capacity to engage with it. Additionally, an individual’s capacity to adjust their norms and values
concerning what is optimal in terms of relationships will influence their perception of loneliness (42). How any individual responds to and copes with a situation can vary widely - some resign themselves, while others attempt to resist or change their position (63). These related yet individual aspects of social relationships each interface with health in their own way, whether it be through practical assistance from a wide social network to psychological support and comfort from close relationships.

2.2 The Influence of Social Integration on Health - Social Integration Theories

In order to better understand how the social relationships of older Irish adults influence their physical and mental health, it is necessary first to explore the mechanisms of influence. The role of attachment and interaction with other humans has long been a topic of research interest (15), and the impact of psychosocial distress, independent of biomedical factors, on health outcomes such as worsening disability and death in older persons has been acknowledged (82). The benefit of social relationships has also been well documented (70). The pathways by which these effects are mediated draw on both the psychological benefits and practical aspects of being engaged in a support network. ‘Social relationships’ is an umbrella term encompassing many different interpersonal interactions, which cover a broad array of contexts and purposes. To elucidate the role of these relationships we can look to social integration theory. The mechanisms by which social integration influences health are multiple and complex in nature, and there are a variety of conceptual frameworks of social integration described. This research aims to elucidate the interplay between some of these social relationships and specific measures of mental and physical health. The following theoretical models may provide the frameworks within which these interactions take place.

Cohen described the positive association between social support and well-being in terms of two models - the overall beneficial effect of support (direct-effect model) and the process of support protecting an individual from or moderating potentially adverse effects of stressful events such as financial problems, divorce, conflicts, and marital stress (buffering model) (83). These effects can happen simultaneously (21).

Viewed as two overarching categories of direct and indirect effects, several other theoretical models can be described as indirect effect models. Sieber’s role accumulation theory suggests that accumulation of a number of different social roles, for example as a parent, a worker or a spouse, affords an individual increasing gratification which tends to outweigh any stress it may cause, and is in general a positive influence despite potential for role conflict or overload (84). In line with this theory Thoits described the concept of social isolation as ‘the possession of few social identities’
Another apparent behavior includes the unused age process. Secondly, identifying distress and adapting both positively and negatively depending on the direction of the transfer (86). This accumulation of multiple roles may also be of consequence as individuals age and some of their roles become redundant as children grow up and older generations pass away, necessitating adaptation to fewer roles. An individual’s role in society may further develop over time and be subject to change with the potential for roles such as worker and spouse to be lost in old age. Durkheim proposed that stable social structures and widely held norms are protective and serve to regulate behaviour – this can be described as the regulatory function of integration (38).

If an individual’s role within their social structure changes this may cause distress. This potential for distress highlights the importance of adaptation with ageing. Baltes’ model of selection, optimization, and compensation (SOC) suggests that these three components of adaptation are the basis of successful individual development, including ageing (87). These components are proposed to help achieve successful ageing firstly by actively or passively reducing the number of activities and identifying goals on which to focus available resources, providing a sense of purpose. It is a process of prioritization, helping to focus on those areas that are most important in one’s everyday life. Secondly, available resources are accessed and skills relevant to a chosen goal practiced. This process of optimization refers to adaptive processes or strategies employed before any ageing losses have occurred, to enhance and refine one’s resources and achieve the selected goals. Finally, any age associated losses are compensated for by ensuring goals are attainable, or looking to new or unused internal or external resources as alternative means of reaching a goal, or maintaining a desired state, once losses have occurred.

The model can be viewed as an advocacy of careful preparedness, as Baltes proposes that in order to achieve successful ageing one should ‘strengthen one’s reserve capacities’ (87) (page 20), which include social groups. Use of selection, optimization, and compensation related life-management behaviors has been associated with successful ageing (88). Within this model the roles of awareness, both of self and surroundings, and goal-oriented behaviour, often developed in earlier years, are apparent in the achievement of later life fulfillment.

Another theoretical perspective on the role of social support in health, known as the stress and coping perspective, describes social support as ‘coping assistance’ (89).Thoits reasoned that if the
same coping strategies used by individuals in response to stress are those that are applied to distressed persons as assistance, models of coping and support can be integrated (89). Many other pathways and mechanisms by which social support may influence coping have also been described (70).

It has been suggested that social integration may influence health and well-being in both positive and negative directions by means of social regulation. Social regulation is described as the provision of stable and rewarding social roles, regulation of behaviour through mechanisms of social constraint, obligation and responsibility, promoting healthy behaviour, deterring the person from ill-advised behaviour, and maintaining stable functioning during periods of rapid change (90). However, it follows that social integration may also influence health and well-being in a negative direction by means of social regulation if the prevailing norms are less health promoting.

2.3 Social Relationships within the Irish Context

Having outlined above various components of social relationships and their potential to affect health, the following section will discuss these relationships in an Irish context. The TILDA findings presented a picture of strong family intergenerational support and social and community engagement (6), with high levels of contact between kin, friends and neighbours among older Irish people. A study on loneliness and social isolation in old age found that the majority of older Irish people are not socially isolated and are part of a locally integrated support network that includes family, friends and neighbours, as well as having some degree of participation in church, social groups and clubs (34).

Known predictors of loneliness include age, sex, marital status, education, health and social network (91), key elements in the social tapestry of a country. Ireland has undergone considerable social and policy changes during the lifetime of the TILDA population. There has been a shift away from the marriage patterns of the early to mid-1900s, in which the eldest son was often the only male sibling in a family to marry due to traditional inheritance patterns (92, page 81). The introduction of free education in 1967, the removal of the public service employment marriage ban in 1973, which had until then compelled female civil servants and other public servants to resign from their jobs when they got married, and the resultant shift in the role of women, have also shaped the life experiences of this cohort. Ireland has benefited from increased access to health care, and has undergone a period of relatively rapid modernisation within its urban and rural communities over the past century. The impact of these changes is further discussed below.
2.3.1 Geography – The Urban Rural Divide

Urban and rural living environments play a key role in social gerontology (93). In comparison to older people living in urban areas, those in rural areas are often disadvantaged (94) in terms of having lower incomes, less education, lack of adequate housing, less access to public transportation and poorer access to health services (95) (96). Compounding these disadvantages, rural dwelling older people are reported to have a higher prevalence of functional disability, more sedentary lifestyles, use less preventative care (97), and have poorer health care access (98). Overall, mental and physical health status of rural dwellers tends to be poorer than urban dwellers (99).

There is a global trend towards urbanisation (100). However, despite the substantial change witnessed in recent decades, analysis of the distribution of Ireland’s population shows that Ireland remains a largely rural country. In addition, a higher proportion of older people - 42% of those aged 65 and older - compared to younger people live in a rural area (101). This trend of rural areas being disproportionately old can be seen internationally (102).

While the experience of growing old in a rural area is neither consistently better nor worse than ageing in urban areas (103), those growing older in these areas face unique challenges. The extent to which such challenges adversely impact on an individual is partly determined by individual characteristics and circumstances (101), such as discrepancy in health care availability and access (104). There is evidence of urban-rural differences across the spectrum of mental and physical health, and from both developed and developing nations. Health parameters reported on range from the considerable urban–rural differences noted in mental health in Britain (105) to a Chinese study reporting that elderly people in urban areas were significantly more likely to be overweight compared with those in rural areas (106).

Social integration and social support are potential mediating factors for these significant effects of geographical distribution on health parameters. Mixed evidence regarding social network connectedness highlights some of the unique attributes of rural living in comparison with urban dwelling older people, for example a higher proportion of older urban residents reported never feeling lonely (62% of urban residents compared to 57% of rural residents), yet a greater proportion of rural residents reported being supported than their urban counterparts (101). Work on attachment and belonging in suburban Ireland found that a sense of attachment to locality was significant in shaping people’s sense of belonging and sense of community (107). This link between place and social ties highlights the importance of social values and communal interactions in contributing to well-being and the value given to one’s place within an established social milieu.

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2.3.2 Church, Family and Living Arrangements

The major integrating structures of society include marriage and family, church affiliation, participation in the labour force, volunteer work and membership of voluntary associations (42). The NCAOP report on loneliness and social isolation among older Irish people reports strong evidence that family and church remain of great importance in Ireland, with the vast majority living within five miles of their nearest relative and 90% regularly or occasionally attending religious services (34). The initial TILDA report findings mirrored these high levels of involvement in family interactions, with 90% of older adults visiting with family or friends at least once weekly, and over 70% of those aged 75 years and over either living with their children or having at least one child living in the same county (6).

In their meta-analysis of studies on social relationships and mortality, Holt Lunstad et al. (13) note trends towards reduced inter-generational living, greater social mobility, delayed marriage, dual-career families and increased single-residence households. The prevailing living arrangement among older people in Ireland is living alone or as a couple with close to a third of 65 to 75 year olds, and nearly half of those aged over 75 years, living alone (6). While living alone is not equal to loneliness, it is an objective measurement related to social isolation and is a recognised risk factor for loneliness (58).

The first results from TILDA showed that, in Ireland, women are more likely to feel lonely than men in general across the age spectrum, and that a socio-economic gradient of loneliness exists whereby more educated individuals are less likely to feel lonely (6). It has been proposed that there is a gender bias in self-disclosure, i.e., men are less prone to admit feelings of loneliness (108), and where marital status is measured along with loneliness, the gender pattern tends to be disrupted by marital status as a more influential factor. Marriage appears to exert a protective effect on both physical and mental well-being of men and women. Mortality rates are lower for married individuals than they are for unmarried individuals and marriage seems to be even more beneficial to men than women in this regard (109).

Traditionally older people living alone in Ireland were either widowed or single. However, the situation is changing due to increasing numbers of people who are either separated or divorced, and increasing numbers of single parent families (7). Additionally, new types of household have emerged where adult offspring remain living in their family home, or individuals defined as ‘single’ actually form cohabiting couples (7). These changing demographics of Ireland’s older people who live alone
may result in reduced access to traditional family based support and a diminished network of traditional family-centric social relationships.

2.4 Patterns and Determinants of Social Integration and Loneliness in Older Adults

Both internationally and in Ireland, developing an understanding of the factors that lead to poor social relationships will support the development of informed and effective interventions to address this issue. The following section discusses the patterns and known determinants of social isolation and loneliness in the context of the TILDA population.

Loneliness is associated with sociodemographic variables, discussed below, poor mental and physical health or poorer health in old age than expected, and having a history of loneliness and time spent alone over the previous decade (60). Irish data from SLÁN 2007 reported that 17% of respondents aged 65 and over report being often lonely. Being widowed and not being in paid employment were the strongest overall predictors of loneliness in SLÁN 2007, with respondents who were widowed about 5 times more likely to feel lonely than married or cohabiting respondents (50).

Similarly, it is recognised that social exclusion is not purely driven by, or solely associated with, a single factor such as poverty, and that it is multi-faceted (110). An individual’s exposure to risk factors for loneliness and exclusion or isolation and their experience of psychosocial, environmental and biomedical risk factors are influenced by their socioeconomic status and ethnicity (111), and by the social norms surrounding them. Eventual discrepancies in health outcomes can be viewed as a function of socio-demographic background, with location, gender and education playing a role.

2.4.1 Health

In addition to the established detrimental effect of loneliness on health, the NCAOP data showed that those who reported their health as poor reported statistically significant higher levels of loneliness in social and emotional subscales when compared to those reporting good health (34. This reciprocal effect of health on loneliness may be mediated by a reduced capacity to ‘get out of the house’ to socialise and interact as mentioned by respondents to in the UK ERSC report who cited health as an important factor in loneliness, through its effect on their or their partners’ levels of physical activity (Victor, 2005 #162). Data from TILDA also showed that individuals who report excellent, very good and good self-rated health are less likely to feel lonely and that those who report being in better health are more likely to participate in social activities and to spend time on hobbies and creative activities (6). Similarly, ELSA reported a strong correlation between poor health and low levels of civic participation, leisure activity and cultural engagement, although it had little association with the extent of social networks (59).
Self-rated health (SRH) is included as a covariate in this research as it is an important covariate of health, including loneliness and depression (112). Initial analysis of the Wave 1 TILDA data showed that SRH declined across age groups, with the oldest adults less likely to report their health as excellent, very good or good when compared to their younger counterparts (79% of those aged between 50 and 64 versus 66% in those aged 75 and older). Additionally, initial analysis reported that older persons with poorer SRH are most likely to be socially isolated (6). The negative associations between poor social relationships and health are likely to be most profound among those who rely most heavily on social support for practical care and may have limited options for accessing healthcare and other services. Loneliness has also been shown to predict SRH in older people (113), indicating that correcting for SRH is likely to be important when investigating these variables.

2.4.2 Other Known Co-variates

A range of individuals’ personal and social resources and restrictions influence their ability to achieve and maintain a high-quality network of relationships. These include personal characteristics such as age, gender, partner and household composition, health status, urban versus rural community of residence, specific circumstances of family and non-family relationships, social skills and socio-cultural norms and values that regulate the self-definition and role conception of older people (42). These factors are also intrinsically involved in the concept of successful ageing, as they are enmeshed with QoL and wellbeing.

The protective effects of social ties on mental health are not uniform across groups in society. Perceived support derived from social network participation can vary between men and women, with social roles adopted within the network influencing the degree of responsibility or assistance felt by the individual – the extent to which they give and receive support within their network. Social connections may paradoxically increase levels of mental illness symptoms among women with low resources, especially if they experience role strain associated with obligations to provide social support to others. This accumulation of multiple roles is more common in the ‘sandwich generation’ as previously noted, and may partly account for the higher prevalence of psychological distress among women compared to men (114).

Loneliness is a dynamic process, the experience of which is influenced by life stage and life events (56). However, very old age has been recognised as a risk factor for loneliness (60), and social, family and romantic loneliness have all been significantly correlated with increasing age (34), as has reduced involvement in leisure and cultural activities (59). This dynamic nature of loneliness is
emphasised by the seasonal and temporal variations in the perception of loneliness noted in the ESRC report. Loneliness was reported more acutely by respondents at times when others were less available, certain significant dates and when weather was inclement (58).

2.4.2.1 Socio-economic Influences

A very marked socio-economic gradient in measures of social detachment was noted in ELSA, with rates of overall social detachment ranging from just 5% in the richest quintile of the population to nearly 35% in the poorest quintile (59). Increased education was also associated with reduced risk of social detachment in ELSA (59). Associations between both increasing education and increasing wealth and greater social engagement are also supported by data from TILDA (6). Echoing these findings, the UK study on risk factors for loneliness found that possession of post-basic education was independently protective of loneliness (60). Even as far back as childhood, socioeconomic status has been found to be consequential for later-life loneliness through an indirect pathway of midlife and later-life statuses, by which the impact of early-life events on later-life social mobility and social capital increases risk factors for loneliness (115). Unemployment or working in the home have also been shown to negatively influence quality of life in older people (116), raising the possibility that loneliness resulting from reduced workplace interactions may be a factor in this diminished QoL. The practical impact of socioeconomic situation was illustrated by responses in the UK ESRC report on social isolation citing reduced income and having to give up the car as negative influences on feelings of loneliness due to their effect of reducing mobility, thus restricting social activities, interaction and travelling (58).

The NCAOP reported a significant correlation between social loneliness and lack of access to transport in Ireland (34). In what has been described as a society built around the ‘assumption of high mobility’ (117) older people may equate losing their ability to drive with losing their independence (94). Low civic participation, limited leisure activity and low cultural engagement were associated with limited access to public or private transport in the English Longitudinal Study of Ageing (ELSA), illustrating the different dimensions affected by the practical issue of transport (59).

2.5 Effects of Social Relationships

The final section of this chapter addresses the effects of social relationships on other health parameters, and discusses the potential mechanisms by which these effects may be mediated.

A causal association between social relationships and mortality was proposed almost 3 decades ago (118) and all-cause mortality is consistently associated with measures of social interaction and
support. Several large-scale epidemiological studies have shown that measures of social integration can predict mortality to a considerable degree (119-121).

Holt-Lunstad and colleagues (13) compared the effect of social relationships with other well-established behavioural factors that promote health, such as physical activity, reducing smoking or alcohol consumption. They concluded that the influence of social relationships on risk of mortality is comparable with well-established risk factors.

The health variables of specific interest in this study, BMI and depression, will be explored in greater detail in the next chapter, but in short loneliness in older people has been associated with higher BMI and poor health beliefs (122). As such, it may mediate poor health outcomes as a result of undesirable health behaviours. This association between increased BMI and loneliness, viewed in tandem with other findings that link loneliness with low BMI status (123), is in line with the non-linear relationship between weight and physical health. As both extremes of weight are cause for concern, the association with loneliness at either end of the scale is of note. Numerous studies have documented the association between loneliness and depression and anxiety, so that loneliness is now acknowledged as an important predictor of depression (1, 31, 124-126). BMI and depression will be discussed in detail in the next chapter.

The following section will further discuss the health impacts of social interactions and the pathways and mechanisms by which these effects are mediated. The health parameters affected by social relationships are wide ranging, and include the most frequent causes of death in Ireland – CVD and cancer (127). The links between social relationships and these common causes of mortality prompts the further investigation of their role with related conditions such as obesity.

2.5.1 All-cause Mortality

Holt Lunstad’s meta-analytic review (13) found overall a 50% increased likelihood of survival for participants with stronger social relationships. These results were further supported by a recent study reporting social isolation as a predictor of mortality comparable to the traditional clinical risk factors of smoking, obesity, elevated blood pressure, and high cholesterol (128).

Holt Lunstad’s review also sought to determine which aspects of social relationships are most highly predictive. They found that the association was strongest for complex measures of social integration, compared to simpler measures such as living alone or with others, emphasising the multifaceted influence of social relationships on health (13). Specific aspects of social integration shown to have a protective effect on mortality risk include social network size (129) and marriage, with even greater reduction in mortality rates for married men than married women (109).
2.5.2 Cardiovascular Disease and Cancer
Cardiovascular disease remains the main cause of death in Ireland, followed by cancer (130). There is a significant body of work supporting the effects of various aspects of social integration and support on cardiovascular disease. Social isolation has been shown to increase cardiac mortality risk (131) and lower levels of support have been associated with higher cardiovascular disease mortality rates in several epidemiological studies (61). A British study (35) investigating the association of social engagement with CVD mortality reported social engagement to have a modest protective effect on CVD mortality even after controlling for socioeconomic conditions, behavioural factors, presence of disease, and physical disability. The probability of having a coronary condition has also been associated with loneliness (132). Smaller social networks have been shown to increase relative risk for cardiac mortality and for all-cause mortality in coronary artery disease patients (131). Social isolation was shown to significantly increase the risk of re-hospitalisation within a year for older men (133), as well as predicting mortality in heart failure patients (25).

There is also evidence linking social support, networks and social attachment to lower mortality rates from cancer (134, 135) disease progression and psychological adjustment (136). It is suggested that some of these benefits are borne from enhanced coping skills, emotional support, and increased opportunities for information-sharing provided by contact with friends and family (137). The influence of an individual’s subjective wishes and perceptions is emphasized in a study on depression and anxiety in cancer patients which highlighted that it is only when a mismatch of perceived and desired support exists that lack of social support is associated with emotional distress (138).

2.5.3 How is this Influence Mediated?
There are multiple pathways through which the relationships between social participation and health may take effect (139). The pathways of influence range from complex biological processes, such as the influence of social isolation on the neuroendocrine and immune systems, to more practical influences such as those of social ties on individuals’ positive and negative health behaviours, including physical activity, smoking, alcohol use and accessing medical care (15). This is important as these practical links suggest that interventions to address negative health behaviours could target the area of social relationships.

The mediating pathways by which social relationships might influence health status include both the positive and the negative influence of societal norms, facilitation and barriers put in place by individuals and society, and it must be acknowledged that not all ties are supportive. While the
directionality of the relationship between social relationships and support can be argued in both directions – the “selection hypothesis” assumes that rather than social relationships improving health, people who are already healthy are intrinsically more likely to enter into close and lasting relationships, and also more likely to be selected as attachment partners (21).

2.5.3.1 Indirect Effects – Health Behaviours
The increased risk of being inactive, smoking and multiple health-risk behaviours associated with social relationships (24, 140) may be mediated through support for behaviour change, different coping styles (141), the important role of social support in health literacy and health accessibility (142), and treatment adherence (143). This is illustrated by older adults who are reliant on an intermediary to help explain medical information and access material and knowledge resources, and who rely on a range of others to access healthcare fully.

Behaviours and attitudes that influence long term health are in turn influenced by social norms and an individual’s social network throughout life. Berkman points out that this influence doesn’t require deliberate or conscious attempts to modify behaviour, but can occur simply by individuals receiving what is termed ‘normative guidance’, where attitudes are confirmed and reinforced when they are shared by a group of peers (15). Early family environments support the development of positive psychosocial profiles and better general coping skills (61). These processes of mutual influence occur at a separate level to deliberate ‘social support’ measures and are based on the social influence that extends from a network’s values and norms (15). In order for psychosocial processes such as social support to have an effect on chronic disease outcomes, they would need to be relatively stable due to the longitudinal nature of disease development, speaking once more to the life-span perspective on the influence of social relationships.

2.5.3.3 Direct Effects – Immune Function and Infectious Disease.
A much more direct pathway by which social interaction influences disease is by restricting or promoting exposure to infectious disease agents. Paradoxically a network that may act in a health promoting capacity may be concurrently detrimental to health if it exposes individuals to the spread of infectious disease (15). The other proposed “direct” effect mechanism is via immune and neuroendocrine effects such as inflammation (19), cortisol response, blood pressure response, sleep patterns and silent coronary problems (144-146). These physiological responses to what might be termed psychological experiences have been associated with social relationships independent of health behaviours (147).
Much of the research in the area of social integration and health to date has been cross-sectional in design, limiting the conclusions that may be drawn regarding directionality of the influence. The physiological and mental effects of health status on loneliness, in addition to the effects of social contacts and social support on health, have to be determined by longitudinal research. It is possible that it is health that determines the degree of social integration, and so the extent of loneliness (42). This research will address the complexity of these relationships by using multiple social relationship variables, as well as mental and physical health indices to investigate the effects of known health risk factors on each other, over time.

The wide variety of social relationships that individuals engage in throughout the ageing process has significant influence on all aspects of life. Their consequences are apparent in health and general wellbeing, and are integral in the attainment of good QoL and successful ageing. The mental and physical health variables chosen for closer examination in this study, depression and raised BMI, represent challenges commonly encountered in older age, and areas of significant impact on QoL. Having explained the social relationship variables included in this research, the following chapter will further explore the physical and mental variables of BMI and depression, and their interactions with social relationships.
Chapter 3. Literature Review: BMI and Depression.

3.0 Introduction

Having detailed the various social relationships and their influence on physical and mental health this chapter will proceed to focus on the health parameters of specific interest in the current study – namely BMI and depression. This chapter will discuss BMI in older people, and the health implications of overweight in this cohort. Patterns and known determinants of BMI will be examined and existing evidence for a relationship with depression will be considered. In addition to BMI, depression will be discussed, both in relation to the other measures in this study and in an Irish context.

This study addresses the interface between mental, physical and social health of older Irish adults. The TILDA population represents a cohort which has experienced great change across their lifetime. These changes include modernisation and the resultant alterations to the nation’s diet and exercise habits, and employment structures. Modernisation has also resulted in change to social norms that govern daily interactions, which may in some areas have undermined the traditional sense of community. These experiences and challenges of growing older are brought to bear on older adults’ mental health, through a framework of social relationships, physical capability and personal resilience.

BMI is an objective measurement that is related to numerous other health indices, and is of particular interest as Ireland is currently experiencing an obesity epidemic, affecting both young and old. Ireland’s age standardised mean BMI has increased from 24.0kg/m² in 1975 to 27.8kg/m² in 2014 (148). It is influenced by current lifestyle, environment, interpersonal influences and habits developed over a lifetime. As such BMI is both a legacy of past influences and an indicator of current health. Influences on mental health are equally broad, spanning past and present. The interactions between BMI, depression and social relationships represent a complex aspect of shared influence across mental and physical health.

3.1 BMI in Older People

The occurrence of overweight and obesity is widespread and growing in the adult populations of most industrialized countries (149), with a similar pattern occurring in older adults (150). Estimates based on available BMI data for all 53 countries in the WHO European region, have been projected to 2030 by the WHO’s Modelling Obesity Project, and were presented at the 2015 European Congress on Obesity. They suggest that by 2030 the proportion of obese men and women in Ireland
will reach 48% and 57% respectively, placing Ireland among the countries with the highest rates of obesity in Europe (151).

Obesity is defined as an unhealthy excess of body fat, which increases the risk of medical illness and premature mortality (152). It is measured as BMI greater than 30kg/m\(^2\), or as central obesity - a waist circumference greater than 102 cm in men and 88 cm in women. There are no specific BMI ranges for older people, WHO BMI cut-off points (normal weight: 18.5–24.9 kg m\(^2\) or <25, overweight: 25–29.9 or <30 kg/m\(^2\), obese class I: BMI 30–34.9 or <35 kg m\(^2\), obese class II+: BMI >35 kg m\(^2\)) are designed for use in adults, although WHO recommends that a measure of fat distribution such as waist circumference or waist: hip ratio be used in calculating the risk of comorbidities (153). Although BMI values correlate with percentage body fat in young and middle-aged adults (154), this relationship may be less robust in older adults due to the body composition changes associated with ageing, namely increases in fat mass and reductions in skeletal muscle (152). Cross-sectional studies have shown that body weight and BMI increase with age until approximately 50 to 60 years, after which they both decline (155). A growing body of evidence supports the idea that BMI thresholds for overweight and obese are overly restrictive for older people (156), and that target ranges for older people should be increased from those for the general population, although optimal targets for BMI in this group have yet to be validated in a large prospective trial (157).

The population included in this study includes adults aged between 50 and 80 years of age, with the majority in the ‘younger old’ group, aged between 50 and 64 years old. BMI ranges used throughout this research to define healthy weight, overweight and obese will be those outlined by WHO. Use of these cut-off points is appropriate in a study with a majority of participants who have not yet reached 70 years of age, the age above which amended recommendations are mooted (156), and in the absence of agreed specific recommendations.

### 3.2 Prevalence of Overweight and Obesity in Older People

Mean body weight and BMI gradually increase during most of adult life and reach peak values at 50–59 years of age in both men and women (152).
Figure 3.1: Obesity Rates in the United States of America (USA)

\(^1\)Crude estimate 35.1\%. \(^2\)Significant difference from ages 20–39. \(^3\)Significant difference from ages 40–59.

NOTE: Estimates are age-adjusted for all adults aged 20 and over by the direct method to the 2000 U.S. census population using the age groups 20–39, 40–59, and 60 and over.

http://www.cdc.gov/nchs/data/databriefs/db131.htm
Figure 3.2: Percentage of Overweight and Obese Persons Increases with Age across Organization for Economic Cooperation and Development (OECD) Countries Source: http://racialreality.blogspot.ae/2012/02/eu-overweight-and-obesity-statistics.html

The most recent figures for the overall prevalence of overweight and obesity in Ireland are from the Survey of Lifestyle, Attitudes and Nutrition in Ireland (SLÁN, 2007). Categorising the overall population by BMI, 1% of respondents were underweight, 35% were healthy weight, 39% were overweight and 25% were obese. SLÁN participants were categorised into two age groups: those aged 18-44 years and those ages 45 years and above. Among the older age-group figures for raised BMI were higher, with 20% men and 28% women healthy weight, 49% men and 39% women overweight and 31% men and 32% women obese (158). A previous study to develop anthropometric reference data for free-living older adults in Ireland conducted in 2001 reported a prevalence of overweight or obesity of 68.5% in males and 61% in females, with 17% of men and 20% of women in the obese group, indicating an increase over time in the SLÁN figures.
More recent data on older adults from TILDA paints a further worsening picture in this age group, with 36% of older Irish adults classed as obese and a further 43% classed as overweight, prompting headlines of ‘4 out of 5 Over 50s in Ireland are Overweight or Obese’ (The Irish World, 17th July 2014; http://www.theirishworld.com/four-out-of-five-irish-over-50s-overweight-or-obese/). Obesity is more prevalent among men (38%) than women (33%) amongst the TILDA population (159), and obesity levels, particularly in men, have increased markedly since SLÁN. According to the 2011 National Adult Nutrition Survey (NANS), between 1990 and 2007 the greatest increase in obesity among Irish adults was observed in 51-64 year old men, rising from 11% to 42% (160).

### Table 1: Overweight and Obesity in Older Irish Adults by Gender

<table>
<thead>
<tr>
<th></th>
<th>Healthy weight BMI 25–29.9kg/m²</th>
<th>Overweight BMI 30–34.9kg m²</th>
<th>Obese BMI &lt;30kg/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SLÁN 2007</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults aged &gt;45 years</td>
<td>Males</td>
<td>20%</td>
<td>49%</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>28%</td>
<td>39%</td>
</tr>
<tr>
<td><strong>TILDA 2014</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(data collected 2009 – 2011)</td>
<td>Total</td>
<td>21%</td>
<td>43%</td>
</tr>
<tr>
<td>Adults aged ≥50 years</td>
<td>Males</td>
<td>16%</td>
<td>46%</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>26%</td>
<td>40%</td>
</tr>
</tbody>
</table>

A comparison of overweight and obesity prevalence was undertaken across 53 countries in the WHO European Region of WHO using overweight and obesity prevalences that were adjusted to the European standard population aged 25–64 to allow for meaningful comparison of available data. The comparison showed that the 50–64-year-olds had higher prevalence of overweight and obesity as compared to the 25–49-year-olds, a pattern which occurred in every country, by male and female, including Ireland (161). This pattern raises a warning flag in relation to the additional burden of weight related co-morbidities faced by this cohort as they continue to age. Obesity is a complex issue, and the question of what can be done to address obesity among older adults requires a multifaceted answer. Identifying modifiable influences on weight status, such as social relationships, provides a potential intervention pathway for prevention and treatment that has yet to be fully explored.

### 3.3 Socio-demographic Patterns and Determinants of Raised BMI in an Older Population

While this thesis will further explore the interactions between social relationships, depression and raised BMI, risk factors for obesity in older adults have been identified by numerous studies (162) and include male gender, low education, and physical inactivity. Energy intake tends not to increase...
in older age and so weight gain resulting from energy imbalance is likely due to reduced energy expenditure through physical activity (152).

SLÁN data showed that obesity was more common in social classes 5 to 6 (158). This mirrors the pattern of greater obesity burden among lower SES populations which can be seen across age groups (163, 164) in developed countries. Addressing lifestyle and dietary habits that contribute to overweight and obesity poses a particular challenge in low socio-economic groups, for whom financial constraints, poor health literacy and access to affordable healthy foods often constitute barriers to healthful choices (165, 166).

Educational attainment is a good indicator of socio economic status and in line with this the National Health and Nutrition Examination Survey (NHANES) data from 2007 to 2010 showed there was a significant linear trend in the prevalence of obesity by educational attainment among women but not among men, with a decrease in obesity prevalence with increasing education in women (167). McLaren’s review also highlighted the global trends in the relationship between obesity and socioeconomic status – moving from high to medium to low Human Development Index countries, the proportion of positive associations between obesity and SES increased and the proportion of negative associations decreased, for both men and women (168). This trend was particularly strong in women, emphasising the value placed on thinness in the western world.

Relationships between appearance, health, body weight and marital role obligations result in complex associations between marital status and weight. However, changes in social roles, such as entering or leaving marriage have been shown to influence body weight (169). This is of relevance among older adults as the likelihood of being widowed increases with age.

3.4 Physiological Effects, Risks and Benefits Associated with BMI in the Older Adult

Obesity is a risk factor for decreased survival (170, 171) and for many chronic diseases, such as diabetes mellitus, hypertension, dyslipidemia, coronary artery disease, and chronic heart failure, which contribute to reduced well-being and disability in older age. It also contributes to risk of some cancers and impaired mobility, but conversely protects against hip fracture in older adults (172). In addition to the effects on individuals outlined below, the increasing prevalence of overweight and obesity (173), and the needs of an ageing population are issues that will impact future resource and service requirements. Obese individuals have been found to have medical costs that were approximately 30% greater than their normal weight peers (173) and, as complications of chronic disease occur in older age, increased health care needs in these areas are to be expected in older populations. Older obese individuals in Ireland visit their GP more frequently, take more
medications, and are more likely to report poly-pharmacy than those who are not obese (159). Additionally, combined obesity and ageing are likely to result in an increase in the prevalence of disability in the future (174). Multimorbidty, associated with raised BMI, is likely, in turn, to detrimentally affect mental well-being, and has the potential to limit ability to fully interact with society. Consequences of obesity are many and varied, and are not stand-alone. The following paragraphs highlight additional physiological effects of raised BMI, which may also represent barriers to good mental health and fulfilling social relationships.

3.4.1 Functionality and Mobility

An important consideration in the concept of ‘successful ageing’ is functionality. Physical function and mobility progressively decrease with ageing because of the loss of lean body mass, strength, and balance, and an increase in joint dysfunction and arthritis (175). This situation is compounded by obesity, a known risk factor for impaired mobility and arthritis-related functional impairment in older people (172).

An individual’s ability to perform activities of daily living independently affects not only their quality of life but their capacity to interact fully with the society around them. Very high or very low BMIs carry increased risk for impaired functionality (176) and co-morbid disease in the general population (177, 178). Both cross-sectional analysis (179) and longitudinal data from the ELSA (180) and the USA (181) have shown greater risk of impaired physical function and disability in older people in higher BMI categories. A study investigating the relationship between BMI and the ability to perform activities of daily living in a sample of community-dwelling elderly showed a greater risk for functional impairment for those with a low BMI or a high BMI. The greater the extreme of BMI, the greater the risk for functional impairment (182), a finding echoed by other studies including Backholer’s review of disability associations with overweight and obesity (176, 179).

The differentiation between lean and fat mass in heavier individuals is an important factor in their functionality, and increased absolute muscle mass may contribute to the maintenance of function in overweight individuals. Those with a higher BMI in old age may be maintaining a higher absolute amount of lean mass compared to those with a normal BMI. However, this advantage diminishes with increasing weight, as further increases in weight towards morbid obesity are predominantly gains in fat tissue not lean body mass. Higher fat mass has been associated with poorer physical performance, while higher muscle mass was a predictor of better physical performance in older people (183).
This “risk factor paradox” is echoed in a study investigating activities of daily living (ADL) scores and instrumental activities of daily living (IADL) scores in nursing home residents (184). They found that functionality scores were higher in higher BMI groups. Even in those with a BMI above 35 kg/m², ADL was significantly higher than 25–34.9 kg/m² residents.

Another review by Rejeski et al. (185) reported a curvilinear relationship between BMI and physical disability such that being underweight poses as great a risk for physical disability as being excessively obese. They acknowledged the protective effect associated with older adults being overweight, but highlighted that the greatest risk for physical disability occurs in older adults who have a BMI in the obese class II or above range and is greater among women. This gender difference was also noted by Friedmann (186) who also highlighted the importance of cut off points employed to categorise BMI. Use of gender-specific quintiles in addition to usual BMI categories identified increased risk of functional impairment for women at BMI of >35kg/m², whereas for men risk did not increase until BMI reached 40kg/m² (186). Observations regarding more extreme BMI are echoed in ELSA. Data from ELSA show that frailty, a condition which can be characterised by an accumulation of “deficits” across many systems, affects those with high BMI as well as those who are underweight, as demonstrated by the U-shaped curve of association between BMI and the frailty index (187).

Mobility is another factor contributing to an individual’s ability to socialise outside of their home and engage in extended social networks, and therefore provides a means by which obesity can influence social relationships. A review by Vincent et al. (188) reported a consistent association between obesity and mobility disability in older adults, especially in those with a BMI greater than 35kg/m². Hip, knee, and ankle joint pain - so common in severe obesity - are likely to impact negatively on both functionality and self-rated health. Functional impairments in turn may cause depression (189), highlighting functionality as a potential pathway by which obesity may influence mood.

The initial report on wave 2 of the TILDA data showed that those who had an increased waist circumference or increased BMI at Wave 1 were more likely to have developed a disability in either their ADL or their IADL by Wave 2, highlighting the effect of being overweight on functionality over time. Similarly, reduced levels of physical activity were noted in those who had a high BMI at wave 1 (190).

These studies highlight the potential social impact of both high and low extremes of weight mediated by functional disability, reduced mobility and frailty.
3.4.2 Metabolic Abnormalities and Immune Function
Excess body weight, especially centrally distributed weight, is associated with insulin-resistance, dyslipidemia and high blood pressure (191). Metabolic syndrome is estimated to affect between 10% and 84% of the population worldwide (191) and 13.2% to 21.4% in Ireland depending on the definition used (192). The burden of chronic disease is significant in older people with multimorbidity, including lipid metabolism disorders, chronic low back pain, diabetes mellitus, osteoarthritis and chronic ischaemic heart disease, all conditions associated with overweight and obesity (193).

In addition to these specific comorbidities, it has also been acknowledged that adipose tissue plays an active role as an ‘endocrine gland’, producing a variety of hormones and factors that may contribute to a generalized inflammatory state, a likely precursor to the development of other comorbid conditions (194).

3.5 Psychological and Psychosocial Associations of BMI in an Older Population
The following section will address the ways in which raised BMI and mental health interact. Psychological distress in obese individuals is well documented and has been related to a wide range of factors, spanning demographics such as age and gender, socioeconomic class, and social and cognitive factors such as a history of stigmatisation in relation to obesity, discrimination, negative reactions from both family and peers, and poor interpersonal relationships (3). Both how an obese individual views themselves and how they are viewed by society influence their daily experiences, such that obesity can significantly negatively impact subjective well-being (195).

3.5.1 Self-rated Health, Health Related Quality of Life and Obesity.
Obesity influences overall health-related quality of life (HRQOL), but interestingly is more strongly negatively related to physical HRQOL than mental HRQOL. (196). The concurrent association between obesity and activity limitations, and the positive influence of exercise and dietary modifications on this relationship suggest that it results from functional impairments that may be improved by exercise interventions. An Italian study of people over 60 years of age reported achievement of a lower score on the physical component of the 36-Item Short Form Health Survey (SF-36) questionnaire by obese and overweight subjects compared to the normal weight group (197). Other studies have also shown that the interaction between weight and HRQL is significantly moderated by physical activity, and that underweight is more significantly associated with reported disability than overweight in older people (198).
The subjective nature of the relationship between weight and SRH was illustrated by a study of actual and perceived weight and BMI, and their associations with self-rated health and life satisfaction. Results showed an association between perceptions of underweight or overweight and higher odds of suboptimal SRH and life satisfaction, independent of BMI (199). Findings from a Spanish study report that the negative effect of obesity on the SRH noted in younger groups was not apparent in those over fifty years-old people (200). The authors suggest that this might be explained by a perception amongst older people that changes in body shape are a normal aspect of ageing, resulting in less distress due to being or becoming overweight or obese.

3.5.2 Obesity and Depression

Epidemiologic studies have long suggested an association between obesity and depression, but findings across studies have varied (201). Early investigations into this relationship, such as Crisp and McGuinness’s 1976 study, found a significant positive relationship between substantial obesity and low levels of anxiety in men and women, and low levels of depression in men (202). This “Jolly Fat” hypothesis was tested and supported in older people by Palinkas in 1995 (203).

Later studies found a significant increase in lifetime diagnosis of major depression associated with obesity (201). A 2008 meta-analysis of longitudinal studies concluded that depression led to an increased risk of developing obesity (204), and there is some evidence for obesity as a causative factor in depression (205). Other research has identified specific aspects of overweight and obesity, such as early onset of obesity and a history of weight cycling, as being particularly risky for later psychological disadvantage (3). Also highlighted were differences between specific groups of obese people, such as men and women, with a positive association in women but negative in men for depression (206). A more recent meta-analysis of longitudinal studies has suggested that the relationship is in fact reciprocal between depression and obesity, such that obesity was found to increase the risk of depression, and depression to be predictive of developing obesity (207).

However, when age is also considered this relationship may change once more. A study of depressive mood and obesity in US adults, considering sex, age, and race found that while young overweight and obese adults were at increased risk of depression, depressive mood and its sustenance were not associated with obesity in either sex among old respondents (208).

The key findings report on Wave 2 of TILDA reported a higher prevalence of major depressive disorder in older adults who had a substantially increased waist circumference or who were obese according to their BMI at wave 1, and the authors suggest that the association between waist...
circumference and depression is evident in men but not in women. No association between obesity and anxiety was observed with either measure of obesity (190).

While the intricacies of the relationship between weight and mental health lack complete clarity, weight continues to be an issue of day to day concern for many. Although fewer of the older adults in SLÁN appeared to be concerned with their weight compared to the study’s younger respondents, 34% of those over 65 years of age reported actively trying to manage their weight (158). This indicates an awareness of weight-related risks and influences among a proportion of older cohorts.

3.5.2.1 Obesity and Depression: Dietary Quality and Fitness as Mediators

Social relationships have also been linked to dietary behaviour which may be an important pathway through which social circumstances influence health (209). A 2013 review of the association between diet quality (210), dietary patterns and depression in adults identified numerous studies that reported reduced odds of depressive symptoms associated with an increased adherence to whole food or healthy diets, increased odds of depressive symptoms associated with increased consumption of processed foods and an association between depressive symptoms and a reduced likelihood of healthy eating. Although the authors summarise the evidence as conflicting due to the findings of two studies that no association existed, significant association between adherence to a healthy diet and a reduced likelihood of depression was noted in two high-quality cohort and four cross-sectional studies.

In studies that investigated depression as a predictor of diet quality, combined evidence was again reported as conflicting, although evidence was reported from two high-quality cross-sectional studies reporting a significant association between depressive symptoms and the reduced likelihood of eating a healthy diet (210). These findings suggest a mediating role of diet in a reciprocal relationship between BMI and depression, and points to other known risk factors for obesity as potential players in the development of depression.

A recent study investigating the role of fitness in the relationship between obesity and depression has found that low fitness was more strongly associated with the onset of elevated depressive symptoms than was fatness, regardless of the measure of fatness used (211). This once again draws attention to the impact of obesity on functionality, and the role of physical functionality on mental health. The protective role of fitness for functionality in the context of obesity, along with the independent beneficial effect of physical activity on depression (212, 213) and its essential role in weight management all promote increased physical activity as an efficacious concurrent treatment for multiple conditions.
Specifically in older people, a meta-analysis of randomised controlled trials on the effect of exercise on depressive symptoms reported that prescribing structured exercise tailored to individual ability will reduce depression severity in those with clinically meaningful symptoms of depression (213), and the benefit for QoL and functional status have also been reported (214).

3.5.3 Obesity and Social Relationships

While obesity is widely accepted as a health risk, it also represents a disadvantaged social position due to the strong stigma associated with it. Stigma associated with obesity originates from a variety of interpersonal sources and results in discrimination and prejudice across a range of situations including the workplace, public spaces, education and health care settings (215), and is linked to availability of opportunity and personal wellbeing (216, 217). Obesity stigma is pervasive and also highly accepted by society (218), with obese people described as the last acceptable targets of discrimination (215). Stigmatization may damage self-esteem, psychological well-being and self-acceptance among severely obese people (219), and inevitably damage social relationships and the skills and self-confidence required to initiate and maintain them. For example, a fear of mockery during physical activity or socialising (220) is likely to result in an individual limiting their potential social interactions as a result of obesity stigma.

Emphasis and concern about weight is greater among women than men (169). There is evidence that obese men are less subject and susceptible to social stigma than women (221) and the negative impact of obesity on physical HRQOL is buffered by social support in men but not in women (222). The distress caused by stigmatization may clearly impair subjective wellbeing and contribute to a sense of hopelessness. Other maladaptive coping strategies such as self-criticism and isolation may also contribute to mental health issues (223), as well as affecting social relationships.

The combination of external stigmatization and personal devaluation creates a significant disadvantage for obese people in terms of fostering social relationships, which may in turn contribute to feelings of loneliness or isolation. For example, Ashmore’s study on the influence of obesity-related stigma showed that individuals who had experienced more frequent stigmatization reported increased feelings of social isolation (224).

The quality of relationships with friends and families is important. Supportive interactions may promote healthy behaviour, encourage weight management, and buffer against weight-related mental and physical stresses such as stigma or health issues. Relationships characterised by strain on the other hand may add to this stress.
Obese people are at risk of discrimination not only by peers, but also by healthcare professionals who are theoretically placed to treat or assist them (225). Several studies have reported negative attitudes of health care professionals towards obese individuals, with doctors ascribing the stereotypes of lazy and lacking self-control to their obese patients (215). The notion that the opinions and insights of overweight and obese people regarding weight issues are not credible is common (218). This may result in a biased healthcare interaction that undermines instead of empowers the individual. Such negative attitudes and reluctance in physicians may lead to obese people feeling reluctant to seek health care (215). Additionally, doctors who attribute negative stereotypes such as ‘lazy’ to obese people may be less likely to appropriately identify symptoms of depression, such as a lack of interest in daily activities. Such interpersonal strains associated with obesity across a broad range of relationships are likely to impair mood and contribute to the relationship between obesity and depression.

The associations between BMI and various aspects of social relationships outlined above are wide ranging and complex, influenced by life stage and degree of obesity. Much of the evidence available is based on younger or mixed populations and so the nature of these interactions in an older population is of interest. While the anonymisation processes employed for the TILDA data limit the information available on extreme BMI in this population, a significant number of respondents fell in the overweight and obese categories, allowing examination of these complex interactions.

3.6 Depression

Depression is the mental health variable considered in this thesis. The following section will consider depression in older adults, both in relation to the other measures in this study and in an Irish context. As a common mental health issue depression plays a role in many older people’s experience of social interaction, daily lifestyle choices and health outcomes. While clinical depression is acknowledged as a significant concern in its own right, subclinical depression or ‘low mood’ also warrants attention due to its potential effect on other important aspects of wellbeing.

3.7 Diagnosis of Depression

The experience of depression may range from a transient feeling of flat mood, to a severe, disabling, and recurrent clinical syndrome (226). Assessment of depression and its clinical diagnosis consider the presenting symptoms and their duration. Clinical depression may be diagnosed if five or more of the symptoms outlined in the Diagnostic and Statistical Manual of Mental Disorders (DSM) published by the American Psychiatric Association, are present over a two-week period, most of the day, nearly every day. At least one of the symptoms must be either a depressed mood or a loss of interest or pleasure.
Categories of depression include dysthymia - a disorder of mood, grief- a reaction to loss, adjustment disorder with depressed mood (a time limited reaction to an event), or major depressive disorder (MDD); a greater number and severity of symptoms are associated with depression (226). As such, a clinical diagnosis of depression identifies a state recognised as detrimental to well-being and as a risk factor for other health conditions, and implies in part its origin. Yet for many older people depressive symptoms go unassessed and depression, although real and present, remains undiagnosed. Self-reported depression measures and clinical interview do not always concur, and the risk of missed diagnosis is greater for older people (227).

3.8 Prevalence and Impact of Depression

Depression is the most common psychiatric disorder among the elderly and research suggests that it is both under-recognised and under-treated in late life (228). Depression can be measured in many different ways in a research context, resulting in variation in estimates.

In TILDA, using the Centre for Epidemiologic Studies Depression Scale (CES-D), 10% of all participants were found to have clinically significant depressive symptoms while a further 18% reported ‘sub-threshold’ depression (6). This is in line with estimates from the EURODEP studies which reported levels of depressive illness among older people across Europe, ranging from 8.8% in Iceland to 23.6% in Munich, with Irish results of 11.9% in Dublin (229). In addition to major depressive disorder there is significant psychological burden from late-life depressive syndromes outside of the criteria for major depression. A study in the USA reported that subthreshold depression was at least twice or three times more common than major depression among older people (230). Although not diagnostic, these sub-threshold levels of depression are important and clinically significant as they have the potential to impair health, cognition or activities of daily living (6). Use of measures such as the CES-D, which provides a score across a continuum from ‘no depression’ to ‘severe depression’, in the place of a diagnostic interview allows for important sub-clinical depressive symptomatology to be identified.

The discrepancy between prevalence figures reported using screening tools and those using diagnostic measures is highlighted by data from SLÁN in 2007, using the CIDI-SF V1.1 health interview survey (a short form of the World Health Organization’s Composite International Diagnostic Interview (WHO-CIDI)), which classified 6% of the total population (8% of women and 5% of men) as having probable major depressive disorder. Those aged 65 and over were less likely (3%) to have experienced depression than younger respondents (50). These results are comparable to a reported European rate of about 5% (50).
Regardless of the measure used, mental health problems among older people appear to be increasing. Reported figures have increased over the past decade, bringing clinical MDD from relatively rare (a weighted average of 1.8% of elderly included in a 1999 review were diagnosed with major depression (231) to a more common concern, as noted above. The 2013 Global Burden of Disease study identified depressive disorders as a leading cause of burden worldwide, listed among the top ten causes of years lived with disability in every country (232). Projections estimate that MDD will become the second leading cause, after cardiovascular disease, of disability-adjusted life years (DALY) worldwide by the year 2020 (233). It is important to remember that MDD does not represent the full scale of depression related burden.

While the prevalence of major depression varies from one setting to another, with figures of 0.9% to 9.4% reported for private households and 14% to 42% for institutional living (234), its significant negative impact is undisputed. Depressive symptoms have a detrimental influence on a wide range of health and social outcomes. The breadth of these influences provides the rationale for investigating the links between depression and social relationships among older people, in the hope of identifying a modifiable factor in the aetiology of depression. The effects of depression are discussed in the following section.

3.9 Effects of Depression

While depression is primarily a mental health condition, its secondary physical effects should not be overlooked. Depressive symptoms are a risk factor for physical health including cardiovascular disease (235), wound healing (236), raised pro-inflammatory cytokine levels (237), and are also associated with high use of health care resources (238). Depression also has measurable effects on functionality (189) and risk of sedentary lifestyle (239), obesity as previously discussed, work performance (240), participation in rehabilitation (241), and additionally impacts memory (242) and quality of life (5, 243). It is an established risk factor for increased mortality rates across multiple patient groups and ages (244-247). A systematic review of functional impairment related treatment outcomes reported associations between depression and global, social, occupational and physical functioning (189), highlighting the breadth of influence of mental health. With such wide reaching impact, the role of addressing depression in pursuit of holistic health and successful ageing, characterised by increased life expectancy, quality of life, and maintained health and independence, is clear.

3.9.1 Depression and Chronic Disease

Depression is a common comorbidity of chronic illness (248) and is associated with increased illness burden (249). Chronic diseases such as cardiovascular disease are common and pose significant
morbidity burden in the older population (250). Major depression is found in approximately 15% of CVD patients (226) and is associated with increased risk of coronary artery disease, myocardial infarction, congestive heart failure, and isolated systolic hypertension. Depressed cardiovascular disease patients also suffer increased morbidity and mortality compared to patients with cardiovascular disease who are not depressed (251). This relationship is incremental, such that as depression severity increases, so too does subsequent risk of mortality and other cardiovascular events (226). Depression has also been identified as a risk factor for the onset of type 2 diabetes, (252, 253). This increase in risk is mutual as diabetes poses an increased risk of depression (253) of up to double (254).

Chronic disease management and outcomes may also be affected by depression, as demonstrated by the poor diabetes outcomes associated with concurrent depression and diabetes (254). Depressive symptoms are associated with poorer health behaviours (255) and reduced adherence to medications across a range of chronic conditions (256, 257). Evidence to support an association between depression and dementia and Alzheimer’s disease has been reported from several longitudinal studies and meta-analyses (258-264) including both case-control studies and prospective studies. The most recent of these (164) reports a significant risk of all-cause dementia, Alzheimer’s disease and vascular dementia associated with late-life depression.

A significant proportion of older Irish people live with multi-morbidity (265), including cardiovascular disease, chronic pain, diabetes or respiratory diseases. While individual conditions affect individuals largely independent of each other, those with multiple conditions are at the highest risk of disability, poor SRH and poor quality of life (266), factors associated with depression (5, 267, 268).

3.9.2.1 Normalisation of Depression in Older Adults
While depression is a common problem among older adults, it is not a normal part of ageing. As noted above, depression is more common in those who have other health conditions or whose function becomes limited. The negative impact of depression in these groups is often compounded by an expectation of declining mental health in older age, and a resultant reluctance to seek treatment. Additionally, it can be difficult to distinguish between depression, sub-syndromal depressive states, and normal ageing in old or very old people (269). Symptoms of depression may go overlooked or diagnoses may be missed in older adults as a result of clinical focus on comorbidities, and an acceptance of resulting low mood as normal. Similarly, individuals who have experienced undiagnosed sub-syndromal depression for some time may not themselves recognise it as anything more than feeling ‘a bit out of sorts’. Such normalisation of depression is problematic as
the expectation that older age brings reduced physical and mental wellbeing is a barrier for many to seeking appropriate assistance.

A qualitative study of depression in older adults by Ludvigsson et al. (270) identified that sub-syndromal depression differs clearly from depression but only a little from non-depression. Interviews conducted with sub-syndromal depression and non-depressed groups both illustrated the importance of independence, adaptation of activity levels to declining physical stamina, and coping with the adversities of old age, and differed mainly in the intensity and extent of perceptions of decline and suffering. They discuss a dimensional view, in which categorical distinctions are replaced by a continuum or spectrum of overlapping normality and disease. This spectrum includes a wide and complex array of emotions and behaviours, resulting from the biological, psychological and social changes that occur in old age. The clouding of the distinction between normal ageing and pathological depressive states described by the authors illustrates the challenges in recognising depression in old age (270).

In light of these wide ranging effects of depression, the predicted increases in mental health problems, in conjunction with the increase in ageing populations, will compound the physical multimorbidity commonly experienced by older people. As such, the factors related to depression in older age warrant investigation, with the aim of identifying appropriate intervention targets to reduce the large scale burden of depressive symptoms among older adults. The following sections will outline the known patterns and determinants of depression, and will consider the evidence linking depression with social relationships.

**3.10 Socio-demographic Patterns and Determinants of Depression**

The main predictors of depressive disorders and depressive symptom cases in older adults have been documented as female gender, somatic illness, cognitive impairment, functional impairment, lack or loss of close social contacts, and a history of depression (234).

The relationship between depression and ageing is complex. The ageing process is characterised by an inevitable degree of physical decline and self-reported physical health has been shown to have a strong relationship with depression (271). Yet, greater age has been associated with higher levels of optimism and resilience and less depression despite worse physical and cognitive functioning (272). Self-rated successful ageing reported in the Successful Aging Evaluation (SAGE) study was influenced by resilience, depression, physical functioning, and age, highlighting the combination of mental and physical health parameters in the concept of successful ageing (272). Psychological development is considered to continue through life, with the dynamic nature of an individual’s life stages playing an
important role in their mental health, including the development or prevention of depression. Data from the NCS-R on lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the USA suggest that mood disorders including depression mostly develop earlier in life and that later life first onset is relatively uncommon with most diagnoses made over the age of 75 years being comorbid conditions (273).

The 1990 Global Burden of Disease study reported depression as the leading cause of disability in both males and females, with the burden of depression 50% greater for females than males (274). This pattern has also been noted specifically in older populations (50, 230, 275) and age itself has also been identified as a risk factor for depression (276), along with bereavement, sleep disturbance, disability, and prior depression (277).

A clear relationship between mental health, social well-being, quality of life, self-rated health and health behaviours was highlighted in the SLÁN study (50). Results from Europe and the USA have also identified medical illness, burden and disability as well as generalised anxiety disorder and subsyndromal depression as predictors of late-life depression. In Meeks’ review of the course of subthreshold depression in older adults, almost 10% of those with subthreshold depression progressed to major depression annually, illustrating the role of both mental and physical health in the aetiology of depression (230, 278).

Patterns of health-related behaviours are also apparent. A high prevalence of alcohol excess has been reported, with almost 20% of those aged 65 years and over diagnosed with depression also having a co-occurring alcohol use disorder (279). Sleep problems have also been associated with and shown to predict depression (275). The role of habitual dietary intake in the development of depression is complex as it is easily confounded by other factors such as socioeconomic circumstances and physical activity. Findings from the prospective Personality and Total Health (PATH) Through Life Study in Australia have shown that even after adjustment for potential confounders and baseline depressive symptoms, lower scores for a healthy dietary pattern and higher scores for an unhealthy dietary pattern independently predicted higher depressive symptoms in participants aged sixty years and over (255). Tobacco use has also been associated with depression, with depressed individuals more likely to continue smoking, to initiate smoking, and not to quit than those who were never depressed (280).

The findings on mental health and wellbeing from SLÁN indicate that low education, low income, holding a medical card, being unemployed – all indicators of social disadvantage - as well as being
divorced or separated and living in an urban area were associated with poorer mental health and social well-being (50). Some of the determinants of mental health identified in SLÁN are shared with the physical health measure of obesity, specifically social disadvantage as indicated by reduced educational attainment. Low socio-economic status (SES) has been shown to predict the occurrence of depression, and a clear inverse relationship between depression and mental health has been demonstrated across international studies and age groups (281-283).

SLÁN also reported lower levels of loneliness and higher levels of social support associated with positive mental health, while poor levels of social support and experiencing loneliness were strongly associated with higher levels of psychological distress (50). This protective effect of social support was also reported in the Amsterdam Study of the Elderly (AMSTEL) where having a marital partner, or for the unmarried having social support, significantly reduced the impact of functional disabilities on the incidence of depression (276).

These patterns illustrate the wide social and economic influences on mental health, and the central role of mental health issues as both a cause and a consequence of social and economic inequalities, and health and social outcomes.

3.1 Depression and Social Relationships
While there is an established relationship between depression and social relationships, the specific nature of the relationship is less clear. Loneliness is a risk factor for depression, and has been shown to be more significantly related to depression than self-reported health (112). However, the same study reported no relationship between social support variables and depression, highlighting the complexity of social relationships’ influence on mental health. Yet in another study lower levels of social support were predictive of significant psychological distress among older people in community and residential settings (284).

3.1.1 Depression and Loneliness
Loneliness and depression correlate highly, which as pointed out by Weeks et al. (285), results in difficulty measuring the associations between them, as measures used may in fact be measuring some of the same things. However, this study also indicated that loneliness and depression are clearly different constructs, which likely share some common origins (285). Depression and loneliness commonly co-occur, and whether depression is an outcome or a predictor of loneliness, or whether there is a reciprocal relationship between the two remains under investigation (286).

There is both qualitative and quantitative, and cross-sectional and longitudinal evidence that loneliness leads to depression (1, 126, 286). This body of evidence includes two longitudinal studies
in which loneliness was shown to increase reports of pain, depression, and fatigue symptom cluster over time (287). In interviews with older people loneliness was viewed as a precursor to depression, and reported loneliness in the week prior to interview was highly associated with depressive symptoms, anxiety, and hopelessness (126).

Cacioppo et al. reported reciprocal influences over time between loneliness and depressive symptomatology (1). A study of residents in independent living retirement communities identified common risk factors for both, namely grieving a recent loss and fewer visits from friends and neighbour. Regression analyses in this study also identified loneliness scores as an independent risk factor for depressive symptoms (288). There is also evidence that the detrimental effects of loneliness and depression may compound each other. A Dutch study of 85 year old adults found neither depression nor perceived loneliness to individually have a significant effect on mortality, yet mortality risk more than doubles for those who suffered from concurrent depression and feelings of loneliness (289).

3.1.2 Depression and Relationship Quality
The importance and role of companionship in maintaining vitality and enthusiasm for life is often characterised by the reluctant participation of a spouse in an activity they profess not to enjoy solely for the benefit of their loved one. As noted by Schulz, individuals who "give up" may also disengage from health promoting behaviours, both preventative and restorative, as well as disengaging from supportive relationships (290). This characteristic of depression may put strain on existing relationships and preclude individuals with depression from forming new relations. The dynamic of a spousal relationship can influence symptoms of depression (291), highlighting the potential for relationships characterised by strain rather than support to contribute to rather than ameliorate symptoms of depression.

Relationships other than spouse, such as those between parents, children and friends, may also cause strain and be affected by depression. The particular situation of younger old adults with living parents has been highlighted as a potential for conflict and relationship breakdown (292). In the case of care of older parents, relationship quality has been shown to suffer in the presence of problem behaviours in a cared for older person and by this pathway to mediate carer depression (293). The role of spousal caregiving can also be associated with caregiver depression, although this can be dependent on the nature of the earlier spousal relationship (294).

3.1.3 Depression and Participation
The objective measures of participation and social isolation are related to but separate from the subjective experience of loneliness and relationship quality and as such may have a different
relationship with depression. Depression leads to, among other negative effects, a reduced desire for social interaction (295) and can have a strongly negative impact on a person’s ability to engage with and participate in activities of daily living (296).

Social isolation is linked to increased depressive symptomatology and decreased ability to manage activities of daily living in post-stroke patients (297), and is more common in depressed dementia patients (298). Social isolation and low societal participation have also been associated with future receipt of disability pension (299). However, despite the well-established associations between depression and loneliness there is little available evidence of a similar relationship specifically between social isolation and depression (300), although this may be a function of the common use of these terms interchangeably.

Varying influences of participation in physical, social, and religious activity on depression have been reported depending on the type of activity participated in (301, 302), an observation that can equally be made in the Survey of Health, Ageing and Retirement in Europe (SHARE) study. In their exploration of depression and the objective measure of participation the SHARE study reported conflicting results (303). Increased participation in religious organisations predicted a decline in depressive symptoms but conversely participation in political/community organisations was associated with an increase in depressive symptoms. Examination of participation in ‘productive activities’ including paid work, formal volunteering, caregiving, informal helping and caring for grandchildren in the SHARE project also yielded conflicting results. Depression was less common among those individuals who were employed or self-employed and those who participated in formal volunteering or informal helping, but caregiving was associated with a higher risk of depression (304). These findings speak to the importance of the subjective quality of the participation one experiences. Being practically employed at a task is different to being mentally engaged in it, and even between mentally engaging activities, some are more likely to give joy while others may more frequently engender frustration, resentment or other negative emotions.

Interventions promoting social interaction might be expected to improve depression via a variety of pathways including reducing loneliness and encouraging greater involvement in enjoyable activities. Snowden et al.’s review of treatment options for depression among nursing home residents comments on the success of some non-pharmacological interventions which target social involvement through peer interaction and recreational participation, such as outings in the facility grounds with staff (305). In contrast with these effective interventions, a Japanese intervention to reduce social isolation showed no significant effect on depression despite improving loneliness (306). While there is evidence that loneliness mediates the relation between active participation as a
measure of social engagement and depressive symptoms in both men and women (307), another study also reported ‘less participation’ to be associated with depression but not with loneliness (288). These varying and somewhat conflicting results highlight the complexity of the relationship between social isolation, participation, loneliness and depression.

Despite the conflicting evidence noted above, there is recognition of the very real impact of depression on the daily interactions of depressed people. The evidence-based guidelines to improve engagement and participation for people experiencing depression highlight group and individual approaches to facilitating those with depression to become more engaged in personally meaningful occupations and roles in life, and to foster a sense of connectedness to other people and communities (296).

3.12 Summary and Conclusion

The domains of successful ageing encompass objective and subjective mental and physical health, including both clinical and sub-clinical depression, and overweight and obesity. Self-rated mental and physical health are significant components of successful ageing, and the interactions between both perceived and actual mental and physical health are at the heart of achieving ‘success’ in later years. In addition to mental and physical health, the SLÁN 2007 report on mental health and social wellbeing underlines the involvement of social relationships in achievement of several aspects of successful ageing. Successful ageing can thus be viewed as a confluence of social, mental and physical wellbeing. The variables being addressed in this thesis were chosen to represent a holistic view of the older adult, and to allow the interactions between the social, physical and mental spheres of wellbeing to be examined. The literature presented in this chapter has outlined the central role of mental health in a variety of disease states, and its important role in the development of social relationships. The influence of body weight on mental health and social wellbeing has also been reviewed.

Having reviewed the multiple types of social relationships described in the literature and in light of their complex relationships with depression and raised BMI, this research endeavours to further our understanding of how these various types of social relationships interact with health. This thesis addresses four different types of social relationships - two subjective: loneliness and relationship quality, and two objective: participation and social network connectedness, in addition to mental health and physical health indices, namely depression and BMI. There has been an increasing public health focus in recent years on the needs for effective interventions in the areas of mental health and weight management. In light of the many links between these areas and that of social relationships, the potential of social relationships as an intervention target warrants investigation.
This thesis will contribute to the evidence for specific types of social relationship as targets for health promoting interventions.

The associations between depression, BMI and social relationships, three integral components of successful ageing, will now be addressed in a series of hypotheses specific to this thesis.
Chapter 4: Research Aims and Objectives

4.0 Theoretical Basis

Loneliness and social isolation represent subjective and objective views of the adequacy of social relationships. Independent effects of subjective and objective aspects of relationships have been demonstrated on loneliness (14), and are likely on other aspects of mental and physical health. This study seeks to describe social relationships, the prevalence of depression and raised BMI among a community dwelling, older Irish population. It also examines the links between four different types of social relationships (two subjective: loneliness and relationship quality, and two objective: participation and social network connectedness) and both mental and physical health indices, specifically, depression and BMI, and seeks to determine their mutual influences after traditional covariates have been considered (Figure 4.1).

![Figure 4.1: Physical and Mental Health Interfaces](image)

Social relationships and health have a bidirectional relationship – in addition to the established role of social interaction in promoting health, poor health itself has been identified as a predictor of diminished social integration over time (308). The health variables being investigated in this thesis are similarly related. Depression is predicted by loneliness (33) and loneliness increased by depression (241) (Figure 4.1, relationship y.) The reciprocal effect between excess weight and mental health (Figure 4.1, relationship x.) has also been established (207, 309), and there is some evidence of an effect of social relationships on the incidence of obesity (310) and of obesity as a risk factor for poor social relationships (311, 312), at least in younger populations. The area that remains unclear is that of the specific roles of individual aspects of social relationships. This thesis poses the question...
are all social relationships equal, and if not which are more important in the achievement or maintenance of mental and physical health.

4.1 Study Aims

This study will build on the available evidence by investigating both subjective and objective social relationships as risk factors for depression and obesity in an older population, and the reciprocal roles of these health indices on social relationships. By analysing the TILDA data to increase our understanding of whether or not social relationships have an impact on health over time in Ireland, this thesis aims to add to the body of evidence from the UK, the USA and Scandinavia (313) in the area of social relationships and health. In assessing the linkages between three concerning aspects of mental and physical health, loneliness, depression and unhealthy BMI, this thesis aims to inform how each should be considered in the aetiology and management of the others. The relationships are complex and directionality of recognised relationships has not been clearly established, as many studies in this area have been cross-sectional in nature. This study will assess the links using both cross-sectional and longitudinal data.

The close but complex association between loneliness, relationship quality, social participation and social network connectedness and health outcomes such as overweight, obesity and mental health has not been investigated in depth in an Irish context. It is important to investigate these links in the context of an ageing Irish population so that development of policy might be informed by data pertaining to the population who will be subject to effects of such policy plans. The National Positive Ageing Strategy of Ireland outlines Ireland’s vision for ageing and older people and the national goals and objectives required to promote positive ageing. A Healthy and Positive Ageing Initiative has been established to implement the research objective of the National Positive Ageing Strategy by monitoring changes in older people’s health and wellbeing linked to the goals and objectives of the strategy (314). Given its potential to increase the quality and quantity of data available on the experience of ageing in Ireland, TILDA is an important component of this initiative. TILDA is the first large population-based cohort study in Ireland to inform research on healthy ageing (315) and has been designed to gather data on a population for whom social and legislative changes throughout their lifetime may result in particular cohort effects. The collection of wave 2 of TILDA data provides an opportunity to explore the impact of health measures such as BMI and depression on the subjective social relationship measure of loneliness over time.

TILDA includes more than one type of social relationship measurement (e.g. marital status, involvement in groups, quality of relationships), and as such gives a more comprehensive picture of
the multiple pathways by which social relationships influence health. This thesis aims to achieve the following:

1. To describe the subjective and objective components of social relationships, namely relationship quality, participation and social network connectedness and loneliness, and the prevalence of depression and unhealthy BMI in the older Irish population using wave 1 data from the TILDA study.

2. To compare four components of social relationships (a) the degree of integration in social networks (social network connectedness), (b) loneliness, (c) participation in social activities and (d) relationship quality, and to investigate how these sub-constructs of social relationships are inter-related.

3. To investigate the links between these subjective and objective measures of social relationships, depression and BMI categories in the older Irish population using wave 1 data from the TILDA study.

4. To investigate any change in loneliness and depression over time using wave 1 and wave 2 data from the TILDA study.¹

5. To investigate the role of social relationships, depression and BMI in predicting depression and loneliness over time using wave 1 and wave 2 data from the TILDA study. Loneliness was the only social relationship variable at wave 2, hence relationship quality, social network connectedness, participation at wave 2 are not discussed. BMI was also unavailable for wave 2, and hence only wave 1 BMI will be considered in analyses.

4.2 Research Hypotheses

The specific hypotheses are outlined below in four sections. Firstly, the various components of social relationships will be examined to assess their relationship to each other. The following sections will deal with the links between social relationships and depression, those between depression and BMI and finally with the links between BMI and social relationships.

To address the first and second aims of describing social relationships among adults living in Ireland aged 50 years and older, addressing separately the objective and subjective components of social relationships, associations between the subjective and objective measures will be assessed.
Hypothesis 1: The interrelationship between subjective measures and that between objective measures are stronger than the relationship between objective and subjective measures.

Cross-sectional data

a) Relationship quality will be related to loneliness scores
b) Social network connectedness will be related to participation
c) The relationships within the categories of objective and subjective measures of social relationships will be stronger than those between categories.

To address the third aim of investigating the interactions between social relationships, depression and BMI in Irish adults aged 50 years and over, cross-sectional and longitudinal associations will be assessed.

Hypothesis 2: The four measures of social relationships (loneliness, relationship quality, social network connectedness and participation) are independently associated with depression.

Cross-sectional data

a) Higher scores on the UCLA Loneliness Scale (ULS) will be correlated with depression (one-tailed).
b) Greater frequency of loneliness will be correlated with depression (one-tailed).
c) Higher scores on social network connectedness will be related to depression (one-tailed)
d) Higher scores on participation will be related to depression (one-tailed)
e) Higher scores on relationship quality will be related to depression (one-tailed)

Longitudinal data

a) Higher scores on the ULS at time 1 will be related to depression a time 2.
b) Higher scores on social network connectedness at time 1 will be related to depression a time 2.
c) Higher scores on participation at time 1 will be related to depression a time 2.
d) Higher scores on relationship quality at time 1 will be related to depression a time 2.
e) Higher scores on depression at time 1 will be related to ULS score at time 2.

Hypothesis 3: Depression and BMI are interrelated

Cross-sectional data

a) Higher BMI will be related to depression category.
Longitudinal data

a) Higher BMI at time 1 will predict depression at time 2

Hypothesis 4: BMI and Social Relationships (Loneliness, relationship quality, social network connectedness and participation) are interrelated

Cross-sectional data

a) Higher scores on the ULS will be related to BMI (one-tailed).
b) Greater frequency of loneliness will be related to BMI (one-tailed).
c) Higher scores on social network connectedness will be related to BMI (one-tailed)
d) Higher scores on participation will be related to BMI (one-tailed)
e) Higher scores on relationship quality will be related to BMI (one-tailed)

Longitudinal data

a) Higher scores on BMI at time 1 will be related to ULS score at time 2.
Chapter 5: Methodology

5.0 Introduction

This chapter will outline the study methodology including the study design, procedure, selection and screening of the study data, assessment measures and the data preparation and statistical analysis plan.

5.1 Study Design and Participants

This research study conducted secondary data analysis of the first and second waves of TILDA, a nationally representative sample of community-dwelling adults aged 50 years and above living in the Republic of Ireland. TILDA is a two-stage clustered survey conducted with a random sample of 640 clusters of 500 to 1,180 residential addresses selected nationally with stratification of clusters by socio-economic group and geography. Clusters were selected randomly with a probability of selection proportional to the estimated number of persons aged 50 years of age or over in each cluster. Forty addresses in each cluster were randomly selected, and all persons aged 50 years and older were asked to participate in the study. Full details of the selection and data gathering have been previously published in the TILDA design report, The Design of the Irish Longitudinal Study on Ageing (316).

In brief, each of the selected addresses was visited by an interviewer, who attempted to ascertain the eligibility of the address, to contact a household member and determine whether any individuals aged 50 years or over lived at that address. All individuals aged 50 years or over in each selected household and their partners (even if aged less than 50 themselves) were invited to be included in the study (6). The first wave of data collection was conducted between October 2009 and July 2011. During field work 8,178 interviews were conducted with individuals over 50 years of age in 6,282 households. There were also 329 respondents younger than 50 who were excluded. The second wave of TILDA interviews were undertaken between February 2012 and March 2013. Of the 8,504 interviewed in wave 1, a second interview was obtained for 7,445 respondents (87.5%). In addition to the returning respondents, 170 interviews were obtained from eligible household members who had chosen not to take part in wave 1 or the new spouses/partners of existing respondents. Further waves of data collection are ongoing, where participants from the first wave of the TILDA study will be invited to complete a follow-up interview every two years and a health assessment every three to four years for a ten year period (http://tilda.tcd.ie/).
5.2 Procedure

TILDA data was gathered at interviews conducted with respondents at their homes by a field researcher. A self-completion questionnaire (SCQ) with more sensitive questions was left for the respondent to complete and return by post. The TILDA questionnaire begins with a cover screen section that confirms eligibility of a given respondent and captures some basic information about other members of the household. During the cover screen section eligible individuals also signed consent forms and authorised a fieldwork agency to return for future data collection. After the cover screen is completed, eligible persons proceed to the computer aided personal interview (CAPI) which consists of 24 modules in total. Successful interviews were obtained in 62% of selected households which included an eligible participant (6). All interviews and questionnaires were conducted in English. Of those, 83% returned the self-completion questionnaire, which included the loneliness scale analysed here.

Data relevant to the current work was identified from the full data set and is further discussed here. The main variables of specific interest to the current work are further discussed below. Their documents of origin and the measures used to assess them are listed in Table 2.

Table 2: Document of Origin of Main Study Variables

<table>
<thead>
<tr>
<th>Computer-aided personal interview (CAPI)</th>
<th>Self-completion questionnaire (SCQ)</th>
<th>Health Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression 20 x item Centre for Epidemiologic Studies Depression Scale (CES-D) (317)</td>
<td>Loneliness 5x items from UCLA Loneliness Scale (318)</td>
<td>Body Mass Index* Calculated from measured weight and height</td>
</tr>
<tr>
<td>Frequency of loneliness Single item with 4 options: Rare or never, Some of the time, Moderate amount of the time, All of the time</td>
<td>Participation * Frequency of social activity: weekly, monthly or yearly (316)</td>
<td></td>
</tr>
<tr>
<td>Social network connectedness * Berkman’s Social Networks Index (SNI): composite of four types of connectedness (319)</td>
<td>Relationship Quality * 7x items asked in 4 rounds (re spouse, children, other family and friends) (320, 321)</td>
<td></td>
</tr>
</tbody>
</table>

* Variable unavailable in Wave 2 data
5.3 The TILDA Data

Permission was sought and granted to access the completed sets from Waves 1 and 2 of TILDA, archived with the Irish Social Science Data Archive (http://www.ucd.ie/issda/data/tilda/). Relevant data was identified from the full data set for analysis and is further discussed here. Ethical approval for TILDA was provided by the Faculty of Health Sciences Research Ethics Committee at Trinity College Dublin.

5.4 Inclusion and Exclusion Criteria

All TILDA respondents were considered for this analysis. While TILDA collected responses from some spouses who were aged less than 50 years, respondents who were under 50 years of age or who did not return the SCQ were excluded from this analysis. Respondents for whom BMI values were missing were also excluded from any analysis including BMI.

The main variables of interest included in the current research are shown is Table 3 below:

Table 3: Main Study Variables

<table>
<thead>
<tr>
<th>Social Relationship variables</th>
<th>Subjective relationships</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loneliness</td>
<td></td>
</tr>
<tr>
<td>Relationship Quality</td>
<td></td>
</tr>
<tr>
<td>Social Network Connectedness</td>
<td>Objective relationships</td>
</tr>
<tr>
<td>Participation</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Health variables</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression</td>
<td>Mental Health</td>
</tr>
<tr>
<td>BMI</td>
<td>Physical Health</td>
</tr>
</tbody>
</table>

5.5 Social Relationship Variables: Loneliness, Relationship Quality, Participation and Social Network Connectedness

5.5.1 Loneliness

Loneliness was assessed as perceived social isolation using five items from the University of California at Los Angeles Loneliness Scale (ULS) (318). The full ULS is a 20-item scale designed to measure a subject’s subjective feelings of loneliness as well as feelings of social isolation by asking them to respond to items such as “There are people I can talk to,” and “I feel part of a group of friends.” Participants rate each item as O (“I often feel this way”), S (“I sometimes feel this way”), R (“I rarely feel this way”), N (“I never feel this way”). The resulting scale ranges from highly socially connected to highly lonely (318).
There are several versions of the ULS available. For use in the TILDA SCQ four negatively-worded questions (e.g. How often do you feel left out?) and one positively-worded one (How often do you feel in tune with the people around you?) were chosen from the amended ULS, each with a three-point response scale of hardly ever or never; some of the time; or often. Higher scores signify greater loneliness; the score is computed as follows:

- For each negative question: The overall score adds +3 followed by subtracting the response the participant has given (Often = 1, Some = 2, Hardly ever/never = 3). Therefore, those who have answered ‘Often’ gain a +2 to their loneliness score, those who answer ‘Some’ gain a +1 and those who answer ‘Hardly ever/never’ gain no points.

- For the positive question: The response score for the question is added to the overall result followed by subtracting 1 so those answering ‘Often’ would add 0 to their loneliness score, those who answer ‘Some’ add 1 to their loneliness score and those who answer ‘Hardly ever/never’ add 2 to their loneliness score.

The ULS items were in the self-completion questionnaire and as such were returned by 7,193 respondents. Any responses including missing data for any of the ULS questions could not be calculated and were coded as missing. The computed composite variable measure of loneliness ranged from 0 (not lonely) to 10 (very lonely). This score was also categorised into low (0-3), moderate (4-7) and high (8-10) loneliness.

5.5.2 Relationship Quality

Relationship quality was measured using 7 items describing positive interactions, e.g. ‘How much can you rely on him/her if you have a serious problem?’, and negative interactions, e.g. ‘How much does he/she criticize you?’, provided by a spouse, children, relatives and friends, taken from the Perceived Social Support and Social Strain Scale (320, 321). These items are similar to the questions on relationship quality in other longitudinal studies such as ELSA and HRS (316). The questions used to measure quality of interactions are included in Appendix 1.

The items comprising each scale are summed to provide separate indices of support and strain in inter-personal relationships with spouse, children and friends. Items were asked in four loops in reference to participants’ spouse/partner, children, family members, and friends. All items were answered on 4-point Likert-type scale (support items: 1 = a lot; 4 = not at all; strain items: 1 = often, 4 = never). Items were recoded so that higher scores indicated either higher support or strain. For those who did not have a spouse or partner, or did not have children or other family members a score of zero was given indicating neither support nor strain from these sources. Social support from
each of the four sources was calculated separately as the sum of the three support items from the corresponding source.

Similarly, social strain from each of the four sources was calculated separately as the sum of the four strain items from the corresponding source. These measurements were used by previous studies and were found to be reliable (165, 320). This procedure generated four scales of social support and four scales of social strain. Their reliabilities were assessed using Cronbach’s Alpha. Participants were categorized according to the number of scales on which they scored high strain and the number on which they scored high support. High levels of support and strain were classified as above and below the population mean respectively.

5.5.3 Participation
Participation was measured by gathering data on participation in and frequency (daily, weekly, monthly, less than monthly) of structured (attending classes, participating in sport activities or exercise, and undertaking voluntary activities) and active or sedentary unstructured activities (visiting people, reading a book, watching television, listening to music or the radio). Respondents were categorized according to frequency of social participation.

5.5.4 Social Network Connectedness
Social network connectedness was measured using Berkman’s Social Networks Index (319), a composite measure of four types of social connection: marital status (married versus not); sociability (number and frequency of contact with children, close relatives, and close friends where two or more is scored as ‘Yes’); church group membership; and membership in other community organisations. The SNI is a well-validated scale for measuring social networks and has been used to predict both short- and long-term mortality in general populations and those with cardiovascular disease and cancer (319, 322-324).

Items on each of the above types of social connection were recoded as dummy variables and the SNI calculated using these. The items included were

- Yes to member of church
- Yes to married / living with partner
- Yes to member of club
- Yes to 2+ close relatives, children or family

Social network connectedness is the derived score of the Social Network Index items above. It is scored as follows: isolated (0-1) moderately isolated (2), moderately integrated (3) and most
integrated (4), although other investigators have used the measure in different ways including using
sum scores, or weighting the item differentially using factor weight. This scoring method was
adopted from Loukes et al. (325) as it was compatible with the format in which the data was
collected.

5.6 Health Variables: Depression and BMI

5.6.1 Depression

Depression was measured using the 20-item Centre for Epidemiologic Studies Depression Scale (CES-
D) (317). This 20-item self-administered scale measures the major components of depressive
symptomatology, including depressive mood, feelings of guilt and worthlessness, psychomotor
retardation, loss of appetite and sleep disturbance. Respondents are asked to rate the frequency of
these symptoms along the following categories: rarely/none of the time, some of the time, most of
the time, or all of the time within the past week. The CES-D was developed to identify current
depressive symptomatology related to major or clinical depression in adults and adolescents and
was chosen because of its widespread use among older populations. The CES-D had been shown to
be a reliable and valid measure with high internal consistency, test-retest reliability, and validity for
all sex and age groups (326) and across socio-economic groups (327).

CES-D responses are combined to give a score with a possible range of 0 to 60, with the higher
scores indicating the presence of more symptomatology. These scores were then divided into
depression categories of ‘none/mild’, ‘moderate’ and ‘severe’. A standard cut-off score of 16 is
used to determine clinically significant or case level depressive symptoms, and is described in this
thesis as ‘severe depression’, while subthreshold symptom levels of depression were defined in
TILDA as those respondents who reported between 8-15 on the CES-D, as per Vahia et al., 2010
(328), describes in this thesis as ‘moderate depression’. Scores under 15 are described here as ‘no /
mild depression’. The CES-D is a screening tool, and does not replace a diagnosis of Major Depressive
Disorder made on the basis of a clinical interview and the criteria for depression listed in the
Diagnostic and Statistical Manual of Mental Disorders (DSM-5), but is an appropriate measure for
use in large population studies where clinical interviews are not practical.

The CES-D has been used in both full length and short versions in other large scale studies of older
people (329, 330), and has been shown to be sensitive to change in depressive status over time
(331), an important consideration in a longitudinal study.
5.6.2 BMI

As part of the health assessment, height was measured in metres and body weight in kilograms and BMI was calculated as weight divided by height squared, BMI kg/m$^2 = \text{Weight (kg)} / \text{Height (m)} \times \text{Height (m)}$. All respondents who completed the CAPI interview were invited to participate in a health assessment in one of two dedicated health centres, in Dublin or Cork, or in their own home. Home visits were offered in order to capture data on participants who were unable or unwilling to attend the health assessment centre, and so minimize bias towards healthier individuals (72.4% of the overall TILDA population had attended up to the release of version 1.4 Wave 1 data used in this study).

BMI values were recorded for all participants who attended for health assessment. In cases where BMI was 18.5kg/m$^2$ or less BMI was recorded as 18.5, and in cases where BMI was 45kg/m$^2$ or above it was recorded as 45+. BMI data was categorised according to established WHO ranges shown in Table 4 below. Due to small numbers in the morbidly obese group these categories were collapsed to normal weight, overweight and obese for analysis.

**Table 4: The International BMI Classification of Adult Underweight, Overweight and Obesity**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Principal and additional cut-off points BMI (kg/m$^2$)</th>
<th>Categories used in the current analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt;18.50</td>
<td>Underweight (not included in analysis)</td>
</tr>
<tr>
<td>Severe thinness</td>
<td>&lt;16.00</td>
<td></td>
</tr>
<tr>
<td>Moderate thinness</td>
<td>16.00 - 16.99</td>
<td></td>
</tr>
<tr>
<td>Mild thinness</td>
<td>17.00 - 18.49</td>
<td></td>
</tr>
<tr>
<td>Normal range</td>
<td>18.50 - 24.99</td>
<td>Healthy weight</td>
</tr>
<tr>
<td>Overweight</td>
<td>≥25.00</td>
<td>Overweight</td>
</tr>
<tr>
<td>Pre-obese</td>
<td>25.00 - 29.99</td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>≥30.00</td>
<td>Obese</td>
</tr>
<tr>
<td>Obese class I</td>
<td>30.00 - 34.99</td>
<td></td>
</tr>
<tr>
<td>Obese class II</td>
<td>35.00 - 39.99</td>
<td></td>
</tr>
<tr>
<td>Obese class III</td>
<td>≥40.00</td>
<td></td>
</tr>
</tbody>
</table>


5.7 Covariates

5.7.1 Socio-demographics
TILDA’s demographics module included questions on marital status and marriage history, living arrangements and education. Data on employment was also gathered elsewhere in the CAPI. Key socio-demographic variables and co-variates considered in this study are shown in Table 5 below.

Table 5: Key socio-demographic variables and co-variates

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male or female</td>
</tr>
<tr>
<td>Age</td>
<td>Measured in years; participants were categorized as younger old (50 to 64 years) and older old (65 years and above) as in the main TILDA report.</td>
</tr>
<tr>
<td>Marital status</td>
<td>Coded into four categories: “married”, “never married”, “separated/divorced”, and “widowed”.</td>
</tr>
<tr>
<td>Level of education</td>
<td>Measured in one of seven categories, and subsequently collapsed to five groups. Those with no formal education at all were classified as ‘none’.</td>
</tr>
<tr>
<td></td>
<td>• Those who did not complete primary education and those with only primary education were classified as ‘primary’.</td>
</tr>
<tr>
<td></td>
<td>• Those who completed a junior certificate, or leaving certificate or equivalent were classified as ‘secondary’</td>
</tr>
<tr>
<td></td>
<td>• Those who completed a diploma, first degree or higher degree are classified as ‘tertiary or higher’.</td>
</tr>
<tr>
<td></td>
<td>• Those who failed to answer the question or responded ‘can’t remember’ were coded as ‘other’</td>
</tr>
<tr>
<td>Co-residence</td>
<td>Divided into three categories according to their residential status: living alone, living with spouse and living with others.</td>
</tr>
<tr>
<td>Location of residence</td>
<td>Urban or rural as stratified by RANSAM system used for sampling.</td>
</tr>
<tr>
<td>Social class</td>
<td>The socio economic variable used in this analysis included the ten categories listed below, and was computed using a combination of both previous social class and current social class and a variable on working which gathered data on those who were unable to work due to illness or whose main occupation was looking after the home, as these groups were not classified in the social class categories used in TILDA.</td>
</tr>
<tr>
<td></td>
<td>o Category 1: Professional, managerial and technical workers</td>
</tr>
</tbody>
</table>
5.7.2 Self-Rated Health
Self-rated overall physical and emotional health status (SRH) was measured using five response options “excellent, very good, good, fair, or poor”. Respondents were also asked to evaluate their physical and emotional health status compared to that of other people their own age, using the same five response options listed above. A single question on self-rated health is a valid and widely used measurement in European and International studies (332). It is an established indicator of general health status and all-cause early mortality (333, 334).

5.8 Statistical Analysis

5.8.1 Data Analysis
Data was analysed using two statistical packages for Windows. This was due to the delayed availability of the preferred software, STATA. Data cleaning was carried out in SPSS Version 21, (335), and main analysis were completed using Stata 13.1, (336). Variables to be examined were identified and selected from the overall TILDA data set, and saved as a working file. A significant component of the main variables of interest were included in the self-completed questionnaire (SCQ) issued to all respondents at the same time as the main questionnaire. It was therefore decided to limit analysis to those who returned the SCQ, comprising 76.6% of the full TILDA sample. Respondents under the age of fifty years were also excluded. This resulted in an initial study population of 6,912 participants. Variables were renamed for ease of identification, and composite variables computed for social relationships, and a project code book was developed.

After data was cleaned, which involved assessment of all study variables for missing values, removal of cases with missing data on the variables of interest, and screening for outliers, descriptive analysis of all study variables was undertaken.
The study population was compared to the full TILDA population, to the population of those who returned the SCQ, and finally to the population of those who attended for health assessment, in order to identify any bias incurred as a result of limitations of data availability.

5.8.2 Reliability of Composite Variables: Relationship Quality Scales
The relationship quality items taken from the Walen & Lachman social support and strain measure (321) were recoded to account for missing and inaccurate data, and separate strain and support scales computed for spouse, children, relatives and friends as described above. The reliability of these scales was assessed using Cronbach’s alpha and, using a cut-off point of 0.7 as an indicator of internal reliability, all scales were found to be reliable.

The support and strain scales from each group (spouse, children, relatives and friends) were further combined to create overall strain and support composites. In order to determine whether the composite measures were reliable, Cronbach’s alpha was assessed for the overall strain composite and the overall support composite scale, but were not found to be acceptable. Cronbach’s alpha values above 0.7 are generally accepted as indicative of good reliability (337).

5.8.3 Multivariate analysis

5.8.3.1 Analysis of Subjective and Objective Social Relationships
Correlations between the social relationship measures were computed to investigate relationships between social integration, social network connectedness and loneliness. Regression modelling of constituent parts of social integration (participation and relationship quality) onto loneliness were undertaken, to investigate if loneliness is more strongly associated with subjective quality of relationships than with objective contact with social network members and participation, as noted by Segrin et al. (338).

Correlations between objective and subjective social relationship measures, BMI, depression and self-rated health were assessed to investigate relationships between both the quantity (participation and social network index) and quality (relationship quality and loneliness) of social relationships and other variables.

5.8.3.2 Regression Modelling
Regression analysis was carried out to examine the study hypotheses that higher scores for loneliness would be related to increased depression and to BMI.

Multi-factorial regression analysis included multinomial logistic modelling (MNLM) to assess the impact of loneliness and other independent variables on depression as the dependent variable with three categories, and on BMI as the dependent variable with three categories, and hierarchical
logistic regression to assess the influence of independent variables on the continuous variable depression and BMI scores.

Covariates controlled for included socio-demographic variables and SRH. Only those variables that were significantly associated with depression in preliminary analyses (one-way ANOVA) were considered in the MNLMs. ‘None or mild depression’ was specified as the ‘omitted’ baseline comparison category in MNLM analysis of depression and normal weight category as the ‘omitted’ baseline comparison category in the MNLM analysis of BMI. MNLM regression coefficients were reports as relative risk ratios (RRRs).

While testing multiple hypotheses incurs a risk of false positive (type one) or false negative (type two) results, their likelihood can be reduced by increasing the sample size, as the larger the sample, the lesser the likelihood that it will differ substantially from the population (339). The use of a large data set reduced the risk of type one errors occurring in the analysis.
Chapter 6: Results

6.0 Introduction
The following chapter outlines the study results. It provides an overview of the study population demographics, the pattern of social relationships, depression and overweight are described and at risk groups are profiled. The relationships between the social relationship variables, depression and BMI and socio-demographic factors are discussed, and the influences between the main study variables are explored as per the hypotheses outlined in Chapter 3.

6.1 Data Preparation and Cleaning

6.1.1 Missing Data
Missing data analysis was performed on all main study variables.

Socioeconomic variables age, gender, marital status, socio-economic group, education, co-habitation and urban/rural location and self-rated health, all had minimal missing data (<1%), and all values were within expected ranges. Missing values for depression scores (2%), loneliness (3%), social network connectedness (0%), participation (0%), and relationship quality (0%) were all within acceptable levels. Missing values for individual items of the CES-D, ULS, social participation, support and strain variables are shown in appendix 2.

BMI values were missing for 22% of the study population. These respondents were excluded from any further analysis including BMI.

Outcomes of the TILDA pilot studies showed that respondents who attended assessment at a health centre tended to be younger and in better health than those who opted for home assessment or than the average for the study, suggesting a potential bias towards healthy individuals attending health centres. The option of health assessment at home was provided in order to avoid systematically over-representing younger, healthier respondents. However, comparisons between the study population and the subgroup who underwent health assessment show that even when a home health assessment was available, mean loneliness (p=0.04) and depression (p=0.00) scores were significantly lower in those who underwent health assessment compared to the full study sample.

The percent of missing data for each variable is displayed in appendix 2. In accordance with Tabachnick & Fidell (340), where the number of missing data is low (5% or less), a system list-wise deletion was adopted for analyses other than those including BMI. Deletion was based on wave 1
data resulting in a final study population of 6,587. Of these Wave 2 data was available for 5,848 respondents.

The percentage of missing values for individual items of the CES-D, the ULS, participation and relationship quality measures are shown in appendix 2.

To assess the potential for bias incurred by limiting data to a subset of the full TILDA population, means for the main dependent variables (depression, loneliness, social network connectedness and BMI) were compared between:

a) The study population and the full TILDA population including respondents who did not return the SCQ
b) The study population and the cohort of the TILDA population who returned the SCQ.

6.1.2 Variable Distribution
Normality of variable distribution was explored with graphical analyses for the main continuous variables – depression score, loneliness, social network connectedness and BMI. Formal normality tests including Shapiro-Wilk test and Kolmogorov-Smirnov test may be used from small to medium sized samples (e.g., n < 300), but may be unreliable for large samples, and graphical analyses are essential (186). According to Kim in sample sizes greater than 300, either an absolute skew value larger than 2 or an absolute kurtosis (proper) larger than 7 may be used as reference values for determining substantial non-normality (186).

Table 6: Distribution Statistics of Main Continuous Study Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>CES-D depression score</td>
<td>2.20</td>
<td>9.37</td>
<td>Not normal</td>
</tr>
<tr>
<td>ULS loneliness score</td>
<td>1.20</td>
<td>3.94</td>
<td>Normal</td>
</tr>
<tr>
<td>BMI</td>
<td>0.55</td>
<td>3.66</td>
<td>Normal</td>
</tr>
<tr>
<td>Social network connectedness</td>
<td>-0.38</td>
<td>2.54</td>
<td>Normal</td>
</tr>
</tbody>
</table>

Graphical analyses confirmed that CES-D scores were not normally distributed and were skewed to the left. Histograms of social network connectedness and BMI appeared normally distributed.

Despite skewness and kurtosis values being below the suggested cut off points, a histogram of ULS scores appeared significantly skewed to the left and non-normally distributed.
According to Tabernick and Fidell (340) an abnormal distribution is more likely to occur in large sample sizes such as the TILDA data. They highlight that the assumptions of normality are dependent on the statistical procedure used. In line with their recommendations, both parametric and non-parametric procedures, as well as multivariate analysis were used in this analysis.

Although the variable distribution was not normal the sample size was large and so t-tests were used to compare variable means across independent groups. The t-test is invalid for small samples from non-normal distributions, but it is valid for large samples from non-normal distributions (311).

Pearson Chi Square test was used to compare categorical variables, and correlations were run with significance identified to a p-value of 0.05.

To address the non-normal distribution of the CES-D measure of depression and ULS loneliness score, these variables were transformed to categorical variables, depression category (mild, moderate or severe) and loneliness category (low, moderate and high), in order to allow the use of MNLM which does not make any assumptions about error distribution (341).

6.1.3 Multicollinearity
Multicollinearity refers to unacceptably high correlations between predictor variables. If two or more predictor variables in a multiple regression model are highly correlated, such that one can be linearly predicted from the others with a substantial degree of accuracy, the validity of findings of multiple regression analysis regarding individual predictors may be reduced. To detect multicollinearity amongst predictors, the tolerance and variance inflation factor (VIF) statistic produced in linear regression analysis of the variables of interest is used to assess whether multicollinearity is unacceptably high. A VIF greater than 10 is considered unacceptable(342). VIF statistics were computed for all the sociodemographic predictor variables and other covariates included in analysis of social relationship measures, depression scores and BMI. All were well below the cut off of 10.

6.2 Comparison of the Study Population with the Full TILDA Populations

6.2.1 Comparison of the Study Population with the Full TILDA Population
To compare the study sample to the full TILDA population single sample t-tests were used to compare mean depression scores, loneliness scores and BMI in the study population to mean scores from the full TILDA population.

There were no significant differences in mean loneliness score or BMI between the full TILDA population and the study sample, however mean depression score was significantly lower (p<0.01)
among the study population than in the full TILDA population. The percentage of respondents classified as severely depressed dropped from 6.90% for men, 11.89% in women and 9.66% overall in the full TILDA population to 6.38%, 10.92% and 8.84% respectively when those who did not return the SCQ were excluded.

6.2.2 Comparison of the Study Population with the SCQ Population
Comparing the final study population, after missing values were dropped, to the cohort of the TILDA population who returned the SCQ no significant differences were noted in mean wave 1 BMI, ULS or CES-D scores.

6.2.3 Comparison of the Health Assessment (BMI) Cohort with the Study Population
Moderate or severe depression decreased from 27.41% in those who did not attend for health assessment to 25.86% in those with BMI measurements, while high levels of loneliness (ULS score 8 or above) fell from 2.76% to 2.49% in those who attended for health assessment. Mean depression score \( (Pr (T > t) = 0.04) \), and mean loneliness score \( (Pr (T > t) = 0.0001) \), were both significantly higher among those who did not have BMI measured.

Those who did not have BMI measured were older \( (Pr (T > t) = 0.0000) \), and attendance for health assessment was significantly associated with other variables, namely education \( (p=0.00) \), marital status \( (p=0.00) \), SES \( (p=0.00) \), co-habitation \( (p=0.04) \), location of residence \( (p=0.00) \) and SRH \( (p=0.00) \).

6.3 Reliability of Composite Variables: Relationship Quality Scales
The reliability of support and strain scales from each group (spouse, children, relatives and friends) and the overall strain and support composites generated was assessed. While Cronbach’s alpha scores for each of the individual support and strain scales were acceptable, and comparable with the original reliability scores reported by Walen and Lachman (321), scores for the overall composite values were below 0.7 (Table 7), indicating poor internal reliability, and so it was decided instead to use the number of support or strain sources above the population mean as overall measures of support and strain.
Table 7: Reliability Measures of Relationship Quality Composite Measures.

<table>
<thead>
<tr>
<th>Composite scale</th>
<th>Chronbach’s Alpha</th>
<th>Number of items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spouse support</td>
<td>0.9782</td>
<td>3</td>
</tr>
<tr>
<td>Children support</td>
<td>0.9538</td>
<td>3</td>
</tr>
<tr>
<td>Relative support</td>
<td>0.9036</td>
<td>3</td>
</tr>
<tr>
<td>Friend support</td>
<td>0.8512</td>
<td>3</td>
</tr>
<tr>
<td>Spouse strain</td>
<td>0.9235</td>
<td>4</td>
</tr>
<tr>
<td>Children strain</td>
<td>0.8700</td>
<td>4</td>
</tr>
<tr>
<td>Relative strain</td>
<td>0.8112</td>
<td>4</td>
</tr>
<tr>
<td>Friend strain</td>
<td>0.7368</td>
<td>4</td>
</tr>
<tr>
<td>Overall support</td>
<td>0.5285</td>
<td>4</td>
</tr>
<tr>
<td>Overall strain</td>
<td>0.6103</td>
<td>4</td>
</tr>
</tbody>
</table>

6.4 Descriptive Statistics

6.4.1 Socio-demographics and Self-Rated Health

The 6,587 participants who were eligible for inclusion in the study, as outlined in the methods, represent 77.46% of the overall TILDA population.

Of these, more were female (54.08%). The majority of the population was in the ‘younger old’ group, aged between 50 and 64 years old (61.73%). Mean age was 63.26 years (SD 9.01 years), with men (mean age 63.53 years, SD 9.00) slightly older on average than women (mean age 63.04 years, SD 9.01) (t=2.18, p=0.01).

The majority were married (n= 4,709, 71.49%), with 9.23% never married (n=608), 6.22% (n=410) separated or divorced and 13.06% (n=860) widowed. Chi squared analysis identified significant differences between men and women across the socio-demographic characteristics of marital status (p<0.01), education (p<0.01) and SES (p<0.01). More men had never married (7.92% women vs 10.78% men), while more women were widowed (17.63% women vs 7.67%men). More women lived alone (18.55% men vs 22.26% women).

In education, more men (29.92%men vs 24.62% women) attained a maximum of primary level schooling whilst more women completed secondary (40.50% men vs 41.66% women) or tertiary (29.55% men vs 33.46% women) level education.
Approaching half (44.9%) of the population were classified as professional or non-manual skilled workers. Significantly more men were classified as farmers (11.17% men vs 1.85% women) while looking after home was most common amongst women (0.60% men vs 26.81% women).

No significant differences were seen between men and women in SRH or their area of residence.

Table 8: Descriptive Statistics and % Missing Values (removed) for Study Population (n=6587)

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<th></th>
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<th>Female</th>
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<td>Lives alone</td>
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<td>Very good</td>
<td>893</td>
<td>1042</td>
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<td>985</td>
<td>1130</td>
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<td>Poor</td>
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<td>29.00 SD=4.12</td>
<td>28.10 SD=4.93</td>
<td>28.51 SD = 4.59</td>
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<td><strong>Mean Loneliness score</strong></td>
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<td>n=6587 (3%)</td>
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<tr>
<td>(Range 0 – 10)</td>
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<td>1.98 SD=2.18</td>
<td>1.93 SD = 2.17</td>
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<td>High, 8-10</td>
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<td>n=6587 (2%)</td>
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<tr>
<td>(CES-D) (Range 0 – 53)</td>
<td>4.83 SD=6.36</td>
<td>6.32 SD=7.38</td>
<td>5.64 SD=6.97</td>
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<td>n=6587 (2%)</td>
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<tr>
<td>Moderate</td>
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<td>Severe</td>
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<td>389</td>
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<td><strong>Participation</strong></td>
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<td>n=6587 (0%)</td>
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<td>--------------------</td>
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<tr>
<td></td>
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<td>n=3562</td>
<td>n=6587 (0%)</td>
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<td>n=6587 (0%)</td>
</tr>
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<td>0 Support&gt; population mean</td>
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<td>139</td>
<td>328</td>
</tr>
<tr>
<td>1 Support&gt; population mean</td>
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<td>1036</td>
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<tr>
<td>2 Support&gt; population mean</td>
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<td>807</td>
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<td>3 Support&gt; population mean</td>
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<td>1103</td>
<td>1949</td>
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<td>4 Support&gt; population mean</td>
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<td>1644</td>
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<td>1701</td>
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<td>826</td>
<td>1510</td>
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<td>3 Strain&gt; population mean</td>
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<td>653</td>
<td>1203</td>
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<td>4 Strain&gt; population mean</td>
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% missing data shown in brackets (x%) after total n.

6.4.2 BMI

Mean BMI (28.51 kg/m², SD = 4.59) was in the overweight category, and over three quarters (77.37%) of the study population were either overweight or obese.

BMI was assessed with known covariates including socio-demographic characteristics, the presence of depressive symptoms and self-rated health (Table 9.).

BMI was not significantly associated with age category, but significant associations were found with all other socio-demographic variables and SRH at the p<.05 level.

There were significant differences between men and women, with significantly larger proportion of men than women falling in the overweight (46.68% men vs 39.94% women) and obese (37.91% men vs 31.29% women) categories. Obesity was more common in rural areas (36.85% vs 32.18%), and
among those with primary only education (40.69% in primary, 33.99% in secondary and 30.36% in tertiary).

BMI category was not associated with the loneliness score or with frequency of loneliness, but was significantly associated with depression category, with higher levels of obesity among those with severe depression.

**Table 9: Characteristics according to BMI (n =5361)**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Normal weight</th>
<th>Over-weight</th>
<th>Obese</th>
<th>P value *</th>
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<tbody>
<tr>
<td>Number of cases (n=5135)</td>
<td>1162 (22.6%)</td>
<td>2210 (43.0%)</td>
<td>1763 (34.3%)</td>
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<tr>
<td>Age, mean (SD)</td>
<td>62.87 (9.20)</td>
<td>62.77 (8.69)</td>
<td>62.91 (8.62)</td>
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<td>Age category (%)</td>
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<tr>
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<td>37.9</td>
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<td>Female</td>
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<td>39.9</td>
<td>31.3</td>
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<td>Marital status (%)</td>
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<td>40.7</td>
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<tr>
<td>some 2°</td>
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<td>Residential location (%)</td>
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<td>Co-Habitation (%)</td>
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<tr>
<td>Living with others</td>
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### Socio-Economic Status (%)

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<th>Non manual skilled</th>
<th>Semi and unskilled</th>
<th>Farmers</th>
<th>Retired</th>
<th>Self-employed</th>
<th>Unemployed</th>
<th>Disabled or sick</th>
<th>Looking after home</th>
<th>In education</th>
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<td>43.9</td>
<td>30.1</td>
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<td>Farmers</td>
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<td>Retired</td>
<td>24.3</td>
<td>40.2</td>
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<tr>
<td>Self-employed</td>
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<td>47.1</td>
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<tr>
<td>Disabled or sick</td>
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<td>38.4</td>
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<tr>
<td>Looking after home</td>
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<td></td>
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<tr>
<td>In education</td>
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<td>34.5</td>
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### Self-Rated Health (%)

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<th>Good</th>
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<th>Poor</th>
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<td>Absence</td>
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<td>44.8</td>
<td>44.3</td>
<td>35.9</td>
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</table>

### Loneliness, mean (SD)

|          | 1.984 (2.19) | 1.79 (2.10) | 1.94 (2.18) |

### CES-D categories of Depression (%)

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<th>34.4</th>
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</thead>
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<td>26.4</td>
<td>42.0</td>
<td>31.6</td>
</tr>
<tr>
<td>Moderate</td>
<td>23.4</td>
<td>37.3</td>
<td>39.3</td>
</tr>
</tbody>
</table>

### CES-D Score, mean (SD)

|          | 5.97 (7.10) | 5.19 (6.39) | 5.76 (7.26) |

* Derived from one-way ANOVA for continuous variables and χ² test for categorical variables.

Multiple regression analysis was conducted to identify the contribution of BMI to depression score when adjusting for loneliness and other known covariates. Only variables that were significant at univariate level were included in the regression, resulting in the exclusion of age.

BMI was not significant after adjusting for the other variables.

### 6.4.3 Depression

The relationship of socio-demographic variables and other covariates to depression was assessed in univariate analyses (Table 10).
Difference in depression scores was significant across all socioeconomic variable groups, SRH, loneliness and BMI categories, as shown in Table 10 below.

Approaching one in ten of the study sample reported severe depression, and an additional 17.37% suffered sub threshold levels of depression. Depression was more common among women, those who were not married, especially those who were separated or divorced, and among those living alone. Those looking after the home and those who were sick or disabled were also more likely to report severe depression.

Mean loneliness score more than tripled from mild or no depression to severe depression, and prevalence of depression was greater in obese than in healthy weight individuals.

Table 10: Characteristics according to CES-D Categories of Depression (n=6,587)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>None / mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>p-value *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cases</td>
<td>4861 (73.8%)</td>
<td>1144 (17.4%)</td>
<td>582 (8.8%)</td>
<td></td>
</tr>
<tr>
<td>Age, mean (SD)</td>
<td>63.39 (8.90)</td>
<td>63.51 (9.50)</td>
<td>61.74 (8.75)</td>
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</tr>
<tr>
<td>Age category (%)</td>
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<td></td>
</tr>
<tr>
<td>Younger</td>
<td>73.1</td>
<td>17.0</td>
<td>9.9</td>
<td>0.000</td>
</tr>
<tr>
<td>Older</td>
<td>74.9</td>
<td>17.9</td>
<td>7.2</td>
<td></td>
</tr>
<tr>
<td>Sex (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>78.9</td>
<td>14.7</td>
<td>6.4</td>
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<tr>
<td>Female</td>
<td>69.5</td>
<td>19.6</td>
<td>10.9</td>
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<tr>
<td>Marital status (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>76.8</td>
<td>15.9</td>
<td>7.3</td>
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</tr>
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<td>Education (%)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>some 1&lt;sup&gt;o&lt;/sup&gt;</td>
<td>70.9</td>
<td>18.2</td>
<td>10.9</td>
<td>0.000</td>
</tr>
<tr>
<td>some 2&lt;sup&gt;o&lt;/sup&gt;</td>
<td>73.8</td>
<td>17.7</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>tertiary</td>
<td>76.4</td>
<td>16.2</td>
<td>7.4</td>
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<td>Residential location (%)</td>
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<td>Urban</td>
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<td>0.009</td>
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<tr>
<td>Co-Habitation (%)</td>
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<td>-------</td>
<td>-------</td>
<td>------</td>
<td></td>
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<td>Lives alone</td>
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<td>12.3</td>
<td></td>
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<tr>
<td>Living with spouse</td>
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<td>16.5</td>
<td>6.7</td>
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<tr>
<td>Living with others</td>
<td>74.4</td>
<td>16.3</td>
<td>9.3</td>
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<tr>
<th>Socio-Economic Status (%)</th>
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<td>Professional</td>
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<td>4.9</td>
</tr>
<tr>
<td>Non manual skilled</td>
<td>76.0</td>
<td>17.4</td>
<td>6.5</td>
</tr>
<tr>
<td>Semi and unskilled</td>
<td>72.0</td>
<td>17.8</td>
<td>10.2</td>
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<td>Farmers</td>
<td>84.4</td>
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<td>4.0</td>
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<tr>
<td>Retired</td>
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<td>19.0</td>
<td>10.5</td>
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<tr>
<td>Self-employed</td>
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<td>6.0</td>
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<tr>
<td>Unemployed</td>
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<td>27.4</td>
<td>11.1</td>
</tr>
<tr>
<td>Disabled or sick</td>
<td>43.1</td>
<td>24.6</td>
<td>32.4</td>
</tr>
<tr>
<td>Looking after home</td>
<td>68.5</td>
<td>19.0</td>
<td>12.5</td>
</tr>
<tr>
<td>In education</td>
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<td>16.7</td>
<td>19.4</td>
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<table>
<thead>
<tr>
<th>Self-Rated Health (%)</th>
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<th></th>
<th></th>
</tr>
</thead>
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<tr>
<td>Excellent</td>
<td>85.3</td>
<td>11.7</td>
<td>3.0</td>
</tr>
<tr>
<td>Very good</td>
<td>81.9</td>
<td>13.4</td>
<td>4.7</td>
</tr>
<tr>
<td>Good</td>
<td>73.3</td>
<td>18.3</td>
<td>8.4</td>
</tr>
<tr>
<td>Fair</td>
<td>58.8</td>
<td>25.6</td>
<td>15.6</td>
</tr>
<tr>
<td>Poor</td>
<td>39.2</td>
<td>25.7</td>
<td>35.1</td>
</tr>
</tbody>
</table>

| Loneliness, mean (SD)     | 1.46 (1.80) | 2.65 (2.21) | 4.47 (2.65) |

<table>
<thead>
<tr>
<th>BMI (%)</th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>71.0</td>
<td>20.1</td>
<td>8.9</td>
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<tr>
<td>Overweight</td>
<td>75.7</td>
<td>16.9</td>
<td>7.4</td>
</tr>
<tr>
<td>Obese</td>
<td>74.3</td>
<td>15.9</td>
<td>9.8</td>
</tr>
</tbody>
</table>

| BMI, mean (SD)           | 28.54 (4.45) | 28.24 (4.97) | 28.77 (4.97) |

* Derived from one-way ANOVA for continuous variables and χ² test for categorical variables.

In addition to analysis of the categorical depression variable, mean depression scores were compared between groups based on socio-demographic variables and SRHs, using t-tests and ANOVA. Mean depression scores were found to be significantly different across all groups (Table 11).
Table 11: Mean Depression Scores across Groups

<table>
<thead>
<tr>
<th></th>
<th>Depression score</th>
<th>P value</th>
<th>Depression Score ANOVA F statistic</th>
<th>Degrees of freedom</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Independent T-test</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex (male/female)</td>
<td>-8.6654</td>
<td>0.0000</td>
<td>75.09</td>
<td>1</td>
<td>0.000</td>
</tr>
<tr>
<td>Age (younger /older)</td>
<td>2.9353</td>
<td>0.0017</td>
<td>8.62</td>
<td>1</td>
<td>0.000</td>
</tr>
<tr>
<td>Location (urban/rural)</td>
<td>4.0047</td>
<td>0.0000</td>
<td>16.04</td>
<td>1</td>
<td>0.000</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>0.000</td>
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<td>Socio economic status</td>
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<td></td>
<td></td>
<td>10</td>
<td>0.000</td>
</tr>
<tr>
<td>Cohabitation</td>
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<td></td>
<td></td>
<td>2</td>
<td>0.000</td>
</tr>
<tr>
<td>SRH</td>
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<td></td>
<td></td>
<td>5</td>
<td>0.000</td>
</tr>
</tbody>
</table>

6.4.4 Loneliness

The relationship of socio-demographic variables and other covariates to loneliness was assessed in univariate analyses (Table 12).

Difference in mean loneliness scores was significant across all socioeconomic variable groups except for age, gender and location of residence. Loneliness scores were not significantly different across BMI categories, but significant differences were found across depression categories.

One in five (19.17%) respondents fell in the moderate loneliness category, while only 2.55% suffered severe loneliness. Loneliness was more common among those who were not married, especially those who were separated or divorced, those living alone and among those who were sick or disabled. Mean depression score was over four times greater for those in the high loneliness category compared to those in the ‘low’ category.
Table 12: Characteristics according to Loneliness (n =6,587)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
<th>P value *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cases</td>
<td>5156 (78.3%)</td>
<td>1263 (19.2%)</td>
<td>168 (2.6%)</td>
<td></td>
</tr>
<tr>
<td>Age, mean (SD)</td>
<td>63.38 (9.0)</td>
<td>62.98 (9.2)</td>
<td>61.87 (9.1)</td>
<td>0.141</td>
</tr>
<tr>
<td>Age category (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.088</td>
</tr>
<tr>
<td>Younger</td>
<td>77.8</td>
<td>19.5</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>Older</td>
<td>79.3</td>
<td>18.7</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td>Sex (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.397</td>
</tr>
<tr>
<td>Male</td>
<td>79.0</td>
<td>18.5</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>77.6</td>
<td>19.8</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>Marital status (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>Married</td>
<td>83.7</td>
<td>14.6</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Never married</td>
<td>63.8</td>
<td>30.6</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>Sep/divorced</td>
<td>62.7</td>
<td>32.0</td>
<td>5.4</td>
<td></td>
</tr>
<tr>
<td>Widowed</td>
<td>66.1</td>
<td>30.0</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>Education (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>some 1&lt;sup&gt;o&lt;/sup&gt;</td>
<td>75.5</td>
<td>20.7</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>some 2&lt;sup&gt;o&lt;/sup&gt;</td>
<td>79.0</td>
<td>18.8</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>tertiary</td>
<td>80.0</td>
<td>18.2</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Residential location (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.876</td>
</tr>
<tr>
<td>Urban</td>
<td>78.3</td>
<td>19.1</td>
<td>2.6</td>
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<td>Rural</td>
<td>78.3</td>
<td>19.3</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Co-Habitation (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.000</td>
</tr>
<tr>
<td>Lives alone</td>
<td>63.5</td>
<td>31.5</td>
<td>5.0</td>
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<tr>
<td>Living with spouse</td>
<td>85.0</td>
<td>13.6</td>
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<tr>
<td>Living with others</td>
<td>78.9</td>
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<td>2.4</td>
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<tr>
<td>Socio-Economic Status (%)</td>
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<td>Semi and unskilled</td>
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<td>Farmers</td>
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<td>Retired</td>
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<td>Good</td>
<td>Fair</td>
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<thead>
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<th>Self-Rated Health (%)</th>
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<tbody>
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<table>
<thead>
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<th>28.28 (4.71)</th>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>80.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>77.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BMI (%)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>77.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>80.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>77.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Derived from one-way ANOVA for continuous variables and χ2 test for categorical variables.*

In addition to analysis of the categorical loneliness variable, mean loneliness scores were compared between groups based on socio-demographic variables and SRHs, using t-tests and ANOVA analysis. Mean loneliness scores were found to be significantly different across sex, education, marital status and SES groups (Table 13)
Table 13: Loneliness Scores across Sociodemographic Groups

<table>
<thead>
<tr>
<th></th>
<th>Loneliness score Independent T-test</th>
<th>P value</th>
<th>Loneliness score ANOVA F statistic</th>
<th>Degrees of freedom</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (Male/Female)</td>
<td>-1.96</td>
<td>0.025</td>
<td>3.84</td>
<td>1</td>
<td>0.05</td>
</tr>
<tr>
<td>Age (younger old/older old)</td>
<td>-0.170</td>
<td>0.4325</td>
<td>0.03</td>
<td>1</td>
<td>0.8649</td>
</tr>
<tr>
<td>Location (urban/rural)</td>
<td>-0.4096</td>
<td>0.6589</td>
<td>0.17</td>
<td>1</td>
<td>0.6821</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td>13.01</td>
<td></td>
<td>3</td>
<td>0.000</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td>154.33</td>
<td></td>
<td>3</td>
<td>0.000</td>
</tr>
<tr>
<td>Socio economic status</td>
<td></td>
<td>16.69</td>
<td></td>
<td>10</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Frequencies and percent of respondents scoring in each point on the UCLA loneliness scale are shown in Appendix 3.

6.5 Analysis of Subjective and Objective Social Relationships

Correlations between the social relationship measures were computed to investigate relationships between social support and strain, participation, social network connectedness and loneliness. All social relationship measures were found to be significantly correlated with each other.

However, using the standards suggested by Evans (343), which describe correlations from 0.00 to 0.19 as very weak, 0.20 to 0.39 as weak, 0.40 to 0.59 as moderate, 0.60 to 0.79 as strong and 0.80 to 1.00 as very strong, although statistically significant, correlations between support and strain, participation and social network connectedness and all other variables were weak or very weak.

Depression had a significant strong positive correlation with frequency of loneliness, and a significant moderate positive correlation with the ULS loneliness score. The correlations between depression and participation and social network connectedness were both very weak.

SRH was also significantly correlated with all social relationship measures except the relationship quality measure of strain, but all correlations were weak or very weak. BMI had a significant but very weak correlation with SRH and participation but with no other social relationship scores.
Table 14: Correlations between Social Relationship Variables and BMI, Depression and SRH (n=5135)

<table>
<thead>
<tr>
<th></th>
<th>Loneliness frequency</th>
<th>ULS</th>
<th>Berkman’s SNI</th>
<th>Participation</th>
<th>Support</th>
<th>Strain</th>
<th>Depression</th>
<th>SRH</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loneliness frequency</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ULS</td>
<td>0.4214**</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social network connectedness</td>
<td>-0.1828**</td>
<td>-0.2337**</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participation</td>
<td>-0.0725**</td>
<td>-0.1093**</td>
<td>0.1758**</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Support</td>
<td>-0.1737**</td>
<td>-0.3866**</td>
<td>0.3189**</td>
<td>0.0821**</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strain</td>
<td>0.0054</td>
<td>0.1357**</td>
<td>0.1500**</td>
<td>0.0655**</td>
<td>0.0945**</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>0.6206**</td>
<td>0.4579**</td>
<td>-0.1803**</td>
<td>-0.1002**</td>
<td>-0.1985**</td>
<td>0.1087**</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRH</td>
<td>0.1662**</td>
<td>0.2481**</td>
<td>-0.1459**</td>
<td>-0.1639**</td>
<td>-0.1491**</td>
<td>0.0025</td>
<td>0.2951**</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>-0.0234</td>
<td>-0.0012</td>
<td>-0.0124</td>
<td>-0.0316*</td>
<td>-0.0073</td>
<td>0.0328*</td>
<td>0.0054</td>
<td>0.1705**</td>
<td>1.000</td>
</tr>
</tbody>
</table>

**p<0.001     *p<0.05
Simple regression modelling of participation, social network connectedness, relationship quality and loneliness onto depression showed that the loneliness score accounted for 20.95% of the variance in depression, whereas social network connectedness score (3.24%), participation (0.99%), support (3.92%) and strain (1.17%) accounted for much less variance in depression scores.

**Table 15: Simple Regression of Social Relationship Measures onto Depression (CES-D score)**

<table>
<thead>
<tr>
<th>Social relationship measure</th>
<th>Regression coefficient</th>
<th>Constant</th>
<th>T statistic</th>
<th>P value</th>
<th>F statistic</th>
<th>R squared</th>
<th>Adjusted r squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loneliness</td>
<td>1.47</td>
<td>2.80</td>
<td>41.79</td>
<td>0.0000</td>
<td>1746.60</td>
<td>0.2096</td>
<td>0.2095</td>
</tr>
<tr>
<td>Social network connectedness</td>
<td>-1.43</td>
<td>9.72</td>
<td>-14.87</td>
<td>0.0000</td>
<td>221.23</td>
<td>0.0325</td>
<td>0.0324</td>
</tr>
<tr>
<td>Participation</td>
<td>-0.95</td>
<td>8.14</td>
<td>-8.17</td>
<td>0.0000</td>
<td>66.82</td>
<td>0.01</td>
<td>0.0099</td>
</tr>
<tr>
<td>Support</td>
<td>-1.19</td>
<td>8.65</td>
<td>-16.43</td>
<td>0.0000</td>
<td>269.89</td>
<td>0.0394</td>
<td>0.0392</td>
</tr>
<tr>
<td>Strain</td>
<td>0.58</td>
<td>4.60</td>
<td>8.87</td>
<td>0.0000</td>
<td>78.69</td>
<td>0.0118</td>
<td>0.0117</td>
</tr>
</tbody>
</table>

6.6 The Relationship of Socio-demographics Variables, Social Relationship Variables and BMI to Depression

Multi-Nomial Logit Modelling (MNLM) was used to examine the independent effect of socio-demographic measures, all social relationship variables and BMI on risk of depression, presented in Table 16. Only those variables that were significantly associated with depression in preliminary univariate analyses were considered in the MNLMs.
Table 16: MNLM with RRR for the Association of Sociodemographic Variables, SRH, Loneliness, Relationship Quality, Social Network Connectedness and participation and BMI with Depression (n=5124)

<table>
<thead>
<tr>
<th>Base category (omitted): No or mild depression</th>
<th>Moderate Depression</th>
<th>Severe depression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RRR</td>
<td>Confidence Interval</td>
</tr>
<tr>
<td>Age</td>
<td>0.10</td>
<td>0.99-1.01</td>
</tr>
<tr>
<td>Sex (vs male)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1.73***</td>
<td>1.44-2.06</td>
</tr>
<tr>
<td>Education (vs. Primary)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>1.05</td>
<td>0.85-1.29</td>
</tr>
<tr>
<td>Tertiary</td>
<td>1.01</td>
<td>0.79-1.29</td>
</tr>
<tr>
<td>Socio-Economic status (vs. professional)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non manual &amp; skilled manual</td>
<td>0.99</td>
<td>0.78 - 1.26</td>
</tr>
<tr>
<td>Semi and unskilled manual</td>
<td>1.17</td>
<td>0.88 - 1.56</td>
</tr>
<tr>
<td>Farmers</td>
<td>0.76</td>
<td>0.49 - 1.18</td>
</tr>
<tr>
<td>Retired</td>
<td>0.98</td>
<td>0.56 - 1.71</td>
</tr>
<tr>
<td>self employed</td>
<td>0.82</td>
<td>0.59 - 1.15</td>
</tr>
<tr>
<td>Unemployed</td>
<td>1.75**</td>
<td>1.21 - 2.55</td>
</tr>
<tr>
<td>Disabling or and sick</td>
<td>1.47</td>
<td>0.95 - 2.26</td>
</tr>
<tr>
<td>Looking after home</td>
<td>1.15</td>
<td>0.87 - 1.52</td>
</tr>
<tr>
<td>In education</td>
<td>1.73</td>
<td>0.654 - 4.64</td>
</tr>
<tr>
<td>Marital status (vs. married)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never Married</td>
<td>1.18</td>
<td>0.77-1.80</td>
</tr>
<tr>
<td>Separated or divorced</td>
<td>1.14</td>
<td>0.75-1.73</td>
</tr>
<tr>
<td>Widowed</td>
<td>1.15</td>
<td>0.78-1.72</td>
</tr>
<tr>
<td>Location of residence (vs urban)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>0.90</td>
<td>0.77-1.06</td>
</tr>
<tr>
<td>Cohabitation (vs lives alone)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living with spouse</td>
<td>1.09</td>
<td>0.75-1.59</td>
</tr>
<tr>
<td>Living with others</td>
<td>0.96</td>
<td>0.69-1.32</td>
</tr>
<tr>
<td>Self-Rated Health (vs excellent)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very good</td>
<td>1.15</td>
<td>0.88-1.49</td>
</tr>
<tr>
<td>Good</td>
<td>1.76***</td>
<td>1.36-2.27</td>
</tr>
<tr>
<td>Fair</td>
<td>2.85***</td>
<td>2.14-3.78</td>
</tr>
</tbody>
</table>
Women were at 73% greater risk of moderate depression and 91% greater risk of severe depression than men. Risk of severe depression increased over four fold for those who were sick and over two fold for those looking after the home, a predominantly female group.

The subjective social relationship measures, loneliness and relationship quality measures of strain and support had significant impact (p<0.01) on the risk of both moderate and severe depression, whereas the objective social relationship measures, social network connectedness and participation, did not have any significant impact.
RRR for both moderate and severe depression increased significantly with each additional source of strain added. Those who had 3 or 4 sources of support were 43% and 57% less likely to suffer moderate depression, respectively. Sources of support were not a significant influence on the relative risk of severe depression.

Risk of moderate depression was doubled (100% increase) for those who were moderately lonely and almost tripled (192% increase) for those who were severely lonely. In the severe depression category the increases in risk were striking with more than a five fold increase in those who were moderately lonely and over a twenty two fold increase in the severely lonely.

Multiple regression analysis of independent variables onto the depression score as the dependent variable was carried out, entering socio-demographic variables and SRH in the first model, then adding BMI in the second model before finally adding loneliness.

Sociodemographic variables and SRH accounted for 12.4% of the variance in depression score, and the addition of BMI did not improve the model. However, the addition of loneliness significantly improved the model, accounting for an additional 14.03% of variance in depression.

6.7 The Relationship of Socio-demographics Variables, Social Relationship Variables and Depression to BMI

Further Multi Nomial Logit Modelling (MNLM) was used to examine the independent effect of socio-demographic measures, social relationship measures and depression on BMI (Table 17). Only those variables that were significantly associated with depression in preliminary univariate analyses were considered in the MNLMs.
Table 17: MNLM with RRR for the Association of Sociodemographic Variables, SRH, Loneliness, Relationship Quality, Social Network Connectedness and Participation and Depression with BMI (n=5124)

<table>
<thead>
<tr>
<th>Base category (omitted): Normal weight</th>
<th>Overweight</th>
<th></th>
<th>Obese</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RRR</td>
<td>Confidence Interval</td>
<td>RRR</td>
<td>Confidence Interval</td>
</tr>
<tr>
<td>Age</td>
<td>0.99</td>
<td>0.98-1.00</td>
<td>0.99</td>
<td>0.98-1.00</td>
</tr>
<tr>
<td>Sex (vs males)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>0.47***</td>
<td>0.40-0.56</td>
<td>0.46***</td>
<td>0.38-0.55</td>
</tr>
<tr>
<td>Education (vs. Primary)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>0.92</td>
<td>0.75-1.13</td>
<td>0.76*</td>
<td>0.61-0.94</td>
</tr>
<tr>
<td>Tertiary</td>
<td>0.83</td>
<td>0.66-1.05</td>
<td>0.65**</td>
<td>0.51-0.83</td>
</tr>
<tr>
<td>Socio-Economic status (vs. professional)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non manual &amp; skilled manual</td>
<td>1.07</td>
<td>0.85-1.32</td>
<td>1.10</td>
<td>0.87-1.39</td>
</tr>
<tr>
<td>Semi and unskilled manual</td>
<td>1.18</td>
<td>0.89-1.56</td>
<td>1.00</td>
<td>0.74-1.34</td>
</tr>
<tr>
<td>Farmers</td>
<td>1.41</td>
<td>0.93-2.14</td>
<td>1.06</td>
<td>0.68-1.64</td>
</tr>
<tr>
<td>Retired</td>
<td>1.02</td>
<td>0.61-1.73</td>
<td>1.01</td>
<td>0.58-1.74</td>
</tr>
<tr>
<td>Self employed</td>
<td>1.46</td>
<td>1.07-2.00</td>
<td>1.56**</td>
<td>1.12-2.15</td>
</tr>
<tr>
<td>Unemployed</td>
<td>0.97</td>
<td>0.65-1.45</td>
<td>1.10</td>
<td>0.73-1.67</td>
</tr>
<tr>
<td>Disabled or sick</td>
<td>1.34</td>
<td>0.84-2.15</td>
<td>1.29</td>
<td>0.80-2.05</td>
</tr>
<tr>
<td>Looking after home</td>
<td>1.07</td>
<td>0.82-1.39</td>
<td>1.14</td>
<td>0.86-1.50</td>
</tr>
<tr>
<td>In education</td>
<td>1.53</td>
<td>0.51-4.59</td>
<td>3.15*</td>
<td>1.09-9.11</td>
</tr>
<tr>
<td>Marital status (vs. married)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never Married</td>
<td>0.91</td>
<td>0.60-1.39</td>
<td>1.05</td>
<td>0.68-1.62</td>
</tr>
<tr>
<td>Separated or divorced</td>
<td>1.23</td>
<td>0.82-1.84</td>
<td>0.98</td>
<td>0.64-1.51</td>
</tr>
<tr>
<td>Widowed</td>
<td>1.30</td>
<td>0.89-1.92</td>
<td>1.21</td>
<td>0.81-1.80</td>
</tr>
<tr>
<td>Location of residence (vs urban)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>1.62</td>
<td>1.00-1.36</td>
<td>1.32**</td>
<td>1.12-1.55</td>
</tr>
<tr>
<td>Cohabitation (vs lives alone)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living with spouse</td>
<td>1.03</td>
<td>0.71-1.48</td>
<td>1.21</td>
<td>0.83-1.77</td>
</tr>
<tr>
<td>Living with others</td>
<td>0.92</td>
<td>0.67-1.27</td>
<td>1.18</td>
<td>0.85-1.65</td>
</tr>
<tr>
<td>Self-Rated Health (vs excellent)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very good</td>
<td>1.15</td>
<td>0.99-1.41</td>
<td>1.48**</td>
<td>1.17-1.86</td>
</tr>
<tr>
<td>Good</td>
<td>1.44**</td>
<td>1.17-1.79</td>
<td>2.14***</td>
<td>1.69-2.72</td>
</tr>
<tr>
<td>Fair</td>
<td>1.36*</td>
<td>1.04-1.77</td>
<td>2.96***</td>
<td>2.23-3.92</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td><strong>Loneliness category (vs Low)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>0.87</td>
<td>0.71-1.07</td>
<td>0.93</td>
<td>0.75-1.16</td>
</tr>
<tr>
<td>High</td>
<td>0.95</td>
<td>0.57-1.57</td>
<td>0.73</td>
<td>0.43-1.23</td>
</tr>
<tr>
<td><strong>Support (vs 0 sources out of 4)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 source out of 4</td>
<td>0.78</td>
<td>0.52-1.17</td>
<td>0.80</td>
<td>0.53-1.23</td>
</tr>
<tr>
<td>2 sources out of 4</td>
<td>0.90</td>
<td>0.60-1.34</td>
<td>0.92</td>
<td>0.61-1.41</td>
</tr>
<tr>
<td>3 sources out of 4</td>
<td>0.85</td>
<td>0.57-1.29</td>
<td>0.90</td>
<td>0.58-1.38</td>
</tr>
<tr>
<td>4 sources out of 4</td>
<td>1.10</td>
<td>0.72-1.68</td>
<td>1.10</td>
<td>0.71-1.73</td>
</tr>
<tr>
<td><strong>Strain (vs 0 sources out of 4)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 source out of 4</td>
<td>1.00</td>
<td>0.80-1.26</td>
<td>1.03</td>
<td>0.81-1.31</td>
</tr>
<tr>
<td>2 sources out of 4</td>
<td>1.06</td>
<td>0.83-1.34</td>
<td>1.09</td>
<td>0.85-1.41</td>
</tr>
<tr>
<td>3 sources out of 4</td>
<td>0.90</td>
<td>0.70-1.16</td>
<td>1.06</td>
<td>0.81-1.38</td>
</tr>
<tr>
<td>4 sources out of 4</td>
<td>1.11</td>
<td>0.83-1.48</td>
<td>1.17</td>
<td>0.86-1.58</td>
</tr>
<tr>
<td><strong>Social network connectedness Score (vs isolated 0)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat isolated (1)</td>
<td>0.28</td>
<td>0.03-2.30</td>
<td>0.24</td>
<td>0.03-2.07</td>
</tr>
<tr>
<td>Moderately isolated (2),</td>
<td>0.32</td>
<td>0.04-2.61</td>
<td>0.29</td>
<td>0.03-2.45</td>
</tr>
<tr>
<td>Moderately integrated (3)</td>
<td>0.36</td>
<td>0.04-3.02</td>
<td>0.28</td>
<td>0.03-2.43</td>
</tr>
<tr>
<td>Most integrated (4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Participation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yearly</td>
<td>1.04</td>
<td>0.59-1.81</td>
<td>1.17</td>
<td>0.67-2.07</td>
</tr>
<tr>
<td>Monthly</td>
<td>1.63</td>
<td>0.96-2.78</td>
<td>1.63</td>
<td>0.95-2.80</td>
</tr>
<tr>
<td>Weekly</td>
<td>1.21</td>
<td>0.74-2.00</td>
<td>1.26</td>
<td>0.76-2.09</td>
</tr>
<tr>
<td><strong>CES-D category (vs mild/no depression)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate depression</td>
<td>0.86</td>
<td>0.71-1.05</td>
<td>0.72**</td>
<td>0.58-0.88</td>
</tr>
<tr>
<td>Severe depression</td>
<td>0.91</td>
<td>0.68-1.22</td>
<td>0.96</td>
<td>0.71-1.30</td>
</tr>
</tbody>
</table>

*p<0.05, **p<0.01, ***p=0.00*
Risk of both overweight and obesity was higher in men. RRR for obesity increased steadily with declining SRH. Educational attainment appeared to be protective with a reduction in RRR for obesity of 24% and 35% for secondary and tertiary education respectively. Risk of obesity increased by 32% for those living in a rural area, and was over three times greater for those in education. No other variables significantly increased the risk of being overweight or obese, but RRR for obesity was 28% lower in those who were moderately depressed.

Regression analysis of independent variables onto BMI as the dependent variable was carried out, entering socio-demographic variables and SRH in the first model, then adding depression in the second model before finally adding loneliness.

Socio-demographic variables and SRH only accounted for 4.35% of the variance in BMI, and the addition of depression and loneliness did not significantly improve the model.

6.8 Analysis of Wave 2 Data

6.8.1 Wave 2 Respondents
Of the 6,587 study population included at Wave 1, 5,848 (88.78%) were surveyed again at Wave 2. The 739 of the study population who were not re-surveyed had significantly higher wave 1 scores for loneliness (p=0.0003), and depression measured by CES-D (p=0.0085), and were significantly older (p=0.0000).

Reasons for attrition at wave 2 were 17.37% refusal, 9.83% lost to follow up and 17.37% deceased (190).

6.8.2 Sociodemographic Changes at Wave 2
Mean age at wave 2 was 63.26 years (SD 9.01 years). The distribution of males and females remained relatively stable (wave 1 45.92% male, wave 2 45.88% male). The proportion of participants who were retired increased from 37.33% at wave 1 to 42.84% of the population included at wave 2. In wave 1, 46.03% of respondents rated their SRH as excellent or very good. This increased to 48.24% at wave 2.

Data on residential area (urban or rural), marital status and living arrangements was not available for wave 2 and so changes in these variables could not be assessed.
6.8.3 Changes in Loneliness and in Depression between Wave 1 and Wave 2.

Paired t-tests were used as they account for correlations between observations within subjects in longitudinal data by considering subject-specific differences (344).

Mean ULS score at wave 2 was significantly lower (single sample t = -1.66, p = 0.048) than the total population mean ULS score at wave 1. When the comparison was limited to those who had completed both waves the difference in ULS between waves remained significant (paired t = -1.694, p=0.045).

Mean CES-D score at wave 2 was significantly lower (single sample t=-5.507, p=0.0000) than the total population mean CES-D score at wave 1. Similarly, when the comparison was limited to those who had completed both waves, the difference in CES-D between waves also remained significant (paired t = -4.472, p=0.0000).

Considering respondents for whom both waves of data were collected, of those who were not lonely at wave 1, 89.5% remained in the same category at wave 2. One in ten of those who were not lonely at wave 1 (9.89%) experienced moderate loneliness at wave 2, and a small proportion (0.65%) experienced severe loneliness at wave 2.

Similar proportions of younger old (89.74%) and older old (88.94%) respondents remained in the ‘not lonely category’ at both waves. Information about respondents’ marital status at wave 2 was not available and so it was not possible to assess how many respondents had been widowed or separated since wave 1, experiences which may have contributed to increases in loneliness between waves.
Table 18: Development of Loneliness between Waves by Socio-demographic Characteristics. (n=5,200)

<table>
<thead>
<tr>
<th>Categorical sociodemographic variable</th>
<th>W1 Not Lonely, W2 Not lonely</th>
<th>W1 Not Lonely, W2 Moderately lonely</th>
<th>W1 Not Lonely, W2 Severely lonely</th>
</tr>
</thead>
<tbody>
<tr>
<td>% (N)</td>
<td>89.5 (3707)</td>
<td>9.9 (410)</td>
<td>0.7 (27)</td>
</tr>
<tr>
<td>Age % (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Younger old*</td>
<td>89.7 (2336)</td>
<td>9.5 (246)</td>
<td>0.8 (21)</td>
</tr>
<tr>
<td>Older old*</td>
<td>88.9 (1367)</td>
<td>10.7 (164)</td>
<td>0.4 (6)</td>
</tr>
<tr>
<td>Gender % (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male*</td>
<td>90.0 (1709)</td>
<td>9.3 (177)</td>
<td>0.7 (13)</td>
</tr>
<tr>
<td>Female*</td>
<td>89.0 (1998)</td>
<td>10.4 (288)</td>
<td>0.6 (14)</td>
</tr>
<tr>
<td>Location % (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban*</td>
<td>89.2 (1968)</td>
<td>10.3 (227)</td>
<td>0.5 (11)</td>
</tr>
<tr>
<td>Rural*</td>
<td>89.8 (1734)</td>
<td>9.4 (181)</td>
<td>0.8 (16)</td>
</tr>
<tr>
<td>Education % (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary*</td>
<td>87.5 (849)</td>
<td>11.6 (112)</td>
<td>0.9 (9)</td>
</tr>
<tr>
<td>Secondary*</td>
<td>89.6 (1571)</td>
<td>9.9 (174)</td>
<td>0.5 (9)</td>
</tr>
<tr>
<td>Tertiary*</td>
<td>90.6 (1284)</td>
<td>8.8 (124)</td>
<td>0.6 (9)</td>
</tr>
<tr>
<td>Marital status (at wave 1) % (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married*</td>
<td>90.6 (2919)</td>
<td>8.9 (287)</td>
<td>0.5 (17)</td>
</tr>
<tr>
<td>Never married*</td>
<td>86.3 (251)</td>
<td>12.7 (37)</td>
<td>1.0 (3)</td>
</tr>
<tr>
<td>Separated*</td>
<td>84.5 (185)</td>
<td>13.7 (30)</td>
<td>1.8 (4)</td>
</tr>
<tr>
<td>Widowed*</td>
<td>85.6 (352)</td>
<td>13.6 (56)</td>
<td>0.7 (3)</td>
</tr>
<tr>
<td>Living arrangement % (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lives alone*</td>
<td>86.2 (568)</td>
<td>13.2 (87)</td>
<td>0.6 (4)</td>
</tr>
<tr>
<td>Lives with spouse*</td>
<td>90.1 (1689)</td>
<td>9.4 (177)</td>
<td>0.5 (9)</td>
</tr>
<tr>
<td>Lives with others*</td>
<td>90.1 (1450)</td>
<td>9.1 (146)</td>
<td>0.9 (14)</td>
</tr>
<tr>
<td>Depression (at wave 1) % (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild / none*</td>
<td>92.0 (3112)</td>
<td>7.5 (255)</td>
<td>0.5 (16)</td>
</tr>
<tr>
<td>Moderate*</td>
<td>80.6 (479)</td>
<td>18.0 (107)</td>
<td>1.4 (8)</td>
</tr>
<tr>
<td>Severe*</td>
<td>69.5 (116)</td>
<td>28.7 (48)</td>
<td>1.8 (3)</td>
</tr>
</tbody>
</table>

*Pearson Chi2 p<0.05

In addition to increases in loneliness, some respondents became less lonely, moving from the severely lonely category at wave 1 to the not lonely category at wave 2 (n=11, 9.65% of the severely lonely at wave 1) or to the moderately lonely category at wave 2 (n=53, 46.5% of the severely lonely at wave 1).

Of those experiencing mild or no depression at wave 1, 86.45% remained in the same category at wave 2, but 10.94% had moved to the moderate depression category and 2.61% were experiencing severe depression by wave 2, as shown in Table 19.
Table 19: Development of Depression between Waves by Socio-demographic Characteristics. (n=5778)

<table>
<thead>
<tr>
<th>Categorical sociodemographic variable</th>
<th>W1 No depression, W2 No depression</th>
<th>W1 No depression, W2 Mild depression</th>
<th>W1 No depression, W2 Severe depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>86.5 (3713)</td>
<td>10.9 (470)</td>
<td>2.6 (112)</td>
</tr>
<tr>
<td>Age % (n)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Younger old*</td>
<td>87.4 (2340)</td>
<td>9.8 (261)</td>
<td>2.9 (77)</td>
</tr>
<tr>
<td>Older old*</td>
<td>84.9 (1369)</td>
<td>13.0 (209)</td>
<td>2.2 (35)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male*</td>
<td>87.9 (1853)</td>
<td>9.9 (209)</td>
<td>2.1 (45)</td>
</tr>
<tr>
<td>Female*</td>
<td>85.0 (1860)</td>
<td>11.9 (261)</td>
<td>3.1 (67)</td>
</tr>
<tr>
<td>Location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban*</td>
<td>85.1 (1886)</td>
<td>12.1 (268)</td>
<td>2.8 (62)</td>
</tr>
<tr>
<td>Rural*</td>
<td>88.0 (1824)</td>
<td>9.7 (201)</td>
<td>2.4 (49)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary*</td>
<td>84.1 (890)</td>
<td>12.9 (136)</td>
<td>3.0 (32)</td>
</tr>
<tr>
<td>Secondary*</td>
<td>87.7 (1560)</td>
<td>9.8 (174)</td>
<td>2.5 (44)</td>
</tr>
<tr>
<td>Tertiary*</td>
<td>86.6 (1261)</td>
<td>11.0 (160)</td>
<td>2.5 (36)</td>
</tr>
<tr>
<td>Marital status (at wave 1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married*</td>
<td>88.2 (2842)</td>
<td>9.3 (301)</td>
<td>2.5 (81)</td>
</tr>
<tr>
<td>Never married*</td>
<td>82.7 (296)</td>
<td>14.3 (51)</td>
<td>3.1 (11)</td>
</tr>
<tr>
<td>Separated*</td>
<td>77.2 (176)</td>
<td>18.4 (42)</td>
<td>4.4 (10)</td>
</tr>
<tr>
<td>Widowed*</td>
<td>82.3 (399)</td>
<td>15.7 (76)</td>
<td>2.1 (10)</td>
</tr>
<tr>
<td>Living arrangement (at wave 1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lives alone*</td>
<td>80.5 (624)</td>
<td>16.9 (131)</td>
<td>2.6 (20)</td>
</tr>
<tr>
<td>Lives with spouse*</td>
<td>86.3 (1586)</td>
<td>10.8 (198)</td>
<td>2.9 (53)</td>
</tr>
<tr>
<td>Lives with others*</td>
<td>89.3 (1503)</td>
<td>8.4 (141)</td>
<td>2.3 (39)</td>
</tr>
<tr>
<td>Loneliness (at wave 1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not lonely*</td>
<td>88.9 (3290)</td>
<td>9.2 (340)</td>
<td>2.0 (73)</td>
</tr>
<tr>
<td>Moderately lonely*</td>
<td>72.1 (398)</td>
<td>21.6 (119)</td>
<td>6.3 (35)</td>
</tr>
<tr>
<td>Severely lonely*</td>
<td>62.5 (25)</td>
<td>27.5 (11)</td>
<td>10.0 (4)</td>
</tr>
</tbody>
</table>

*Pearson Chi2 p<0.05 (No depression=CES-D score <7, mild depression = CES-D score 8-15, severe depression = CES-D ≥16)

There was a decrease in depression for both men and women across waves and men became less lonely but women became lonelier, as shown in Table 20.
Table 20: Mean Age, CES-D Scores and ULS Scores at Wave 1 and Wave 2 by Gender (n=5848)

<table>
<thead>
<tr>
<th></th>
<th>Males Wave 1 ln_w2 only</th>
<th>Males Wave 2 ln_w2 only</th>
<th>Females Wave 1 ln_w2 only</th>
<th>Females Wave 2 ln_w2 only</th>
<th>Total Wave 1 ln_w2 only</th>
<th>Total Wave 2 ln_w2 only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ULS score (SD)</td>
<td>n=2683 1.86 (2.15)</td>
<td>n=2352 1.77 (2.09)</td>
<td>n=3165 1.93 (2.14)</td>
<td>n=2848 1.97 (2.21)</td>
<td>n=5848 1.90 (2.15)</td>
<td>n=5200 1.88 (2.16)</td>
</tr>
<tr>
<td>Mean CES-D Score (SD)</td>
<td>n=2683 4.73 (6.22)</td>
<td>n=2651 4.45 (6.10)</td>
<td>n=3165 6.28 (7.40)</td>
<td>n=3127 5.75 (7.16)</td>
<td>n=5848 5.57 (6.92)</td>
<td>n=5778 5.15 (6.73)</td>
</tr>
<tr>
<td>Mean Age (SD)</td>
<td>n=2681 63.29 (8.88)</td>
<td>n=2683 65.33 (8.88)</td>
<td>n=3160 62.83 (8.84)</td>
<td>n=3165 64.86 (8.84)</td>
<td>n=5841 63.04 (8.86)</td>
<td>n=5848 65.07 (8.86)</td>
</tr>
</tbody>
</table>

Note: analysis limited to those who participated in both waves of data collection.

6.8.4 BMI at Wave 1 and Subsequent Depression at Wave 2

Chi square tests showed a significant relationship (p=0.03) between BMI category at wave 1 and major depressive episode in the previous twelve months at wave 2, with those in the overweight and obese categories at wave 1 more likely to have suffered a major depressive episode.

A chi square test showed a significant relationship between BMI category at wave 1 and depression category (none, mild or severe) at wave 2 (chi square p=0.013), although there was no significant correlation between BMI at wave 1 and CES-D score at wave 1 or 2, as shown in Table 21.

Simple linear regressions of BMI onto wave 1 and wave 2 depression scores and the change in depression variable were not significant.

6.8.5 BMI at Wave 1 and Subsequent Loneliness at Wave 2

Chi square tests showed a significant relationship (p=0.02) between BMI category at wave 1 and loneliness category at wave 2, with greater numbers of severely lonely people in the overweight and obese categories. There was no significant correlation between BMI at wave 1 and ULS score at wave 1 or 2, as shown in Table 21.

Simple linear regressions of BMI onto wave 1 and onto wave 2 ULS scores and onto the ‘change in loneliness’ variable were not significant.

6.8.6 Social Relationships and Depression over Time

Bivariate analyses were performed to identify the relationship between social relationship measures and depression measures at each wave, and between depression and loneliness changes and loneliness and depression at wave 2. Results are shown in Table 21.
6.8.7 Social Relationships at Wave 1 and Subsequent Depression at Wave 2
Chi square tests showed a significant relationship (p=0.000) between loneliness category at wave 1 and depression category at wave 2. Loneliness at wave 1 was significantly correlated to CES-D score at both wave 1 (moderate strength correlation) and at wave 2 (weak correlation), as was change in loneliness, as shown in Table 21.

6.8.8 Depression at Wave 1 and Subsequent Loneliness at Wave 2
Chi square tests showed a significant relationship (p=0.000) between depression category at wave 1 and loneliness category at wave 2. CES-D score at wave 1 showed a significant moderate correlation with loneliness score at both wave 1 and at wave 2, although depression change was not significantly correlated with loneliness at wave 2, as shown in Table 21.

Additionally, loneliness measures at both waves and depression measures at both waves were significantly related to each other, demonstrating stability of the relationship.
Table 21: Correlations between Wave 1 and Wave 2 Depression, Social Relationships and BMI, and Depression and Loneliness Change Scores

<table>
<thead>
<tr>
<th></th>
<th>W1 Depression</th>
<th>W2 Depression</th>
<th>W1 Loneliness</th>
<th>W2 Loneliness</th>
<th>W1 BMI</th>
<th>Loneliness change</th>
<th>Depression change</th>
<th>W1 Social connectedness</th>
<th>W1 participation</th>
<th>W1 Support</th>
<th>W1 Strain</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1 Depression</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2 Depression</td>
<td>0.5208 **</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1 Loneliness</td>
<td>0.4579 **</td>
<td>0.3867 **</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2 Loneliness</td>
<td>0.4009 **</td>
<td>0.4517 **</td>
<td>0.6591 **</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1 BMI</td>
<td>0.0054 NS</td>
<td>0.0101 NS</td>
<td>0.0012 NS</td>
<td>0.0054 NS</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loneliness change</td>
<td>-0.0557 **</td>
<td>0.0929 **</td>
<td>-0.3866 **</td>
<td>0.4388 **</td>
<td>0.0183 NS</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression change</td>
<td>-0.4236 **</td>
<td>0.3733 **</td>
<td>-0.0700 **</td>
<td>0.0122 NS</td>
<td>0.0024 NS</td>
<td>0.1083 **</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1 Soc. network connectedness</td>
<td>-0.1803 **</td>
<td>-0.1717 **</td>
<td>-0.2337 **</td>
<td>-0.2101 **</td>
<td>-0.0124 NS</td>
<td>0.0127 NS</td>
<td>0.0104 NS</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1 participation</td>
<td>-0.1002 **</td>
<td>-0.0961 **</td>
<td>-0.1093 **</td>
<td>-0.0988 **</td>
<td>-0.0316*</td>
<td>-0.0103 NS</td>
<td>-0.0082 NS</td>
<td>0.1758 **</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1 Support</td>
<td>-0.1985**</td>
<td>-0.1853**</td>
<td>-0.3866**</td>
<td>-0.3113**</td>
<td>-0.0073 NS</td>
<td>0.0929*</td>
<td>0.0173 NS</td>
<td>0.3189**</td>
<td>0.0821**</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>W1 Strain</td>
<td>0.1087**</td>
<td>0.1206**</td>
<td>0.1357**</td>
<td>0.1261**</td>
<td>0.0328*</td>
<td>-0.0154 NS</td>
<td>0.0074 NS</td>
<td>0.1500**</td>
<td>0.0655**</td>
<td>0.0945**</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

** p<0.01, *P<0.05, NS= not significant
Effective application of methods for assessing individual change over time such as random coefficient modelling requires multiple waves of truly longitudinal data, and so these data were unsuitable (160).

Overlap between those scoring in the severe depression category and those scoring more than one standard deviation above the mean on the UCLA Loneliness Scale was small at 4.36% (n=287). A further 3.7% (n=244) of respondents overlapped on moderate depression and one standard deviation above the mean on the UCLA Loneliness Scale.

At wave 2 these were reduced in line with the reduced ULS and depression mean scores, with 3.43% (n=176) overlapping between scoring more than one standard deviation above the mean on the UCLA Loneliness Scale and the severe depression category, and 3.85% (n=189) overlapping on the moderate depression category.

In order to examine the contribution of change in variables assessed at both waves, variables measuring changes in depression and loneliness between wave 1 and wave 2 were created. Depression change ranged from -2 (maximum improvement, i.e. reduction in depression) through 0 (no change) to +2 (maximum increase in depression). Loneliness change ranged from -8 (maximum improvement, i.e. reduction in loneliness) to +9 (maximum increase in loneliness).

Sequential regression models were constructed to predict depression in wave 2. Socio-demographic variables, SRH and wave 1 depression were added initially, followed by loneliness at wave 1, and finally by change in loneliness and loneliness at wave 2. The models and their adjusted $R^2$ values are shown in Table 22. Loneliness at wave 1 accounted for a small additional amount of variance in depression at wave 2 after other variables were adjusted for, as did loneliness change (Table 22).

Depression at wave 1 accounted for a lesser amount of variance in loneliness at wave 2 but remained significant after other variables were adjusted for (Table 23).

**Table 22: Regression onto Wave 2 Depression Scores**

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables included in Model</th>
<th>n</th>
<th>R squared</th>
<th>Adjusted $R^2$</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Age, sex, education, living arrangement, urban/rural, marital status, SRH, SES, wave 1 depression</td>
<td>5765</td>
<td>0.2903</td>
<td>0.2892</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>2</td>
<td>Model 1 + Wave 1 ULS</td>
<td>5765</td>
<td>0.3148</td>
<td>0.3136</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>3</td>
<td>Model 1 + Wave 1 ULS + Loneliness change</td>
<td>5128</td>
<td>0.3537</td>
<td>0.3523</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>
### Table 23: Regression onto Wave 2 Loneliness Scores

<table>
<thead>
<tr>
<th>Model</th>
<th>Variables included in Model</th>
<th>n</th>
<th>R squared</th>
<th>Adjusted R²</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Age, sex, education, living arrangement, urban/rural, marital status, SRH, SES, wave 1 loneliness</td>
<td>5188</td>
<td>0.4412</td>
<td>0.4404</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>2</td>
<td>Model 1 + Wave 1 CES-D</td>
<td>5188</td>
<td>0.4506</td>
<td>0.4495</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>3</td>
<td>Model 1 + Wave 1 CES-D + Depression change</td>
<td>5128</td>
<td>0.4686</td>
<td>0.4675</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>4</td>
<td>Model 1 + Wave 1 CES-D + depression change + Wave 2 CES-D</td>
<td>5128</td>
<td>0.4864</td>
<td>0.4852</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

### 6.8.9 Loneliness and Depression Change Variables and Sociodemographic Factors.

To assess whether changes in loneliness and depression differed across socio-demographic groups, t-test and one-way ANOVA analyses were conducted on change in loneliness and change in depression variables across socio-demographic variables.

Total mean change in loneliness was 0.04, but this was significantly different between genders (t (5,198) = -2.0466, p = 0.02) with a mean increase in loneliness observed among women (0.087) and a mean decrease in loneliness among men (-0.014). There were no significant differences in the change in loneliness between younger old and older old groups. Significant differences were noted across wave 1 marital status [F (3, 5196) = 3.68, p = 0.0116] such that those who were married, or separated or divorced at wave 1 experienced a mean increase in loneliness of 0.08 and 0.08 respectively, while those who were widowed or never married at wave 1 experienced a mean decrease in loneliness of -0.12 and -0.12 respectively. Significant differences were noted across living arrangement groups [F (2, 5197) = 5.97, p = 0.0026] such that those who lived alone at wave 1 had a reduction of -0.12 in mean loneliness, while those who lived with a spouse or others had a mean increase of 0.11 or 0.05 respectively. Significant differences were also noted across SES groups [F (10, 5189) = 2.03, p = 0.0264] such that mean loneliness increased among professionals (0.04), non-manual (0.11) and semiskilled (0.16) workers, those looking after the home (0.09) and those in education (0.39), but decreased among farmers (-0.04), those who had been retired at wave 1 (-0.4), the self-employed (-0.03) and the unemployed (-0.15). Loneliness increased among urban dwellers (0.08) while there was a mean decrease among rural dwellers (-0.005), t (5195) =1.71, p = 0.0437). There were no significant differences in the change in loneliness across education groups.
Total mean change in depression was -0.033, and while both men and women experienced a reduction in depression, this was significantly greater (t (5776) =3.00, p =0.0014) among women (-0.06) than men (-0.006). These are reflected in the mean scores for men and women shown in Table 20. Compared to the older old group, reduction in depression was significantly greater for the younger old (t (5770) =2.00, p = 0.023). Mean depression decreased more among rural dwellers (-0.05) compared to urban dwellers (-0.010). One-way ANOVA analysis showed no significant differences across marital status or education groups. Reduction in mean depression score was significantly different across living arrangements [F (2, 5775) = 3.61, p = 0.0272], with those living alone experiencing a greater reduction in depression (-0.054) than those living with others (-0.051) or those living with a spouse (-0.005). Change in depression was also significantly different across SES groups [F (10, 5767) = 3.67, p = 0.0001]

To investigate which variables contributed to change in depression and loneliness between waves, linear regression onto each of the change variables was conducted. The model for each included sociodemographic variables, BMI, wave 1 social relationship variables and wave 1 depression.

The variables of wave 1 depression, wave 1 loneliness, education, urban or rural location, social network connectedness and strain were all significant in accounting for change in depression. The variables of wave 1 depression, wave 1 loneliness, gender, social network connectedness, support and strain were all significant in accounting for change in loneliness. These results are presented in Table 24.
Table 24: Simple Regression of Predictor Variables onto Change Variables for Depression and Loneliness

<table>
<thead>
<tr>
<th>Predictor variable</th>
<th>Regression onto Change in Depression</th>
<th>Regression onto Change in Loneliness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$</td>
<td>95% Confidence Interval</td>
</tr>
<tr>
<td>Wave 1 loneliness</td>
<td>0.04*</td>
<td>0.04 - 0.05</td>
</tr>
<tr>
<td>Wave 1 Depression</td>
<td>-0.05*</td>
<td>-0.05 - -0.04</td>
</tr>
<tr>
<td>Gender</td>
<td>0.00</td>
<td>-0.00 - -0.00</td>
</tr>
<tr>
<td>Education</td>
<td>0.01*</td>
<td>0.00 - 0.01</td>
</tr>
<tr>
<td>Urban or rural location</td>
<td>-0.06*</td>
<td>-0.09 - -0.03</td>
</tr>
<tr>
<td>Social network connectedness</td>
<td>-0.04*</td>
<td>-0.06 - -0.02</td>
</tr>
<tr>
<td>Support</td>
<td>-0.01</td>
<td>-0.03 - 0.01</td>
</tr>
<tr>
<td>Strain</td>
<td>0.03*</td>
<td>0.02 - 0.04</td>
</tr>
</tbody>
</table>

*p < .05

6.9 Research Hypotheses.

The research objectives and hypotheses are reviewed here, presenting the evidence in support of or against each of the study hypotheses in turn. Correlation strength descriptors are based on the categories suggested by Evans (very weak 0.00 – 0.19, weak 0.20 – 0.39, moderate 0.40 – 0.59, strong 0.60 – 0.79, very strong 0.89 – 1.0) (343).

Hypothesis 1: The interrelationship between subjective measures and that between objective measures is stronger than the relationship between objective and subjective measures.

The hypothesis that objective and subjective social relationship measures are related to each other, but more strongly to measures within their subjective or objective category was partially supported.

a) Relationship quality will be related to loneliness scores on the ULS

Relationship quality comprises measures of support and strain. The support measure was significantly but very weakly correlated with the ULS score (0.174), and strain measure was not (Table 14).

b) Social network connectedness will be related to participation
This hypothesis was supported by a significant but very weak correlation (0.178) between social network connectedness and participation (Table 14).

c) The relationships within the categories of objective and subjective measures of social relationships will be stronger than those between categories.

This hypothesis was not supported as significant correlations were found between subjective and objective measures (ULS and SNI 0.234, ULS and participation -0.109), with the correlation between loneliness and social network connectedness of a greater magnitude than the significant correlations within subjective or objective groups.

**Hypothesis 2: The four measures of social relationships included are independently associated with depression.**

This hypothesis was partially supported by significant, although mostly weak, correlations between depression and all social relationship measures (Table 14). Additionally, in multivariate analysis loneliness, support and strain remained significant in MNLM of depression, but participation and social networks were not.

**Cross Sectional Data**

a) Higher scores on the ULS will be related to increased depression.

This is supported by a moderate significant positive correlation of 0.4579.

b) Greater frequency of loneliness will be related to increased depression.

This is supported by a strong significant positive correlation of 0.6206.

c) Higher scores on social network connectedness will be related to reduced depression.

This is poorly supported by a significant but very weak negative correlation of -0.1803.

d) Higher scores on participation will be related to reduced depression.

This is poorly supported by a significant but very weak negative correlation of -0.1002.

e) Higher scores on relationship quality will be related to reduced depression.

This is supported by a significant negative correlation of -0.1985 with support and a significant positive correlation of 0.1087 with strain. However, both correlations are very weak.
Longitudinal Data

a) Higher scores on the ULS at time 1 will be related to increased depression at time 2. This is supported by a significant but weak positive correlation of 0.3867 (Table 14)

b) Higher scores on social network connectedness at time 1 will be related to depression at time 2. This is supported by a significant but very weak negative correlation of -0.1717

c) Higher scores on participation at time 1 will be related to depression at time 2. This is supported by a significant but very weak negative correlation of -0.0937

d) Higher scores on relationship quality at time 1 will be related to depression at time 2. This is supported by a significant negative correlation of -0.1853 with support and a significant positive correlation of 0.1206 with strain. However, the correlations are very weak.

e) Higher scores on depression at time 1 will be related to ULS score at time 2. This is supported by a significant moderate negative correlation of 0.4009 (Table 21).

Hypothesis 3: Depression and BMI are interrelated.

Cross sectional Data

a) Higher BMI will be related to depression category. This was not supported; no significant correlation was found between BMI and depression at Wave 1, and mean BMI did not vary significantly across W1 depression category.

Longitudinal Data

a) Higher BMI at time 1 will predict depression at time 2. This was not supported, no significant correlation was found between BMI and depression at Wave 2 and mean BMI did not vary significantly across W2 depression category.
Hypothesis 4: Social Relationships and BMI are interrelated

Cross sectional Data

a) Higher scores on the ULS will be related to BMI.

This was not supported, no significant correlation was found between ULS scores and BMI.

b) Greater frequency of loneliness will be related to BMI.

This was not supported, no significant correlation was found between frequency of loneliness and BMI.

c) Higher scores on social network connectedness will be related to BMI.

This was not supported, no significant correlation was found between social network connectedness and BMI.

d) Higher scores on participation will be related to BMI.

This was not supported, no significant correlation was found between participation and BMI.

e) Higher scores on relationship quality will be related to BMI (one-tailed)

This was supported by a significant but very weak positive correlation of 0.0328 with strain, however no significant correlation was found between support and BMI.

Longitudinal Data

a) Higher scores on BMI at time 1 will be related to ULS score at time 2.

This was not supported, no significant correlation was found between BMI and loneliness at Wave 2.
Chapter 7: Discussion

7.0 Introduction
The aims of this study were, firstly, to describe the subjective and objective components of social relationships, and the prevalence of depression and raised BMI in the older Irish population, and secondly, to compare and investigate how these sub-constructs of social relationships are inter-related and their associations with depression and BMI. Further aims were to investigate any change in loneliness and depression over time and to investigate the role of the various social relationship measures in predicting depression, and the reciprocal role of depression in predicting loneliness. Finally, the role of BMI in predicting social relationships and depression over time using wave 1 and wave 2 TILDA data was also investigated.

The complex nature of social relationships was addressed through using multiple measures encompassing both subjective and objective aspects of older adults’ relationships with others, while the mutual influences between depression and loneliness and the influence of BMI on either of these states were investigated using two consecutive waves of longitudinal data.

In this chapter the findings of the study will be discussed in turn, and their implications and possible directions for future research will be considered. Challenges encountered in interpreting BMI in an older population will be considered, and the study strengths and limitations will also be discussed.

7.1 Summary of Findings
Depression is a significant concern in this population with over a quarter of respondents reporting moderate or severe depressive symptoms, and a disproportionate risk noted among women. One in five respondents reported loneliness and the links between loneliness and depression were clear. Risk of loneliness increased over 22-fold among those with concurrent severe depression. Of all the social relationship variables assessed, loneliness was the only one to have a strong correlation with depression, or to account for a large amount of variance in depression scores - more than socio-demographic variables and SRH combined. Raised BMI was also prevalent, with over three quarters of the study population of older adults found to be overweight or obese. Raised BMI was more common among men. Contrary to the study hypotheses, no association between BMI and loneliness or depression was found after other covariates were adjusted for.

Overall, both depression and loneliness decreased between waves 1 and 2, but one respondent in ten moved from not being lonely at wave 1 to experiencing loneliness at wave 2, and a similar proportion developed depression in this time frame. Loneliness increased more among women, yet greater reductions in depression were also seen among women. In addition to socio-economic
variables, the variables of depression, loneliness, social network connectedness and relationship quality were all significant in accounting for change in depression and loneliness, showing the mutual influence of depression and social relationships over time.

The following sections will discuss the study findings and consider the implications of the main points outlined below in further detail:

- Loneliness is strongly associated with depression in older adults
- Subjective measures of loneliness and relationship quality are of greater consequence than objective measures of participation or social network connectedness in relation to depression.
- Raised BMI is of concern from a population health perspective in Ireland but current BMI is not associated with loneliness or depression.

7.2 Sociodemographic Influences on Loneliness and Depression and their Association in Older Adults

The findings of this thesis add to existing evidence for a bidirectional relationship between loneliness and depression. Previous studies have provided evidence for a relationship between these states in either direction (287), but studies assessing their mutual influence concurrently have been few (1).

The synergistic effects of loneliness and depression present a potent impediment to well-being in older age. This study highlights a concerning prevalence of depressive symptomatology among older adults, and presents evidence of the risk factors shared between loneliness and depression, discussed below.

7.2.1 Prevalence of Depression and Loneliness

The prevalence of severe depression in the study sample was 8.84%, and an additional 17.4% suffered sub threshold levels of depression. This is somewhat higher than figures from SLÁN reporting 6.1% of the total population with a probable major depressive disorder, and significantly higher than the SLÁN figure of 3% of respondents aged 65 years and above (50). However, the SLÁN study used a diagnostic tool, the CIDI-SF V1.1 health interview survey which is a short form of the World Health Organization’s Composite International Diagnostic Interview to make a diagnosis of probable major depressive disorder (345), compared to the CES-D screening tool used in TILDA. Screening tools are designed to identify those at risk and are typically more sensitive than diagnostic tools which have a higher degree of specificity, resulting in rates that cannot be directly compared (346). As these figures are not directly comparable it is not possible to ascertain whether depression
is increasing, but it is clear that depressive symptoms are a sizable problem among older adults, and the high prevalence of sub-threshold levels of depressive symptoms is cause for concern.

Reported prevalence of depression in older populations varies significantly (234). Across Europe levels of depressive illness among older adults reported from the EURODEP studies ranged from 8.8% in Iceland to 23.6% in Munich. While the use of different measures may create difficulties in drawing comparisons across countries, the use of a single validated measure across the EURODEP studies confirmed that the significant variance in rates of depression is independent of the measure used (229).

Moderate loneliness occurred in 19.2% of the study population, while 2.5% had high loneliness scores. These figures are higher than the figure for older people included in SLÁN (17% of SLÁN participants aged 65 years and above were lonely), and significantly higher than the figures for the middle aged SLÁN participants (13% of SLÁN participants aged 30-44 years and 13% of those aged 45-64 years were lonely). They reflect the ‘U-shaped’ curve of loneliness over the life course, peaking in early adulthood and in later life, described by Pinquart et al. (347). Yet in contrast with this suggested trajectory, this study found loneliness to be less common among the older old compared to the younger old.

High levels of loneliness were associated with an extremely high relative risk of depression. Loneliness has previously been identified as one of the three main factors leading to depression (Green et al., 1992). This association was strongly supported in this study, by the highly significant relative risk ratios. Loneliness and depression also shared multiple socio-demographic risk factors.

7.2.2 Age in relation to Loneliness and Depression in Older Adults

The population examined in this study comprised respondents in a longitudinal study of ageing. Their experiences as they progress from ‘young old’ to ‘older old’ are of interest as older age has been associated with better self-rated successful ageing despite worsening physical and cognitive functioning (272). Attributes of old age contributing to this include both physical and mental health.

‘Old age’ encompasses a wide range of health status and levels of wellbeing and so cannot be seen to represent a homogenous category. To acknowledge the significant heterogeneity within this cohort, old age was divided into younger old and older old. Depression was significantly associated with age, and there were higher levels of severe depression in the younger old. This is in contrast to previous literature (276) and reflects an experience at odds with the ‘third age’, described by Baltes as a period characterised by ‘positive views’ compared to those of the fourth age, a time that ‘entails a level of biocultural incompleteness, vulnerability and unpredictability’ (348). While the
differentiation between third and fourth age is not synonymous with the ‘younger old’ and ‘older old’ categories used in this study, as functionality and life stage cannot be defined by absolute age, it is of note that this study found increasing age to be associated with reduced depression. This might suggest that as individuals age, they implement the selection, optimisation and compensation strategies described by Baltes (87) as they learn to cope with their changing circumstances. The progression to older old age may provide sufficient time for the benefits of these coping processes to become manifest, in contrast with younger old age, when the transition from middle age is still being tackled and the coping skills are only being developed or newly implemented.

Psychological and sociological factors have a significant influence on how well individuals age (349) and it is clear that not all individuals experience the same path through the ageing process. Studies have found that the oldest of olds may have better coping skills to deal with depression, making depressive symptoms more common but not as severe as in younger populations (349).

The life-stage when onset of depression occurs is also significant. Depression that first occurs in earlier life is likely multifactorial, with genetic, personality and life experience factors contributing to the depression. Depression that first develops in later life may also have multiple factors but is more likely to be influenced by physical health problems due to the psychological effects of living with an illness and disability, the effects of chronic pain, and the social restrictions incurred by some illnesses that can result in isolation and loneliness (349). Those who developed depression between wave 1 and wave 2 in this study were more likely to be in the younger old group, perhaps reflecting the time of greater transitions, such as retirement, faced by this group.

The associations found in this study between loneliness and depression are of note when taking a life-stage view of depression. Loneliness is a dynamic phenomenon, and may be experienced as acute or chronic. This study showed an association between loneliness at wave 1 and subsequent depression at wave 2. The measure of loneliness used in this study does not refer to a specific time frame, but as an individual’s recent frame of emotional reference may change over time, so too may feelings of loneliness. The experience of chronic loneliness in earlier life is likely to further strengthen this association with later life depression. Research using data that reflects a longer time frame would be useful to further investigate the impact of duration of loneliness on depression.

The findings of this study did not show any significant difference in loneliness between the ‘younger old’ and ‘older old’ age groups. As people grow older, the likelihood of experiencing age-related losses increases. Social and family roles change, and opportunities for initiating new relationships may be reduced. An individual’s network of social interactions may markedly change with a change
in employment status, household composition or the loss of friends and relatives. Certain changes are more likely to occur in early older age, such as retirement from the work force and grown up children leaving the family home, while others such as the loss of peers is more likely in later years. Posner points out that older people tend to make friendships predominantly with those within the same age cohort (350). Thus with advancing age, it is inevitable that friendship networks reduce and that individuals find it more difficult to initiate new friendships and to belong to new networks. Yet in this study there was no significant relationship found between loneliness and increasing age, suggesting that the effect of increasing age may already be manifest by early old age. This is in contrast with the ELSA findings that people aged eighty years and older are the most vulnerable to loneliness (351).

While we categorise people according to their age in order to facilitate comparisons, Gilleep and Higgs make the point that ‘old age itself seems to have changed and in so doing, frustrates any attempt at chronologically defining its onset.’ (352). As age distributions of industrialized societies have changed, and population ageing heralds improved health for many older adults, the new ‘middle age’ increasingly overlaps with what was in previous decades considered as ‘old age’. There is substantial literature linking social involvement and health inequalities such as lower mortality (353) and reduced cognitive decline (354) in more socially active older adults. These observations highlight that understanding of the concepts of loneliness and social isolation, and their life long influence on mental health, is critical to the development of recommendations and actions that promote social inclusion and quality of life in the third and fourth ages (34).

7.2.3 Gender Differences in Loneliness and Depression in Older Adults
Severe depression was significantly more common in females (10.92% vs 6.38%, p<0.01) and moderate and high levels of loneliness were also more common among women in this study, although the difference was not significant. This is in line with results from ELSA that report more women than men feeling lonely, although the difference noted in the ELSA population lessened with age (351). Female gender has previously been highlighted as an important risk factor for depression among older people (234, 267). In light of these increased burdens it is encouraging that women have been shown to have positive attitudes concerning psychological openness and more favourable intentions to seek help from mental health professionals than men (355).

The increased loneliness among women may be influenced by women’s socialising patterns. Singh and Misra (356) found that men were more sociable compared to their female counterparts. This may have been due to the fact that all of the elderly men they studied were employed in government jobs before retirement and were more confident in socialising compared to the women
who were housewives. The TILDA population encompasses many women whose main employment was looking after the home. Women tend to take on the main caring role within families and relationships and evidence suggests that men benefit more from marriage (357). Not working outside of the home and the burden of responsibility for home care may influence the social interactions available to them.

Higher rates of widowhood among women (17.63% vs 7.67%) are also likely to have contributed to such differences. Such reduced opportunity for social interactions and the diminishing sense of social worth that may result is one pathway by which loneliness might contribute to the development of depression.

On the contrary, research has highlighted smaller numbers of men participating in interventions aimed at active ageing and participation (358), yet this does not seem to translate into greater loneliness among men.

### 7.2.4 Marital Status and Living Arrangements in Relation to Loneliness and Depression in Older Adults

The findings that loneliness was more common in those who lived alone and those who were unmarried, separated or widowed and those with poorer SRH are also in accordance with the existing literature in the area. Living alone, non-married status, low quality of social relationships, a lack of close family ties, reduced connections with their culture of origin or an inability to actively participate in the local community activities have all been suggested to contribute to loneliness (349, 359). It is also likely that these risk factors are mutually influential. Living alone or being unmarried may result in reduced opportunity for participation in community activities as a consequence of reduced practical support such as transport, or reduced information exchange.

Marital status has been identified as an independent vulnerability factor for loneliness among older adults (Victor, Scambler, Bowling, and Bond, 2005). It has been noted that marital status is highly variable for Irish birth cohorts born before the Second World War (115). This variability results from traditional patterns of inheritance of land in rural Ireland by which the eldest son in the family typically inherited the land and subsequently increased his marriage prospects, while other male siblings with poorer employment prospects often remained as bachelors. These factors produced rates of non-marriage in Ireland which differed for men and women. As noted by Kamiya, women were also more likely to complete their schooling and to emigrate than men (115). These patterns of marriage and emigration resulted in larger numbers of older unmarried men than women (10.78% vs 7.92%) in the TILDA cohort.
Kamiya also reported that these Irish marital patterns could be characterised by growing up in a rural area, having a father who was a farmer, and having only a primary education. However, this study did not find any significant differences in loneliness between urban and rural dwellers, and the percentage of respondents in the high loneliness category was third lowest for farmers compared to other socio-economic status groups.

Loneliness and depression were both more common among those who were not married, especially those who were separated or divorced, those living alone and among those who were sick or disabled. These results highlight as a group requiring particular attention those older Irish people who live alone and do not enjoy good health. Such individuals may easily become isolated from the community due to reduced mobility and low confidence in going out alone. Older people with fewer family connections are more reliant on community initiatives and charities such as Alone for companionship and social interaction, yet may be reluctant to engage with such groups due to lack of knowledge of their existence, feelings of shyness or pride.

Depression was highest among those who were separated or divorced, followed by those who were widowed, and those who were never married. Lack or loss of close social contacts is a known risk factor for depression (234), and is likely to result from marriage breakdown or death of a spouse. There were significant differences in depression across co-habitation groups, with those living alone reporting greater levels of moderate and severe depression that those living with others. Living alone is an uncertain risk factor for depression (267) and there are various points of view regarding the benefits of living with others. A study of living alone and mental health conducted in the United States in the 1980’s reported that unmarried persons who live alone have comparable mental health to unmarried persons who live with others, and makes the point that while socially integrated relationships provide direct social rewards through reinforcement and increased meaning in life, they also incur social constraint, obligation, and responsibility, which may in turn contribute to psychological distress (90). However, the independent influence of living alone on depression, even after accounting for support from and interaction with friends, undesirable life events, disability, and financial strain has been shown (360), although it varies across ethnic groups (361), and is compounded by feelings of loneliness (362). Interestingly, it has also been noted that a country’s culture may also influence the experience of loneliness as illustrated by the Eurobarometer study findings that loneliness is more frequent in the traditionally family-oriented cultures of southern Europe than in the more individualistic cultures of northern Europe (41), suggesting that variation in how at ease people feel with solitude may influence their perceptions of loneliness. Ireland’s
traditionally strong family and community values may contribute to the overall low levels of loneliness experienced by older adults in Ireland.

Living alone is not the only living arrangement considered a risk factor for poor mental health. A recent study on the role of living arrangements in psychological distress among older adults reported that those living alone or with others fare worse than those living with a spouse only (363). This suggests that the quality of the relationship between cohabitants is an important factor, and underlines the role of marital status in depression.

7.2.5 Socioeconomic Status and Education in Relation to Loneliness and Depression in Older Adults

Research suggests risk of loneliness is also influenced by factors such as social class, social group membership, income, educational level, and employment via their effect on shaping lifestyles (359, 364). SES and education were significantly associated with loneliness in the current study. This is in line with the socio-economic gradient in loneliness reported from ELSA (351). Singh and Misra suggest that those with more physical, material and intellectual resources also have more social “capital,” which allows them to continue to seek out new relationships and forms of social involvement (349).

An association between greater levels of education and lower levels of loneliness in TILDA respondents has been reported by Kamiya, however they note that it is largely accounted for by marital status and later life events (115).

Depression levels in the current study also varied significantly across education and SES. There were a greater proportion of respondents with moderate depression and with severe depression in the primary only education group compared with those who had secondary or tertiary education. Levels of depression were highest among the disabled and sick and those in education. Similar inverse associations between higher levels of socioeconomic factors and depressive symptoms have been reported in many countries (281, 282).

Education and SES are closely linked and educational attainment is often used as a measure of SES. As discussed above higher educational attainment was associated with lower levels of depression, however it is notable that rates of severe depression were highest amongst those categorised as ‘in education’ within the TILDA SES. This group may represent a subset of the population who have returned to education in later life in order to improve their employment prospects, having been unable to secure employment without additional training. The younger old category of respondents had not yet reached retirement age, and of the 36 respondents categorised as in education, 35 were
in the younger old category. Being unable to find employment without further training may contribute to the higher depression rates noted in this group.

As previously discussed, presence of depression or loneliness influences multiple aspects of health and wellbeing in older age, and limits attainment of successful ageing. In order to prevent and treat depression and loneliness optimally we need to understand their causes. The many shared risk factors for loneliness and depression speak to their similarly multifaceted aetiology. The sense of worth and purpose borne of fulfilling roles such as spouse, and the material and opportunity benefits bestowed by higher education and SES influence both the available quality and quantity of relationships, and the sense of personal value and contentment that depression undermines. The culmination of these shared socio-demographic patterns, and closely intertwined constructs is the mutual influence seen between loneliness and depression across waves 1 and 2 in this study.

7.3 Changes Over Time

7.3.1 Changes in Loneliness
The results of the current study demonstrate that the experience of loneliness can change over time. For a small proportion of the population, the subjective experience of feeling lonely can be chronic, and for others it is a transient or fleeting experience (365). Mean ULS score at wave 2 was significantly lower than at wave 1. This suggests either a transient experience of loneliness, perhaps related to specific external circumstances or life events (365) which had changed, alleviating the loneliness before wave 2 data collection, or perhaps that those experiencing loneliness at wave 1 had developed coping skills so that their perceptions of loneliness became less acute over time. Of those who were not lonely at wave 1, most remained not lonely at wave 2, but one in ten of them experienced moderate loneliness at wave 2, and a small number went on to experience severe loneliness by wave 2.

These changes in loneliness were not uniform across the study population. Differences in mean change scores for loneliness showed that men became less lonely while women actually experienced greater loneliness at wave 2. Additionally, urban dwellers became lonelier while those living in rural areas were less lonely, although this was accounted for by other variables and did not remain significant in regression analyses.

Increasing age and the possible loss of friends and family during the intervening period may have contributed to these increases in loneliness. However, as data on marital status was unavailable for wave 2 it was not possible to examine the effect of becoming widowed or separated on respondents’ loneliness. Considering the disparity in life expectancy between men and women it is
possible that becoming widowed was a factor in the increase in loneliness noted among women. While it may seem more likely that loneliness would be a problem for those living in more sparsely populated rural areas, the presence of multiple neighbours does not guarantee quality social relationships, and these results suggest that combination of sociodemographic factors, social relationships and depression found in urban areas are more likely to result in loneliness.

Accepting losses and finding new meaning in ageing can help older people to maintain a sense of worth despite altered physical capabilities and reduced social networks. If, instead of this acceptance, individuals experience a sense of conflict against the ageing process, they may feel despondent and consider ageing solely as a time of loss. Despite findings that the older old report more health-related problems, yet tend to be more positive in rating their own health (366), not all older old are able to cope well with the losses and change associated with ageing. The function of loneliness in motivating individuals to seek company has been likened to that of physical pain protecting from physical dangers (367). For those with sufficient resources of self-awareness and self-efficacy, feelings of social isolation and loneliness may motivate attempts to build new connections following bereavement or a move of location away from friends (49), or to re-assess their life priorities and find new meaning in other areas. However, for many older people such coping skills are lacking.

Acknowledging the role of both self- and social awareness in accessing the benefits of social relationships raises the issue of older adults’ expectations of their experience of old age. If diminishing networks and feelings of loneliness are normalised, or rationalised by older adults as an inevitable result of advancing years, they may be less likely to seek out new relationships or apply the selection, optimisation and compensation process of adaptation described by Baltes (87) (Page 1). In this context, self-awareness and awareness of one’s social relationships could be considered as pre-requisites for successful implementation of the selection, optimization, and compensation processes of adaptation. Although reducing the number of activities or goals on which to focus available resources may be achieved either actively or passively, without self-awareness and purposeful selection of attainable goals this reduction may contribute to a sense of disempowerment and ‘no longer being able’ rather than the adaptation described in Baltes’ theory.

Public health campaigns promote the importance of social support for older adults, but often focus on mobilising the groups of society who are well placed to offer support – neighbours, family and healthcare professionals. Reluctance among older adults to admit to inadequate networks and loneliness or to ask for help represents a barrier to wellbeing that is not routinely addressed. Campaigns that directly involve and empower older adults to sustain community involvement and
explore alternative approaches to cultivating new social involvement may represent an avenue not wholly optimised heretofore.

The adjustment process following loss is similarly dynamic. While some respondents remained in the ‘severely lonely’ category across both waves, over half experienced improvements in feelings of loneliness between waves, moving from the severely lonely category at wave 1 to the not lonely or moderately lonely category at wave 2. This is heartening considering that loneliness often breeds loneliness. Pre-existing perceptions of social isolation, or loneliness can cause an individual to become hypervigilant for social threat (49), resulting in a cycle of loneliness, feelings of isolation or rejection and consequent defensive social behaviours that reduce social contact and lead to loneliness becoming more pronounced. Improvements in loneliness may be explained by wave 1 loneliness resulting from acute events which had passed by wave 2, or by respondents adjusting or developing coping skills over time following the loss of loved ones.

7.3.2 Changes in Depression

Among those who had completed both waves 1 and 2 mean CES-D score at wave 2 was significantly lower than at wave 1. In contrast with loneliness, depression decreased in both men and women across waves, however, not all respondents experienced an improvement in their mental health. Of those experiencing mild or no depression at wave 1, most remained in the same category at wave 2, but one in ten had moved to the moderate depression category and 2.61% were experiencing severe depression by wave 2. Those who experienced a decline in their mental health were more likely to have lived alone at wave 1, and those who were married at wave 1, were younger and were male were less likely to develop depression, patterns that are in line with known associations with depression (276).

A similar urban-rural difference to that seen in loneliness was noted for depression, with those living in rural areas experiencing a greater mean reduction in depression compared to urban dwellers. Location of residence remained significant when other factors were adjusted for. It has been suggested that social capital is more common among families in rural communities than in urban communities and that this might reflect different availability of support services (368). Higher levels of networks, civic participation and cohesion have also been reported in rural areas and have been associated with better mental health among rural dwellers (369). Stronger traditional values relating to community and family provision of care and companionship in rural areas, and greater changes in these values occurring over recent decades in urban areas than rural due to modernisation, may account for the urban-rural difference noted in change in loneliness and depression in the current study. Geographic place is an important component in developing a sense of meaning and identity.
and not only in rural areas, but also in urban neighbourhoods (107). It is possible that the modernisation and inward migration of new population groups that many urban areas have seen in recent decades has eroded some of the sense of community and belonging that is to do with familiarity of surroundings and neighbours.

7.4 Subjective and Objective Measures of Social Relationships.

As hypothesised, subjective and objective aspects of social relationships were found to be correlated. However, the subjective measure of loneliness was more strongly associated with depression than measures of objective components such as social network connectedness or participation. Loneliness accounted for markedly more of depression scores than other social relationship variables assessed. This underlines once more the fundamental difference between the subjective experience of loneliness and the objective assessment of social network connectedness or participation.

This study hypothesised that subjective social relationship variables would be inter-related, and that objective social relationship variables would also be inter-related. Furthermore, it was hypothesised that either of these inter-relations would be stronger than relationships between subjective and objective social relationship variables. This was not found to be the case. In fact, the correlation between many of the social relationship measures, although statistically significant, was very weak. Correlation values for participation were less than 0.2 with loneliness and social network connectedness, and under 0.1 for both support and strain. Such weak correlations with all other social relationship measures in this study raise the question of how valuable such a measure actually is. If, as these results suggest, an individual’s participation in quantifiable activities tells us very little about their levels of loneliness we can conclude that objective measures such as participation do not assess the extent to which an individual experiences all facets of social relationships, or their full benefits.

There appears to be a preoccupation in research with measuring constructs, whether to create rankings, or to compare influences and effects. This fixation upon measurement runs the risk of missing what is at the heart of the issue at hand. By counting the number of contacts someone has, we cannot capture the essence of social relationships. The role of perception of quality and adequacy is key. To gain a holistic understanding of social relationships we need to reach much further than quantitative measures of group participation or face-to-face contact, and endeavour to appreciate the individual’s qualitative assessment of their relationships.
In assessing the associations of subjective and objective social relationship measures with depression, similarly low correlations were found between depression and measures of participation, social network connectedness (SNI) and relationship quality. Loneliness was the only social relationship measure to have a strong significant correlation with depression. This suggests that measures which do not assess the perceived adequacy of relationships potentially miss out on an essential component of how and why inadequate social relationship status increases the risk of poor mental health.

In assessing the impact of social relationship measures on depression and of depression on loneliness RRRs were reported. RRR is the ratio of the probability of an event occurring (for example, depression or loneliness) in an exposed group to the probability of the event occurring in a comparison, non-exposed group. Loneliness and the relationship quality measures of strain and support were found to be more important indicators of depression risk than objective measures. Loneliness incurred strikingly large increases in risk of severe depression. It has been suggested that the quality of family relationships is as important for mental health as their mere presence or absence (370). The quality of relationships is also an important component of loneliness as feeling lonely can be prevented by the presence of even one high quality relationship, just as such feelings may remain amid a crowd where there are no quality relationships. The importance of this quality aspect is illustrated by the findings from ELSA that having children but not feeling close to any of them is associated with higher rates of loneliness than being childless (351).

These results highlight the importance of addressing subjective experiences of older people as important influences on mental health. Quality of social relationships is important, as even those who participate in activities or have regular interaction with others may feel the pang of loneliness if these interactions are not as they desire. The potential discord between objective and subjective measures is apparent in the weak correlations between the individual measures. Although statistically significant, the strength of the correlations between social network connectedness or participation and loneliness scores were relatively weak considering that such measures are often discussed concurrently or even interchangeably.

The findings that subjective measures were more important in relation to depression than objective measures are in keeping with Alpass and Neville’s study on loneliness, health and depression in older men (112). They reported that social support variables were unrelated to depression, yet loneliness had a significant relationship to depression. Another reason for the weak association between the objective measure of participation and depression is the breadth of types of participation available and the potential for them to have opposing effects on mental health. A study of social participation
and depression in old age reported that participation in religious organisations predicted reduced depressive symptoms 4 years later, while participation in political or community organisations was associated with increased depressive symptoms (303). This underlines the importance of the perceived quality of the interaction and the subjective worth of the experience.

Perceptions of health, measured as SRH, are strong indicators of wellbeing, and have been shown to predict mortality (371). Parallels can be drawn between the importance and influence of individuals’ subjective opinions and perceptions of their health circumstances, and those of their social circumstances. Perceptions are developed over time and while they are not easily or quickly altered, neither are they immutable. Identifying subjective perceptions of social relationships as the key to their influence on health suggests that interventions to manage and improve perceptions of existing social relationships may yield benefit, even in the absence of increased social contacts.

Loneliness was far more important in accounting for variance in depression than social network connectedness, participation, support and strain in this study. While social network connectedness is considered necessary for wellbeing (372), if non-participation is the choice of the individual it is less likely to incur feelings of being left out, or isolated. Choice, in this context, can be referred to as voluntariness, whether one chooses to enter a relationship. The degree of voluntariness within a relationship may also influence how beneficial it is. Friendships are voluntary, and are considered the least permanent type of relationship, existing purely for companionship, they can be ceased when the relationship ceases to be emotionally rewarding. Family ties such as parents, siblings, and children on the other hand, are involuntary and are based on a powerful sense of obligation (373), yet may not always be emotionally rewarding. The impacts, both positive and negative, of particular family ties on mental health are cumulative over the life course (370). Considering the various degrees of strain and support relationships may provide, and how such subjective networks may be experienced throughout a lifetime, it is understandable that subjective measures have a greater influence on mental health than simple quantitative measures of participation or objective interactions.

It is possible to be alone but not lonely, or indeed, as noted in ELSA, be among the most lonely yet the least isolated (374). The distinct subjective and objective aspects of social relationships may also interact such that an individual’s personal circumstances, environmental factors and life events are experienced in the context of their individual psychological response and personality. The Campaign to End Loneliness highlighted intrinsic and extrinsic factors that can combine to impact on individuals’ lives and decision making capacity. They describe the inter-relationship between the objective condition of social isolation and the subjective experience of loneliness as a fused ‘psycho-
social’ phenomenon, suggesting that despite their independence both views should be considered when assessing the influences on wellbeing in older age. This view raises the potential problem of focusing on specific types of measurement to assess social relationships – if both subjective and objective experiences influence each other, then neither can be adequately assessed in the absence of the other.

As noted above, loneliness may remain amid company where quality relationships are lacking. Yet, despite such a seemingly fundamental link between loneliness and relationship quality, even the associations between these measures were not as strong as might be expected in the present research. This suggests that along with the important differences between the objectively measured social contacts and the individual experience of such interactions, the range of subjective measures available are also incongruent with each other.

This raises another more pragmatic question about the measurement approach taken to assessing and addressing social relationships and their influence. If objective measures such as participation in quantifiable activities, or even subjective relationship quality, are unable to provide us with a meaningful portrayal of the essence of what it is to feel connected, supported, or part of a community, if they cannot fully capture the aspects of social relationships that actually matter to the individual, then perhaps such a measurement driven approach is futile in advancing the goal of successful ageing and wellbeing. The array of measures available and the range of social relationship definitions that abound all bear testament to the difficulties researchers have encountered in reaching consensus on how to capture the individual’s experience of the multiple and mutually influential facets of social relationships.

Social relationships of older adults influence their physical and mental health via mechanisms involving both psychological benefits and practical aspects, direct and indirect-effects. To understand the roles of the various social relationships described, and their influence, research attempts to quantify them. The challenge encountered is that the constructs being assessed and measured do not lend themselves to clear definition or easy measurement, and the combination of multiple aspects of relationships frequently work together to create an effect that is more than the simple sum of their parts. The influence of social relationships also has the potential to be conflicting. Negative influences may be seen if the prevailing norms among an individual’s network do not promote health, yet the psychological benefits of having a network may remain.

The buffering model described by Cohen (83) describes how relationships can make it easier for individuals to ‘weather the storm’ of stressful events such as financial problems or conflicts. Such
indirect effects are not easily captured in a questionnaire, nor are they easy for an individual to describe. The roles that individuals play afford gratification and are in general a positive influence (84). Yet, roles such as parent or friend may be such an integral part of the fabric of everyday life that their influence remains ‘hidden in plain sight’ and they are not readily identified as the source of wellbeing. It is only when such roles or relationships are lacking that their loss is felt. The sense of non-specific support, comradery and familiarity that arises from having an adequate network of sufficient quality relationships, throughout good times and bad, is arguably as difficult to assess and quantify as it is important.

The regulatory function of integration (38) confers both demands and rewards on the members of societies. There is an obligation to conform to the social norms that regulate daily interactions but also the sense of safety and familiarity that comes from ‘knowing the rules’ and having a sense of one’s place in society. Once again these benefits may not be recognized when they are present, only when social disruption results in uncertainty and anxiety are the benefits of normal social interaction missed.

Despite the large longitudinal data set and multiple measures employed in this research, relatively little variance in loneliness and depression is explained by the analyses undertaken. Other variables not explored in this thesis may potentially explain more variance in the experience of later life depression and loneliness, and warrant further attention. These include biological, psychological and social influences, spanning a broad time frame from before birth through an individual’s early years (375). The experiences in an individual’s early life continue to shape their perceptions and interactions throughout life, and children exposed to adverse psychosocial experiences have been shown to be at elevated risk of depression later in life (376). Given the common risk factors between depression and loneliness, adverse events such as bereavement or mistreatment in younger years should also be explored in the context of later life loneliness. In addition to the events of formative years, genetic predisposition or heredity factors may contribute to the experience of loneliness or depression in later life (375).

Further qualitative research exploring social relationships might better capture older adults’ experiences and insights into how their interactions with others, and perceptions of these interactions, influence their wellbeing. By inviting older adults to share their experiences in their own words we might avoid the pitfalls of using questionnaires purporting to measure discrete aspects of social relationships, and gain a more meaningful understanding of how a range of social relationships interact to influence mental and physical health. In addition to qualitatively exploring
individuals’ understanding of social relationships, further waves of data may shed more light on the complex interactions between the social relationship measures employed in the TILDA.

7.5 BMI
TILDA highlights the combined impact of the obesity crisis and a rapidly ageing population on health and health service demand. The majority of the study population (77.4%) was either overweight or obese, and more men than women were above a healthy weight. Given the established association between excess adiposity and chronic diseases such as Type 2 diabetes and CHD, common among older populations, these high levels of unhealthy BMI are cause for concern.

7.5.1 Comparing TILDA with SLÁN 2007 & ELSA
The prevalence of obesity among the population of the current study was 34.33%, much greater than the reported prevalence range of 15% to 20% among older people in industrialized countries (162). In the Irish context, the SLÁN population for whom BMI was measured was a sub-sample of 1,207 participants aged 45 years and above (158). While the sample is not directly comparable to the TILDA population, there are minimal differences between the BMI of females in the TILDA and SLÁN populations: 39.9% of females were overweight and 31.35 obese in TILDA compared to 39% overweight and 32% obese in SLÁN. More of the male respondents in TILDA were classified as obese than in the SLÁN population with 46.7% overweight and 37.9% obese in TILDA and 49% overweight and 31% obese in SLÁN. The mean BMI of the study population was marginally higher among men (29.00 kg/m² vs 27.8 kg/m²) and very similar among women (28.08 vs 28.0 kg/m²) when compared to the ELSA population (377).

While there are some disadvantages to using a measure that does not consider individual variations in weight distribution or body composition, for a large scale study such as this, BMI provides a useful marker of adiposity at a population level. BMI is a measure of weight for height, and assumes that most of the variation in weight among individuals of the same height is caused by fat mass. It is a reflection of both body fat and lean mass, but does not differentiate between the two. It has been suggested that the BMI thresholds for overweight and obese are overly restrictive for older people (156), and that slightly increased BMI is actually protective against early mortality. However, there are no agreed increased thresholds, and it has been shown that the absolute mortality risk associated with increased BMI increases with age, up to the age of 75 (152). It is widely accepted that a BMI in the obese range remains detrimental to health among older adults as it can exacerbate the age-related decline in physical function (378). Even considering a potential benefit from a slightly raised BMI, the high prevalence of obesity in this study, a significantly raised BMI of 30 kg/m² or above, remains concerning.
7.5.3 BMI and Sociodemographics

Despite the lack of any association between BMI and loneliness or depression as hypothesised in this study, the levels of overweight and obesity warrant attention. Much of the effort directed at reducing the burden of overweight and obesity in Ireland is directed at childhood obesity, and subsequent overweight and obesity in early and middle adulthood. The high prevalence of overweight and obesity in this older adult population suggests that older adults should also be included in the target audience for these public health campaigns. The socio-demographic patterns of obesity in this age group may help to inform the development of age group appropriate weight management messaging for this sector of the population.

The current study found that both overweight and obesity were significantly more common in men than in women. This is in contrast with data from the Longitudinal Study of Aging and the Assets and Health Dynamics of the Oldest Old Survey (AHEAD) from the United States, which reported that older women were less likely than older men to be overweight but more likely to be obese. The greater numbers of men in the overweight and obese categories may reflect the greater societal pressures felt by women to conform to a slim aesthetic.

In the current study overweight was most common in those who were separated or divorced, while obesity was most common among married people. While marital status was found to be unrelated to body size in the AHEAD study, Kaplan et al. reported being married as a risk factor for overweight and being unmarried as a risk factor for obesity (162). There do not appear to be any consistent patterns within marital status across these large-scale studies.

The findings of the current study were in line with the AHEAD study regarding the negative association between education and obesity (379). An inverse association between educational attainment and obesity has been described across many countries (149, 380, 381). This pattern was seen in the current study among obese respondents, where higher levels of obesity were noted among those in the lowest education category, but the pattern was not discernible among overweight respondents. Education and SES are closely linked. In the current study, obesity levels were highest among those who were in education, disabled or sick, and unemployed. A negative association such that lower SES is associated with higher BMI has been described in highly developed countries (168) and lifestyle choices associated with overweight and obesity have been associated with individuals from lower SES groups (382). The high levels of obesity found in this study among those who were disabled and sick, and the unemployed, highlight an additional health risk faced by an already vulnerable population.
BMI and Loneliness and Depression

BMI category was not found to be associated with loneliness score or with frequency of loneliness. While there were significant differences in BMI category across depression categories, there was no significant correlation between depression score and BMI and, after adjusting for the other variables, BMI was no longer a significant contributor to depression. This suggests that the relationship seen between BMI and depression categories in univariate analyses was due to other factors. It has been indicated that obesity is associated with depression mainly among persons with severe obesity (BMI>40kg/m²) (206). In the current study data on BMI above 40kg/m² was amalgamated for anonymity purposes, but only 8.04 % of respondents were in this class 3 severe obesity range, reducing the likelihood of seeing such an effect.

Depression and obesity both adversely influence the outcome of comorbid health disorders and frequently co-occur. The relationship between BMI and depression has been examined in older people in other studies, yet remains unclear. A prospective study examining the relationship between BMI and depressive symptoms in a biracial sample of community-dwelling older American adults reported that increased BMI predicted depressive symptoms three years later (383). Yet, another study of Korean older adults reported that underweight older adults had a higher depressive symptom score than those of normal weight and that older adults with higher levels of depressive symptoms were more likely to be underweight and less likely to be overweight than normal weight (384). It has been documented that 30% to 36% of weight loss seen in outpatients and nursing homes is due to depression (385). Such depression-related weight loss is likely to have the effect of obfuscating the relationship between depression and obesity.

Potential Influence of Earlier Life BMI and Loneliness

A positive relationship between depression and BMI was reported from the American Behavioural Risk Factor Surveillance Survey data. Depressive symptoms were significantly more likely among young overweight and obese women and young overweight men, compared to non-overweight/non-obese young people. However, these associations were not seen in old respondents (208), suggesting that age of onset of obesity may play a role, or that being overweight or obese has different impact depending on the stage of the lifespan. TILDA assessed BMI at the time of data collection; there is no data available on respondents’ BMI earlier in life, precluding further exploration of its influence. It is possible that time of onset of obesity plays a role in its influence on mental health, and that a relationship between earlier life BMI and later life mental health might be discernible in those who have a long history of obesity.
Similar to the potential influence of earlier life BMI on later life mental health, the onset of loneliness and its duration are likely to influence the extent to which loneliness affects health and lifestyle behaviours, with chronic loneliness more associated with maladaptive eating behaviours. There is a relationship between loneliness and eating disorders across the entire weight spectrum, from anorexia nervosa to binge eating and obesity. Emotions, including feeling depressed or lonely are predominant binge eating triggers. When eating takes on a role of ‘self-soothing’, as in the case of comfort eating, food is endowed with an emotional quality and is used to numb feelings, including that of loneliness, providing a sense of comfort that takes the place of human connections (367). The development of such maladaptive coping strategies takes time and is therefore less likely to be associated with acute or transient experiences of loneliness.

It has also been shown that people who grow up in warm and safe environments during their formative years are more likely to enjoy mental well-being even at a very old age (125), highlighting the relevance of a total life course view of the aetiology of loneliness. The loneliness borne of social networks diminishing as a result of ageing is less likely to trigger emotional eating than chronic loneliness experienced throughout life-stages (367). This may explain the lack of association noted in this study between loneliness and BMI, and advocates for further exploration of earlier and mid-life experiences of loneliness, and their role in the development of overweight and obesity.

7.5.6 A Protective Effect of Raised BMI
The current study suggests that having a BMI in the obese range reduces the risk of having depression (RRR 0.73) compared to those with a BMI in the normal range. Similar findings were reported from ELSA in a publication examining the associations between BMI and waist circumference (WC), and QoL and depressive symptoms in older men and women. The authors reported that for a given WC, increased BMI was related to reduced odds (RRR 0.92) of women having depressive symptoms. The relationship was not significant for men. However, in contrast to BMI, increased WC was found to significantly increase odds of depressive symptoms among women (RRR 1.08), again not significant in men (377).

Their findings that central fat distribution is associated with higher depressive symptoms among women, but that an opposing relationship exists for BMI, are surprising. The authors suggest that the association between higher waist circumference and poorer physical functioning in this age group (386), which is independent of BMI, may explain the opposing effects of WC and BMI, as functional limitation is a known determinant of mental health (234, 387). Furthermore, they propose that the protective effects of BMI (for a given WC) on both QoL and depression can be explained by body shape, rather than weight for height. This would occur if increased BMI in women was due to greater
muscle rather than fat mass, which might in turn represent greater physical activity or reduced sarcopenia of ageing. It might additionally occur in women with pear-shape (peripheral obesity) rather than apple-shape (central obesity) fat distribution, which in turn may incur reduced health risk and less body dissatisfaction (377). A difference in relationships between anthropometry and depression across genders such as was reported by Zaninotto et al. was not seen in the current study (362).

Research suggests that BMI cut-off levels for reducing health risk in older adults should be higher than those for the general population. Much of the literature advocating for higher ‘healthy’ weight range in older people focuses on physical measures such as functional status (184) or mortality outcomes (171, 388), suggesting that older people with a BMI within the normal weight range may have higher mortality than those who are overweight (156). This has been termed “the obesity paradox’ and advocates for an upward shift of the cut-off points at which increased risk is incurred by excess weight for older people, reflecting the increase in risk of mortality discernible at extreme BMI values over 35 to 40 kg/m2 (157). The findings of this study suggest that increased weight may also have beneficial effects for mental health in this age group.

However, while there may be benefits for aspects of both physical and mental health for older people in having a BMI slightly above the current definition of ‘healthy’, evidence suggests that the effect of a BMI in the obese range on health and morbidity amongst older people is detrimental (152, 172). In consideration of these two pools of evidence, treatment recommended for moderately obese older adults focuses on maintaining body weight and improving physical fitness and function rather than weight loss (389).

Additionally, compared to historic cohorts, onset of overweight and obesity in developed nations has been noted at younger ages in recent decades (390). By virtue of their age, those included in TILDA who are overweight or obese into old age are survivors. The manifest effects of overweight or obesity on morbidity and mortality might not be observed among this population of older adults due to earlier mortality among susceptible individuals. A study on the impact of obesity on USA mortality levels which highlighted the importance of age and cohort factors in population estimates indicated that the effect of high BMI on mortality risk grows significantly stronger with increasing age (390). Successive waves of data in cohorts with onset of weight gain at young ages will give better estimates of risks in different weight categories as relevant to current populations.
7.6 Implications

Successful ageing can be described as avoidance of disease, maintenance of physical and mental faculties and sustained engagement in social and productive activities (391). The links between depression and loneliness, and their position as risk factors for other conditions, place them at the heart of this concept. Policies aimed at achieving the goal of ‘successful’ ageing include alleviation of loneliness in their list of desired outcomes, acknowledging the importance of social relationships as a core influence on an individual’s ability to thrive in later years.

This study found that loneliness and depression were highly associated, and that they exhibit a longitudinal relationship such that a higher level of either increases the risk of the other occurring in the future. Understanding this bidirectional relationship allows for the development of informed interventions that address both the psychological distress of perceived isolation and the isolating effect of depressed mood. Breaking the cycle of loneliness and depression requires a multi-faceted approach to address the reduced motivation that results from depression and the low self-efficacy and confidence in social situations that loneliness can generate. In later life older people often confront more frequent experiences of loss and grief and have to cope with the loss of loved ones and changing patterns of social relationships. Interventions targeting loneliness therefore need to reinforce and develop underlying adaptive strategies to deal with the changes experienced during this life stage, in addition to addressing the more objective aspects of social isolation.

In light of the close associations shown between loneliness and depression, the detection, assessment and treatment of either condition takes on increased significance for the other. In the context of such closely connected aspects of mental health, the attitudes towards mental health in general among older adults are of concern. A decline in mental health may be perceived as a “normal” consequence of ageing (377). This is cause for concern as such perceptions may discourage older people who are experiencing mental health difficulties, across the areas of depression and loneliness, from seeking assistance. Accessibility, health care utilization, treatment adherence and self-management are all important pillars of chronic disease management, and are all likely to be significantly impacted by an individual’s mental health and support networks. Positioning mental health, including social inclusion and prevention of loneliness, as a central target for older people’s health care has the potential to improve outcomes concurrently across multiple physical health areas.

Much of the focus on healthcare for older adults is on physical health as chronic disease and multiple physical conditions become more common in old age. However, it is important to consider what older people value in this time of their lives and to tailor the focus of their care appropriately. It has
been suggested 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 (392). In this context, the value and importance of mental and social wellbeing in older age should not be underestimated. Acknowledging the challenges in adequately assessing or measuring social relationships in their multiple forms, in the pursuit of successful ageing, it remains essential to provide truly holistic care, where the impact of social and mental health are acknowledged and addressed on equal standing with that of physical health.

7.6.1 Interventions
Loneliness is increasingly being recognised as a real and genuine problem that has significant impact on mental and physical health, but addressing this problem remains a complex issue. Translating the growing body of evidence into available community interventions is a challenge that should be addressed in the planning of future health service provision. Interventions may aim to prevent the advent of loneliness via early intervention with high-risk groups and community educational awareness campaigns, to alleviate loneliness by facilitating social bonding, or to prevent loneliness from evolving into other serious problems by enhancing coping (41).

The results of this study suggest that, compared to the objective measures of participation or social network connectedness, the subjective dimension including loneliness and relationship quality is more influential in relation to mental health. Yet, in terms of public health policy, subjective meaningfulness of community participation is not easily captured by empirical indicators, and objective goals are more easily measured and targeted. The NCAOP has advocated for the knowledge of specific risk factors for social isolation and loneliness to be utilised in routine screening. This call for action is furthered by the Campaign to End Loneliness, a UK based advocacy group aiming to reduce loneliness in older age by creating the right policy and funding conditions for groups and individuals working to tackle the issue. They recommend that organisations find creative solutions to identifying the people most likely to benefit from their support by using screening tools to assess known risk factors, linking statutory and voluntary organisations (390). It has also been acknowledged that different groups of people deal with loneliness in different ways, for example by resigning themselves to it or by attempting to change it (42). With this in mind, an additional consideration for organisations such as the NCAOP is how best to reach out to and connect with lonely individuals who do not actively seek to change their situation. Although strategies, initiatives and policy documents have been developed focused on addressing loneliness and social isolation, especially in the U.K., the majority of this work has been focused largely in urban areas with the needs, expectations and attitudes of older people living in rural areas less well attended to (393).
Adoption of protective lifestyle behaviours such as being physically active, a non-smoker, a moderate alcohol consumer and having adequate fruit and vegetable intake has been shown to improve mental health in addition to physical health risk factors such as overweight (394). Yet there continues to be a greater focus on physical health outcomes across national health promotion campaigns. Many of the care considerations for older adults in the community focus on the provision of practical assistance. While home help programmes can be very beneficial in terms of practical day-to-day needs, the social contact they provide is usually limited to functional visits and may not provide for the companionship needs of the older person. The NCAOP report noted much lower levels of social and emotional loneliness among those older people who have regular verbal interactions with relatives, friends and neighbours, advocating a meaningful social network and social interaction as strong supports against loneliness and social isolation (395). Fostering meaningful relationships takes time, and the experiences of loss encountered in older years can rapidly eliminate important relationships that took years to build.

The health benefits of being socially connected depend to a degree on open, comfortable and trusting communication, including the open discussion of health-related concerns with members of one’s social network. This is more likely to occur within the context of a high quality supportive relationship. When health is discussed openly, confidants may be better able to identify and deliver the kind of support, care, and other resources a person needs. In the NSHAP study Cornwall et al. noted that older adults are in general very open to discussing health matters with people in their networks (2). The implementation of patient centred, communication focused practice across disciplines may allow functional relationships with healthcare professionals to be elevated to more meaningful interactions in which older adults can share their concerns.

Where loneliness is present, helping the lonely to better cope with their experiences may reduce the likelihood of loneliness contributing to depression. Interventions have been developed to target coping strategies, via behavioural training and feedback, to improve social skills and capacities for establishing links with others, enhance social support, increase opportunities for social contact, and address maladaptive social cognition by influencing expectations about personal efficacy (41, 42, 396-398). There is great scope in Ireland for the expansion of such targeted approaches to sustaining and improving mental health among older adults.

The interplay between intrinsic and extrinsic pathways should be utilised to identify approaches that can improve subjective experiences of social interactions through objectively designed interventions. Research using the ELSA data reported that while both social isolation and loneliness were associated with increased mortality, the association between social isolation and mortality was
unchanged when loneliness was accounted for. The authors concluded that efforts to reduce isolation are likely to be more relevant to mortality (399). Yet from the results of this study we can see that subjective feelings of loneliness are likely to play a greater role in reducing morbidity in older age, and so need to be addressed in order to ensure quality as well as quantity of years.

As noted above, identification of at-risk groups is an essential step in the targeted delivery of preventative interventions. Many older people in Ireland fall into groups at risk of both loneliness and depression, namely those who live alone and do not enjoy good health. Yet, it is not routine to opportunistically screen for depression or loneliness during health care encounters. Depression is more likely to be missed in the elderly and retired patients and is both under-diagnosed and under-treated in primary care settings (400, 401). This may be as a result of healthcare providers feeling ill equipped to deal with these problems where they are discovered.

When asking individuals about their experiences of loneliness it is necessary to consider the effects of stigma associated with loneliness. The implications of asking about loneliness directly may be that respondents minimise the loneliness they report, or deny it altogether. In fact, stigma is associated with all three of the main issues addressed in this thesis – loneliness, depression and obesity, and constitutes an important link between them. The experience of stigma related to either mental health issues, or loneliness itself, can negatively impact social relations and lead to further feelings of loneliness and depression (402). Loneliness stigmatisation can in a sense become a self-fulfilling prophecy, as those who are lonely are perceived more negatively in relation to psychological attributes and interpersonal attraction (403). Stigma in obesity can similarly contribute to an unhealthy cycle of comfort eating (404).

Stigmatisation is an unpleasant additional effect of any of these undesirable conditions, and represents a source of chronic stress and a major barrier to recovery for people with mental illnesses (402). The effects of stigma are an important pathway by which loneliness and depression are inter-related. It has been demonstrated that loneliness mediates the detrimental effect of stigma on depression (402). In light of this, bringing the discussion of both loneliness and depression to the fore is an important component in the treatment and prevention of both conditions. The issue of stigma takes on additional public health relevance when its impact on treatment seeking is considered. Both patient initiated conversations and healthcare professional led screening and treatment would be supported if the conversation around mental and social health can be moved to centre stage. Being assured of an open and non-judgemental forum in which to discuss their concerns might encourage patients to seek assistance.
Raising awareness of the links between loneliness and depression, and their combined effect on health, and concurrently providing information on suggested pathways of care may help to mobilise healthcare providers to address this area. Appropriate pathways of care might be better elucidated if existing projects and organisations addressing loneliness and depression among older people are enlisted to liaise and coordinate with primary healthcare providers. Where resources such as social groups or home visits are available via independent organisations, timely referral from healthcare personnel might support older people to access them. Where such resources are not yet in place, the experience of organisations such as Aware and Alone in tackling depression and loneliness is valuable in developing targeted and evidence based initiatives. One of Alone’s key campaigning issues seeks new structures to coordinate services for older people across housing, health and social supports. Such structures should ideally be embedded in national policy in order to facilitate synchronized approaches to holistic care for older people in the community.

The results of this study signpost policy-makers and those involved in the care of older adults to specifically address subjective assessment of social relationships. Involvement of older adults themselves in the development of novel initiatives to address their social needs may result in proposals aimed at improving relationship quality, and fostering more meaningful relationships, rather than solely focusing on ensuring participation or contact with others. Such engagement in the ongoing development of resources for the older community may itself provide an environment in which meaningful relationships might flourish. By providing shared goals and purpose, and valuing the experience and insights of older adults, the benefits of peer support may also be realised in such a client-centred approach to intervention development. Collaboration between public, private and individual stakeholders in the development and implementation of interventions aimed at expanding opportunities for older adults to engage in meaningful social interaction across a range of environments is recommended.

Ageing can be viewed from various perspectives – it has been described as a universal, progressive and deleterious process that affects social relationships and emotional well-being (405), yet increasingly international discussion of ageing turns to physically, mentally and socially successful ageing (406). The relationships between social relationships and emotional well-being in older age are apparent yet remain complex. As population ageing continues and societal norms change, the community landscape that older people find themselves within will be significantly transformed from that of their youth. Old age is no longer considered the flagging stages of life, but a time when knowledge and experience gained throughout life, and freedom from responsibilities of middle age, allow individuals to flourish.
7.7 Strengths and Limitations.

Strengths of this study include the use of a large longitudinal dataset from a nationally representative sample of older people. The data used include objective anthropometric measures rather than self-reported measures for BMI, and well validated measurement tools were used to assess key social relationship and depression variables.

This study also used two consecutive waves of data to assess the directionality of the relationship between depression and loneliness, building on the associations identified in cross-sectional data.

Potential limitations of this study arise from the attrition of a disproportionate number of more depressed individuals both at the wave 1 health assessment where BMI was measured, and between waves of data collection. There were no significant differences in mean loneliness score or BMI between the full TILDA population and the study sample, however mean depression score was significantly lower (p<0.01) among the study population than in the full TILDA population. This is unsurprising as depression is likely to have resulted in reduced motivation to return the SCQ, resulting in exclusion from this study. Additionally, those who did not complete questionnaires at the second wave had significantly higher wave 1 scores for loneliness and depression and were significantly older. Those who were re-surveyed reported higher self-rated health that the wave 1 cohort.

Despite home visits being offered in order to capture data on participants who were unable or unwilling to attend the health assessment centre, and so minimize bias towards healthier individuals, the subgroup who attended for measurement of BMI were younger, less lonely and less depressed than the full study sample. It is also possible that those with extremely high BMI were less likely to attend for health assessment. Several studies have reported increased weight as a reason given by patients for delaying or cancelling visits because they knew they would be weighed (215). It has been acknowledged that healthcare professionals’ judgments and practices may be influenced by obesity. This in turn may deter obese individuals from attending non-essential medical appointments. These differences between those with BMI measurements and the full study population may have incurred bias towards a less depressed, less lonely cohort, with an under-representation of morbidly obese individuals in analyses of BMI, potentially reducing the likelihood of identifying any links between these variables and BMI. These results highlight the potential for missed relationships between BMI and social relationship and depression variables, as the individuals for whom data was unavailable could be considered those most likely to demonstrate such associations. Additionally, the lack of data on residential area (urban or rural), marital status and living arrangements at wave 2 limited the use of these variables in analysis to those from wave
1, in order to avoid making any assumptions regarding their status at wave 2. This precluded changes in these variables, and the potential impact of such changes, from being assessed.

Much research has examined the link between older adults’ network connectedness and health. The way in which connectedness is measured influences the inferences that may be drawn from the data. The National Social Life, Health, and Aging Project (NSHAP) measured social networks of older adults in an ‘egocentric’ manner, such that the set of individuals who were important to the respondent were identified, and the type of relationship they shared. They refer to individuals in the social network as ‘alters’ to the individual’s ‘ego’ (407).

This is in contrast with the approach employed to measure social network in the current study using the Berkman’s SNI. The SNI categorizes contacts according to pre-defined groups, namely children, close relatives, and close friends, church groups and other community organisations. Cornwell points out that the extent to which older adults include their ‘alters’ directly in discussions and decisions regarding medical treatment is a potentially important mechanism by which network connectedness may affect health. Hence, by assessing social networks in terms of predefined groups instead of groups identified as important by the respondent, the importance of such health confidants or advocates may be overlooked. Berkman’s SNI was used in the current study as an objective measure of social networks and was accompanied by subjective measures of relationship quality, yet it is possible that the combination of these measures did not adequately capture the varying degrees of subjective importance placed on individuals within the older person’s social network.

7.8 Future Research
The complexity of social relationships and their multiple aspects merit further attention. The evidence from the two waves of data examined in the current study is suggestive of a bidirectional relationship, but subsequent waves of TILDA data will be required to further establish this pattern. Further waves of TILDA will make it possible to examine trajectories of social relationships and depression over multiple time-points and allow examination of longitudinal mediation.

It would be useful to assess the other social relationship measures (social network connectedness, participation and relationship quality) at further time points to ascertain if their associations with loneliness, depression or BMI change over time, or if they mediate or moderate the relationship between loneliness and depression. The impact of the death of a spouse on both social and mental wellbeing warrants attention as it is a life event more frequently encountered in older age. The adaptation that occurs after bereavement is seen as a process that takes time and is shaped by environmental and individual-level risk and protective factors, including social relationships (408).
Assessment of the role of social relationships in bereavement recovery may shed further light on the pathways connecting loneliness and late life onset depression.

Further research in the area of health advocates of older people is warranted to investigate the role of such relationships in access and utilization of health services, and in maintenance of good mental health. Other avenues for future research highlighted by this study include the role of early and mid-life BMI and loneliness in the development of subsequent depression. This was outside of the scope of the current study, but the time of onset of obesity may be an important factor in the relationship between BMI and mental health, and warrants further exploration.

7.8 Conclusions

Today's challenge for policy-makers and society alike is to meet the demands of an ageing population across physical, mental and social spheres. Maintenance of social relationships is important for subjective well-being, but also because of the substantial body of evidence that good social relationships are associated with better physical health and function. This thesis reports on the associations between social relationships and mental and physical health, and provides evidence for a bidirectional relationship between loneliness and depression. In this thesis, subjective and objective social relationship variables were studied concurrently, allowing a comparison to be drawn of their relative association with and importance in the development of depression. The study's results highlight the importance of subjective perceptions of social relationships, and remind us of the individuals at the centre of prominent health and social issues. These findings contribute to the body of evidence that advocates for the alleviation of loneliness to be considered with the same importance as other more easily measured outcomes in efforts towards successful ageing.

The bidirectional longitudinal relationship demonstrated in this research between depression and loneliness highlights the potential for a detrimental cycle to develop. The implication of this mutual influence is to underline the need for multi-faceted approach to address both components of this cycle. Interventions aiming to advance successful ageing should support both alleviation of and adaptation to the challenges presented by diminished social relationships, as well as acknowledging the heightened risk of depression.

Attitudes towards mental health among older adults need to shift towards acknowledgement and acceptance of the central role played by social and psychological health in broader wellbeing. Beyond the focus on physical health, early recognition of depression and loneliness are essential to achieving successful ageing. The stigma associated with both loneliness and depression is an important pathway by which the two are related. A holistic approach that encompasses subjective
social relationships as a pillar of their prevention and treatment will help to attenuate the stigma so often associated with mental and social health issues.

In addition to developing a more connected network of health care bodies and interventions to address social relationships, we must not lose sight of the individual patient. Involving older adults in the formative stages of interventions will help to ensure that such interventions meet user requirements and are of adequate subjective worth to achieve the positive effect on mental health. Patient centred interactions with healthcare professionals, where communication is as much a focus as information gathering or problem solving, may help to promote a shift towards addressing mental health on an equal standing with that of physical health. Health challenges faced in older age predispose towards depression, but the nurturing of quality supportive relationships can lessen the burden of ill-health and support mental wellbeing in later years. A health and social care system that maximises holistic health outcomes in later life needs to consider the importance of social wellbeing and its complex role in supporting physical and mental wellbeing. A patient-centred system focused on broader outcomes than morbidity and mortality requires a shift away from the acute care focus taken in Ireland, towards greater investment in the provision of on-going support to older adults and their families in the community.

William Thomas, founder of Eden Alternative, an organisation dedicated to creating quality of life for older people and their care partners, said “elders are the glue that bind us together” (406). Social relationships are the threads that keep the fabric of society together, and older people are an important part of that. The significant contributions that older people make to society are indispensable, not least as providers of emotional support and knowledge borne of experience, to younger generations. In order to ensure that such relationships are maintained it is necessary to both acknowledge their importance and actively seek to facilitate them within our communities.
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Appendices

Appendix 1: Self Completed Questionnaire (SCQ) Items on Relationship Quality, Loneliness and participation, and Computer Aided Personal Interview (CAPI) items on Depression.

Relationship Quality

Response options were ‘A lot’, ‘Some’, ‘A little’, ‘Not at all’.

We would now like to ask you some questions about your spouse or partner. The seven questions below were repeated for the respondent’s children, other family members and friends.

- How much does he/she really understand the way you feel about things?
- How much can you rely on him/her if you have a serious problem?
- How much can you open up to him/her if you need to talk about your worries?
- How much does he/she make too many demands on you?
- How much does he/she criticise you?
- How much does he/she let you down when you are counting on him/her?
- How much does he/she get on your nerves?

Loneliness

Response options: Often, Some of the time, Hardly Ever or Never

- How often do you feel you lack companionship?
- How often do you feel left out?
- How often do you feel isolated from others?
- How often do you feel in tune with the people around you?
- How often do you feel lonely?
Participation

How often, if at all, do you do any of the following activities? Response options: daily/almost daily, once a week or more, twice a month or more, about once a month, every few months, about once or twice a year, less than once a year, never.

- Watch television.
- Go out to films, plays and concerts.
- Attend classes and lectures.
- Travel for pleasure.
- Work in the garden, or your home, or on a car.
- Read books or magazines for pleasure.
- Listen to music, radio.
- Spend time on hobbies or creative activities.
- Play cards, bingo, games in general.
- Go to the pub.
- Eat out of the house.
- Participate in sport activities or exercise.
- Visits to or from family or friends, either in person or talking on the phone.
- Do voluntary work.

Depression

The next section of the interview is about people’s mood, feelings and well-being. I am going to read a list of statements that describe some of the ways you may have felt or behaved in the last week. Please look at this card and indicate how often you have felt this way during the past week.

Response options: Rarely or none of the time (less than 1 day), Some or a little of the time (1-2 days), Occasionally or a moderate amount of time (3-4 days), All of the time (5-7 days)
• I was bothered by things that usually don't bother me
• I did not feel like eating; my appetite was poor.
• I felt that I could not shake off the blues even with help from my family or friends.
• I felt that I was just as good as other people.
• I had trouble keeping my mind on what I was doing.
• I felt depressed.
• I felt that everything I did was an effort.
• I felt hopeful about the future.
• I thought my life had been a failure.
• I felt fearful.
• My sleep was restless.
• I was happy.
• I talked less than usual.
• I felt lonely.
• People were unfriendly.
• I enjoyed life.
• I had crying spells.
• I felt sad.
• I felt that people disliked me.
• I could not get "going."
Appendix 2: Missing values (%) for individual items of the CES-D, ULS, social participation, support and strain variables

<table>
<thead>
<tr>
<th>CES-D item</th>
<th>% missing values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  I was bothered by things that usually don’t bother me</td>
<td>0</td>
</tr>
<tr>
<td>2  I did not feel like eating</td>
<td>0</td>
</tr>
<tr>
<td>3  I felt that I could not shake off the blues even with help from my family or ...</td>
<td>0</td>
</tr>
<tr>
<td>4  I felt that I was just as good as other people</td>
<td>0</td>
</tr>
<tr>
<td>5  I had trouble keeping my mind on what I was doing</td>
<td>0</td>
</tr>
<tr>
<td>6  I felt depressed</td>
<td>0</td>
</tr>
<tr>
<td>7  I felt that everything I did was an effort</td>
<td>0</td>
</tr>
<tr>
<td>8  I felt hopeful about the future</td>
<td>0</td>
</tr>
<tr>
<td>9  I thought my life had been a failure</td>
<td>0</td>
</tr>
<tr>
<td>10 I felt fearful</td>
<td>0</td>
</tr>
<tr>
<td>11 My sleep was restless</td>
<td>0</td>
</tr>
<tr>
<td>12 I was happy</td>
<td>0</td>
</tr>
<tr>
<td>13 I talked less than usual</td>
<td>0</td>
</tr>
<tr>
<td>14 I felt lonely</td>
<td>0</td>
</tr>
<tr>
<td>15 People were unfriendly</td>
<td>0</td>
</tr>
<tr>
<td>16 I enjoyed life</td>
<td>0</td>
</tr>
<tr>
<td>17 I had crying spells</td>
<td>0</td>
</tr>
<tr>
<td>18 I felt sad</td>
<td>0</td>
</tr>
<tr>
<td>19 I felt that people disliked me</td>
<td>0</td>
</tr>
<tr>
<td>20 I could not get ‘going’</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UCLA Loneliness Scale item</th>
<th>% missing values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Lack companionship</td>
<td>&lt;1</td>
</tr>
<tr>
<td>2  Feel left out</td>
<td>&lt;1</td>
</tr>
<tr>
<td>3  Feel isolated</td>
<td>&lt;1</td>
</tr>
<tr>
<td>4  Feel in tune with people</td>
<td>&lt;1</td>
</tr>
<tr>
<td>5  Feel lonely</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social Participation items</th>
<th>% missing values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Go to films, plays, concerts</td>
<td>3</td>
</tr>
<tr>
<td>2  Attend classes, lectures</td>
<td>6</td>
</tr>
<tr>
<td>3  Play Cards, bingo, games</td>
<td>5</td>
</tr>
<tr>
<td>4  Go to pub</td>
<td>4</td>
</tr>
<tr>
<td>5  Eat out of house</td>
<td>2</td>
</tr>
<tr>
<td>6  Participate in sport, exercise</td>
<td>5</td>
</tr>
<tr>
<td>7  Charity work</td>
<td>4</td>
</tr>
<tr>
<td>Relationship Quality items</td>
<td>% missing values</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td><strong>Spouse</strong></td>
<td></td>
</tr>
<tr>
<td>1. Understand the way you feel about things</td>
<td>3</td>
</tr>
<tr>
<td>2. Rely on for serious problem</td>
<td>2</td>
</tr>
<tr>
<td>3. talk about worries</td>
<td>3</td>
</tr>
<tr>
<td>4. too many demands on you</td>
<td>3</td>
</tr>
<tr>
<td>5. criticises you</td>
<td>3</td>
</tr>
<tr>
<td>6. let’s you down when counting on them</td>
<td>3</td>
</tr>
<tr>
<td>7. Gets on your nerves</td>
<td>3</td>
</tr>
<tr>
<td><strong>Child</strong></td>
<td></td>
</tr>
<tr>
<td>1. Understand the way you feel about things</td>
<td>7</td>
</tr>
<tr>
<td>2. Rely on for serious problem</td>
<td>7</td>
</tr>
<tr>
<td>3. talk about worries</td>
<td>7</td>
</tr>
<tr>
<td>4. too many demands on you</td>
<td>7</td>
</tr>
<tr>
<td>5. criticises you</td>
<td>7</td>
</tr>
<tr>
<td>6. let’s you down when counting on them</td>
<td>7</td>
</tr>
<tr>
<td>7. Gets on your nerves</td>
<td>7</td>
</tr>
<tr>
<td><strong>Family</strong></td>
<td></td>
</tr>
<tr>
<td>1. Understand the way you feel about things</td>
<td>8</td>
</tr>
<tr>
<td>2. Rely on for serious problem</td>
<td>8</td>
</tr>
<tr>
<td>3. talk about worries</td>
<td>8</td>
</tr>
<tr>
<td>4. too many demands on you</td>
<td>8</td>
</tr>
<tr>
<td>5. criticises you</td>
<td>9</td>
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<tr>
<td>6. let’s you down when counting on them</td>
<td>8</td>
</tr>
<tr>
<td>7. Gets on your nerves</td>
<td>8</td>
</tr>
<tr>
<td><strong>Friends</strong></td>
<td></td>
</tr>
<tr>
<td>1. Understand the way you feel about things</td>
<td>4</td>
</tr>
<tr>
<td>2. Rely on for serious problem</td>
<td>4</td>
</tr>
<tr>
<td>3. talk about worries</td>
<td>4</td>
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<tr>
<td>4. too many demands on you</td>
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<tr>
<td>5. criticises you</td>
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<tr>
<td>6. let’s you down when counting on them</td>
<td>4</td>
</tr>
<tr>
<td>7. Gets on your nerves</td>
<td>4</td>
</tr>
</tbody>
</table>

Note: Relationship quality missing data ranged from 2% to 9% for individual items. However, the support and strain measures for each source were set to zero if items were missing, resulting in 0% missing data for these measures. This approach was adopted to be in line with the coding for those for whom the items were not applicable (e.g. questions regarding strain and support from spouse for those who were unmarried).