Assessment Of The Association Between Fear Of Falling And Dual-Task Performance In People With Parkinson's Disease: A Cross-Sectional, Observational Study

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ASSESSMENT OF THE ASSOCIATION BETWEEN FEAR OF FALLING AND DUAL-TASK PERFORMANCE IN PEOPLE WITH PARKINSON’S DISEASE: A CROSS-SECTIONAL, OBSERVATIONAL STUDY

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A dissertation submitted in partial fulfilment of the requirements for the degree of MSc in Neurology and Gerontology.

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Supervisor: Prof. Marie Guidon
Candidate Thesis Declaration

I declare that this thesis, which I submit to RCSI for examination in consideration of the award of a Master of Science in Neurology and Gerontology 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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Summary

Introduction

People with Parkinson’s Disease (PwP) report greater levels of fear of falling (FOF) and demonstrate poorer ability to complete two tasks at once (i.e. dual-tasking) than healthy age-matched controls.

Aims and Objectives

Aim: to assess the association between FOF and dual-task performance in community-dwelling PwP. Objectives: a) to assess the level of FOF in PwP in Ireland, b) to investigate the association between FOF and both motor and cognitive dual-task performance.

Methods

Thirty-one PwP (54.8% male) participated (Hoehn and Yahr Stages I-IV) with a mean age and duration of disease of 69.5 (±8.4) and four (±five) years respectively. The Activities-specific Balance Confidence scale was used to estimate the level of FOF. Dual-task ability was assessed by adding concurrent tasks to the Timed Up and Go (TUG) test. The motor dual-task involved carrying a glass of water (TUG-Manual) and the cognitive dual-tasks were serial subtractions (TUG-Arithmetic) and reciting the days of the week backwards (TUG-Literacy).

Results

Forty-five percent of participants reported high levels of FOF. Correlation testing and linear regression analysis demonstrated that FOF was strongly associated with the motor dual-task (p=0.01), explaining 25% of the variance in the TUG-Manual. Fear of falling was moderately associated with the TUG-Literacy when outliers were removed.
(p=0.045) but was weakly associated with the TUG-Arithmetic (p=0.13). Fear of falling explained 10.2% and 5.6% of the variance in the TUG-Literacy and the TUG-Arithmetic respectively.

**Conclusions**

There was a strong association between FOF and the motor dual-task and a weak to moderate association between FOF and the cognitive dual-tasks.

**Implications of findings**

Dual-task difficulties and FOF are common in PwP. The association between FOF and dual-task performance depends on the type of dual-task. Future research could assess the impact of balance and dual-task training on reducing FOF and improving dual-task performance in PwP.
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LIST OF ABBREVIATIONS

ABC – Activities-specific Balance Confidence Scale
BBS – Berg Balance Scale
FES – Falls Efficacy Scale
FOF – Fear of falling
ICC – Intraclass correlation coefficient
IQR – Inter-quartile range
MMSE – Mini-Mental State Examination
n – Number of participants
PD – Parkinson’s Disease
PwP – people with Parkinson’s Disease
SD – standard deviation
TUG – Timed Up and Go
Introduction

Parkinson’s Disease (PD) is a progressive, neurodegenerative disease characterised by cardinal features including movement slowness (bradykinesia), postural instability, muscle rigidity and tremor (Stokes, 2004). The prevalence of PD in Ireland is expected to rise significantly in years to come due to Ireland’s ageing population (McGill, 2010; Yssel et al., 2012). This may have a significant impact on healthcare resources as people with PD (PwP) are at high risk of falls due to leg muscle weakness, postural instability and fear of falling (Mak and Pang, 2009; Mak et al., 2012). A systematic review reported that 60.5% of PwP report a history of one fall, with 39% of people reporting recurrent falls (Allen et al., 2013). These falls may result in soft tissue injuries or fractures and can result in a reduction in physical activity levels (Rudzinska et al., 2013).

Fear of falling (FOF) was defined as “low perceived self-efficacy at avoiding falls during essential, non-hazardous activities of daily living” (Tinetti et al., 1990, p239). Self-report outcome measures such as the Activities-specific Balance Confidence (ABC) scale or the Falls Efficacy Scale (FES) were developed to estimate FOF both in the clinical setting and in research trials. Fear of falling was significantly higher in PwP than healthy age-matched controls (Rochester et al., 2014) and increases with advancing PD severity (Dal Bello-Haas et al., 2010; Mak et al., 2012). It was associated with physical impairments in PD such as postural instability and reduced functional mobility and strength (Lohnes and Earhart, 2010; Mak et al., 2012). Increased FOF was also associated with activity avoidance and reduced quality of life (Rahman et al., 2011). In the short-term activity avoidance due to FOF may reduce the risk of falls. However, over time this may lead to further reductions in physical and
mental health and subsequently result in increased falls risk (Mak and Pang, 2009; The Irish Longitudinal Study on Ageing, 2011).

People with PD subjectively report that their ability to complete two tasks at once is reduced due to FOF (Bloem et al., 2001). Completing two tasks at once is known as dual-tasking and is required for most activities of daily living such as walking while talking or carrying items (Donoghue et al., 2013). The ability to complete dual-tasks deteriorates naturally with age (Priest et al., 2008) but PwP consistently demonstrate poorer dual-task performance than healthy age-matched controls (Rochester et al., 2004; Galletly and Brauer, 2005; Mak et al., 2013; Panyakaew and Bhidayasiri, 2013).

Dual-task ability can be assessed with concurrent cognitive or motor tasks while walking. An example of a cognitive dual-task could be walking while completing serial subtractions or generating words beginning with a specific letter (Shumway-Cook et al., 2000; Fuller et al., 2013). An example of a motor dual-task could be walking while carrying a glass of water or a tray of glasses (Galletly and Braeur, 2005; Rochester et al., 2008). Motor dual-tasks are reportedly easier to perform than cognitive dual-tasks in PwP (Rochester et al., 2004; Galletly and Braeur, 2005).

Previous research has demonstrated significant associations between dual-task ability and FOF in healthy older adults (Reelick et al., 2009; Hadjistavropoulos et al., 2012; Donoghue et al., 2013). This association in PwP has only been investigated in one research study by Rochester et al. (2008). It was reported that FOF was significantly associated with dual-task ability when a motor dual-task was assessed, explaining 10% of the variance in this outcome measure. However, to this author’s knowledge, there has been no previous research investigating the association between FOF and cognitive dual-task performance in PwP.
Further information regarding the strength of the association between FOF and dual-task performance may assist physiotherapists working with PwP. If a strong association was identified, this may support investigating the addition of cognitive behavioural therapy techniques to the recently identified role of dual-task training programs for PwP (Yogeve-Seligmann et al., 2012). The research study by Rochester et al. (2008) assessed a motor dual-task only. Therefore, this present study aimed to assess the association between FOF and both motor and cognitive dual-task performance in PwP.
CHAPTER 1 – LITERATURE REVIEW

1.1 Parkinson’s Disease

Parkinson’s Disease (PD) is a chronic, progressive, neurodegenerative disease (Stokes, 2004). Motor symptoms of PD include movement slowness (bradykinesia), postural instability, muscle rigidity and tremor. People with PD (PwP) also present with non-motor complications such as sleep disturbance, depression and reduced cognition (Trail et al., 2008). People with more advanced PD often report fluctuations in their motor symptoms in association with their antiparkinsonian medication. When the medication results in improved symptoms, this is considered the ‘on-state’. In contrast, when a deterioration of motor symptoms re-occurs due to the effect of the medication wearing off this is known as the ‘off-state’ (Schapira, 2010). Participants are routinely assessed during the ‘on-state’ in research studies as gait parameters are most stable at this time (Morris et al., 2001).

A twenty year longitudinal study of people who were newly diagnosed with PD (n=136) demonstrated that there were variations in the symptoms experienced and in the rate of disease progression (Hely et al., 2008). Two scales are commonly used clinically and in research to monitor disease progression and facilitate comparisons of groups of research participants: the Hoehn and Yahr scale and the Unified Parkinson’s Disease Rating Scale (UPDRS). The Hoehn and Yahr scale was developed by American neurologists, Margaret Hoehn and Melvin Yahr in 1967. It consists of five consecutive stages which are graded according to PD disability and impairment. These stages range from unilateral involvement with minimal functional impairment (Stage I) to confinement to bed or wheelchair unless aided (Stage V) (Hoehn and Yahr, 1967). Subsequently, the UPDRS was developed in 1987 and was a 55-item questionnaire
assessing PwP in relation to daily activities, motor function and mental capacity. The Movement Disorder Society modified the UPDRS (MDS-UPDRS) in 2007 to include the assessment of non-motor symptoms of PD and to establish a consistent scoring system across all parts of the questionnaire. The MDS-UPDRS is a 65 item scale and includes the Hoehn and Yahr scale. A higher score on the MDS-UPDRS represents greater disability (Goetz et al., 2007).

1.2 Falls risk in people with Parkinson’s Disease

The number of people aged 65 and over is projected to rise significantly in Ireland in the next decade (McGill, 2010). Although these improvements in life expectancy are welcome, it has been acknowledged that the incidence of disability, in particular, the risk of Parkinson’s Disease (PD) increases with age (Yssel et al., 2012). Therefore, the prevalence of PD in Ireland is expected to rise in years to come. This will have an impact on healthcare resources as it has been reported that 54% of people with Parkinson’s Disease (PwP), in comparison with 18% of healthy age-matched controls, fell at least once during a one-year period (Rudzinska et al., 2013). An individual who falls twice or more in a one year period is defined as a recurrent faller (Allen et al., 2013). The Irish Longitudinal Study on Ageing (TILDA) (2014) reported that 8.8% of a large sample (n=7,610) of healthy community-dwelling adults, over the age of 50, were recurrent fallers. Comparatively, 21% to 35% (Mak and Pang, 2009; Rahman et al., 2011; Smulders et al., 2012) of PwP were reported as recurrent fallers.

People with PD present with multiple fall risk factors in comparison with healthy age-matched controls to account for this increased number of falls. These include postural instability, fear of falling (FOF), impaired ability to complete two tasks at once and compromised lower limb muscle strength and endurance (Robinson et al., 2005; Rochester et al., 2008; Stevens-Lapsley et al., 2012). In turn these falls may have
serious consequences such as soft tissue injuries or fractures and may further increase FOF and reduce activity levels (Allen et al., 2013). While a reduction in activity levels due to FOF may reduce the risk of falls in the short-term, this restriction of activity may diminish physical and mental health and increase the risk of future falls (TILDA, 2011; Mak and Pang, 2009).

1.3 Dual-tasking

Historically, postural instability has been identified in people with more advanced PD (Trail et al., 2008). The presence of impaired righting reflexes, defined as unsteadiness with turning or when pushed in standing with the feet together and the eyes closed, was considered a significant marker of disease progression and places the patient at Stage III on the Hoehn and Yahr scale (Hoehn and Yahr, 1967). However, advances in the development and use of outcome measures may facilitate identification of postural instability and gait abnormalities earlier in the disease process (Fuller et al., 2013; Panyakaew and Bhidayasiri, 2013).

Falls risk is commonly assessed using single task outcome measures such as the Timed Up and Go (TUG) (Power et al., 2014). The TUG measures the time taken to stand from a chair, walk three metres at a comfortable and safe pace, turn around and return to sit on the chair (Podsiadlo et al., 1991). However, most activities of daily living require the performance of two tasks at once, such as walking while talking or carrying items (Donoghue et al., 2013). People with PD consistently report difficulties with completing two tasks at once, known as dual-tasking (Bloem et al., 2006; Lindholm et al., 2014). Types of dual-tasks include cognitive dual-tasks and motor dual-tasks. An example of a cognitive dual-task assessment could be walking, or completing the TUG, while reciting the days of the week backwards (Campbell et al., 2003). An
example of a motor dual-task is completing the TUG while carrying a glass of water (Galletly and Braeur, 2005).

The ability to complete dual-tasks deteriorates naturally with age (Priest et al., 2008) and is associated with cognitive status as measured by the Mini-Mental State Examination (MMSE) (Al-Yahya et al., 2011). People with PD consistently demonstrate poorer dual-task performance than healthy age-matched controls (O’Shea et al., 2002; Campbell et al., 2003; Rochester et al., 2004; Galletly and Brauer, 2005; Mak et al., 2013; Panyakaew and Bhidayasiri, 2013). For example, Rochester et al. (2004) found that PwP of moderate severity (Hoehn and Yahr Stage II-III) demonstrated a significantly greater reduction in gait speed and step length when completing a cognitive dual-task when compared with healthy age-matched controls.

1.4 Dual-task Assessment

Dual-task assessment may facilitate earlier identification and treatment of postural instability and mobility problems in PwP. During normal walking no difference was observed in gait parameters between PwP (n=21) of mild severity (Hoehn and Yahr Stages I-II) and healthy age-matched controls (n=21) (Panyakaew and Bhidayasiri, 2013). However, when completing an arithmetic dual-task while walking, compensatory mechanisms (increased cadence and reduced swing cycle time) were significantly greater in PwP (Panyakaew and Bhidayasiri, 2013). Similarly, Galletly and Brauer (2005) demonstrated that PwP of relatively mild severity (UPDRS=14.4/108) took significantly longer than healthy age-matched controls to complete the TUG with concurrent motor and cognitive dual-tasks.

Based on the evidence available, dual-task ability may be associated with falls risk in PwP. Plotnik et al. (2011) demonstrated that people with moderate PD (average Hoehn
and Yahr Stage II) who had a history of falling demonstrated reduced gait speed, larger gait variability and reduced bilateral coordination during dual-task walking when compared with those without a history of falling. Moloney and French (2012) (unpublished research dissertation) found that the TUG combined with a cognitive dual-task (TUG-Cognitive) had a greater ability to retrospectively identify fallers from non-fallers in a sample of PwP than a commonly used outcome measure (the Berg Balance Scale (BBS)).

The impact that a dual-task may have on walking performance depends on both the complexity and the type of task. As the complexity of the task increases, walking performance deteriorates in PwP (Campbell et al., 2003; Lapointe et al., 2010; Wild et al., 2013). Campbell et al. (2003) assessed the TUG under three conditions in PwP. Firstly the TUG was completed as a single task only. The TUG was then completed with a simple cognitive dual-task by repeatedly reciting ‘Where is the child?’ Finally the TUG was completed with a more complex cognitive dual-task i.e. reciting the days of the week backwards. It was found that the first simple cognitive dual-task did not affect the completion time for the TUG but the second, more complex, task resulted in a significantly increased completion time.

Furthermore, PwP may find cognitive dual-tasks more difficult than motor dual-tasks. It was demonstrated that a concurrent cognitive dual-task resulted in a greater reduction in gait performance than a concurrent motor dual-task in PwP (Rochester et al., 2004; Galletly and Brauer, 2005). For example, PwP showed a greater reduction in stride length for arithmetic and language cognitive dual-tasks than a motor dual-task. Conversely, O’Shea et al. (2002) reported that a motor and a cognitive dual-task both resulted in reduced gait speed and stride length in PwP. However, as the tasks assessed differed between the aforementioned studies in both type and complexity it makes it
difficult to make comparisons. Therefore, it may be necessary to include both motor and cognitive dual-tasks to comprehensively assess dual-task performance.

1.5 Theories of Dual-task Interference

Dual-task interference occurs when the addition of a dual-task results in a deterioration of the performance of one or both tasks (Kelly et al., 2012). Three theories are proposed to explain why dual-task interference occurs. Firstly, the capacity theory proposes that when performing dual-tasks there is competition of information processing resources. If the available resource capacity is exceeded, this can result in deterioration of performance in one or both tasks (Pashler and Johnston, 1998; Kelly et al., 2012). Secondly, the bottleneck theory proposes that tasks are performed in a sequential nature. When a dual-task is being performed, one task is prioritised and the performance of the second task is compromised (Pashler and Johnston, 1998; Kelly et al., 2012). Finally, the cross-talk model suggests that when two tasks are similar, dual-task interference is reduced as less attentional resource capacity is required. In contrast if two tasks are different this may result in cross-talk between the separate pathways and result in increased dual-task interference (Pashler and Johnston, 1998).

There are several additional factors that may contribute to dual-task walking difficulties specifically in PwP (Kelly et al., 2012). Firstly, the ability to complete a skilled movement without conscious attention is known as automaticity. The basal ganglia are proposed to play a vital role in this. In PD, neuro-degeneration occurs in the basal ganglia (Stokes, 2004) and this may lead to reduced movement automaticity. Secondly, PD results in the specific degeneration of dopamine-producing neurons in the basal ganglia. Dopamine is a neurotransmitter and a reduction in the production of dopamine results in a reduction of movement, known as bradykinesia, and an increase
in tremor. Lord et al. (2011) demonstrated that antiparkinsonian medication, which attempts to replace the deficient dopamine, results in improvements in some aspects of dual-task ability. This suggests that dual-task walking is influenced by reduced levels of dopamine. However, although antiparkinsonian medications may improve some aspects of dual-task ability, such as increased gait speed and reduced gait variability, problems persist even when patients are taking their medication (Galletly and Brauer, 2005; Yogev et al., 2005; Lord et al., 2011). This suggests that non-dopaminergic pathology in PD may also play a role in dual-task interference (Lord et al., 2011).

In conclusion, there are a number of proposed mechanisms that may contribute to dual-task walking difficulties in PwP. The relative contribution of each mechanism may depend on a variety of factors such as each person’s individual presentation or the type of task being completed (Kelly et al., 2012).

1.6 Fear of Falling

The self-efficacy theory was first discussed by Bandura (1977) and was defined as a person’s confidence in their ability to perform a given task. It was proposed that higher self-efficacy increased the likelihood of success in performing an activity, regardless of actual physical ability (Bandura, 1982). Subsequently, research focussed on self-efficacy at avoiding falls during essential, non-hazardous activities of daily living, which was defined as fear of falling (Tinetti et al., 1990). Fear of falling (FOF) can be identified as present or absent by asking the participant if they were fearful of falling. While this method of assessment is quick and simple to administer, it does not indicate the degree of fear (National Institute of Clinical Excellence, 2013). Tinetti et al. (1990) developed the Falls Efficacy Scale (FES) to measure an individual’s degree of FOF during everyday activities. The FES is a ten-item self-report questionnaire, primarily
focused on self-efficacy at completing indoor activities without losing balance. The Activities-specific Balance Confidence (ABC) scale was subsequently developed and was proposed as more suitable for estimating FOF in people who are functioning at a higher level and regularly mobilise outdoors (Myers et al., 1996). A lower score on the ABC scale represents greater FOF.

In research trials a cut-off score is routinely used with either the ABC scale or the FES to group participants into those who have low or high levels of FOF. Reelick et al. (2009) reported in a sample of 100 community-dwelling older adults that FOF may not be readily admitted by participants when asked as a direct question. Twenty-nine participants were classified as being fearful of falling based on their scale score, however, only half of these had admitted to FOF when asked directly. Therefore, it was proposed that FOF questionnaires may more accurately identify people who are fearful of falling. Furthermore, both the FES and the ABC scale are recommended for assessment of FOF in PwP (van der Marck et al., 2014).

Twenty-six percent of a sample of 1,307 healthy adults over the age of 65 in Ireland reported that they were fearful of falling when asked the dichotomous question ‘are you fearful of falling?’ (Donoghue et al., 2013). Fear of falling increased with age (TILDA, 2014) but was reportedly higher in PwP when compared with healthy controls. Rochester et al. (2014) demonstrated that PwP scored on average 82.5% on the ABC scale in comparison with 91.8% in healthy age-matched controls. Fear of falling also increases with PD duration and severity. Newly diagnosed PwP reported an average score of 82.5% on the ABC scale (Rochester et al., 2014) in comparison with an average of 70% on the ABC scale in people with a mean duration of 14 years since diagnosis (Steffen and Seney, 2008). Similarly, PwP had greater FOF as
measured by the FES (mean=38) (Rahman et al., 2011) when compared with a sample of 500 healthy adults (mean=22.6) (Delbaere et al., 2010). A higher score on the FES represents greater FOF. This higher score was recorded despite the PD group being younger than the healthy adults (mean age of 66.7 years versus 77.4 years).

In order to design effective treatment interventions for FOF it is important to identify factors that contribute to FOF. Fear of falling significantly increased with greater PD severity (Lohnes and Earhart, 2010; Dal Bello-Haas et al., 2010; Mak et al., 2012) and increased self-rated disability (Rahman et al., 2011). Additionally, using univariate analysis FOF was higher in the overall sample of PwP who had a higher frequency of falls in the past (Rahman et al., 2011; Bryant et al., 2013). However, a number of research studies have demonstrated that after multi-variate analysis, controlling for other variables such as disease duration or Hoehn and Yahr Stage, FOF is not associated with a history of falls in PwP (Mak et al., 2012; Nilsson et al., 2012; Lindholm et al., 2014).

It has been identified that there may be a subgroup of PwP who fall regularly but do not report FOF (Rahman et al., 2011; Thomas et al., 2010). This may be due to the fact that despite falling regularly, these patients did not sustain significant injuries. Conversely, people with high FOF may have no history of falling. Twenty-percent of a sample of people with moderate PD reported high FOF but had no history of falling (Bryant et al., 2013). Therefore, caution is warranted when assessing PwP for falls risk as patients who perceive their balance as being significantly better than it actually is may have an increased risk of falls due to over-confidence. Conversely, those who perceive their balance as being significantly worse than it is may avoid activities as they do not trust their capabilities.
1.7 Fear of falling and activity avoidance

People with PD subjectively report a restriction in activities of daily living and the ability to carry out dual-tasks due to FOF (Bloem et al., 2001; Nilsson et al., 2010; Rahman et al., 2011). A strong correlation was found between FOF and activity avoidance with PwP with greater FOF more likely to avoid activities particularly those outside the home and those involving crowds of people. This in turn resulted in a negative impact on quality of life with FOF explaining 65% of the variance in this outcome (Rahman et al., 2011).

Furthermore, there was consistent evidence that increased FOF was significantly associated with self-reported walking difficulties (Nilsson et al., 2012; Lindholm et al., 2014) and people who were less fearful of falling were more likely to be community walkers (Elbers et al., 2013). Lindholm et al. (2014) demonstrated that self-reported walking difficulties in everyday life was the strongest independent predictor of FOF in PwP (n=104), explaining 60% of the variance. Additionally, a qualitative study of community-dwelling PwP found that FOF was identified as a barrier to participating in regular exercise (Ellis et al., 2013). In the short-term avoidance of activities due to FOF may protect against falls, however, this can lead to reduced physical and mental health over time and may further increase the risk of falls (TILDA, 2011). A prospective study of a large sample of community-dwelling healthy older adults (n=2212) demonstrated that individuals who limit their activities due to FOF are at high risk of becoming fallers (Friedman et al., 2002). This is supported by recent research which found that FOF was a strong predictor of future recurrent falls in PwP (Mak and Pang, 2009). This research highlights the importance of identifying FOF when assessing PwP.
1.8 Association between fear of falling and other outcome measures

Fear of falling also correlates with outcome measures assessing physical impairments and balance in PwP. The correlation coefficient (represented by ‘r’) is a measure of the strength of an association between two variables and ranges from –1 to +1 (Plichta-Kellar and Kelvin, 2013). The further the correlation coefficient is from zero, the stronger the association. Increased FOF was significantly correlated with reduced knee extensor strength ($r=0.301$) in a sample of 57 PwP (Mak et al., 2012) and with increased completion times for the TUG and a 6 minute walk test ($r=-0.372$ and $r=0.458$ respectively) in a sample of 89 PwP (Lohnes and Earhart, 2010). There is consistent evidence that increased FOF significantly correlates with postural instability and gait difficulty specific to PD as measured by the UPDRS motor sub-scale (Adkin et al., 2003; Lohnes and Earhart, 2010; Mak et al., 2012).

Bryant et al. (2013) categorised PwP ($n=79$) into those with a high level of FOF and those with a low level of FOF (<69 or >69 respectively on the ABC scale). It was demonstrated that those with high FOF took significantly longer to perform all balance tests including a 5-step test, 360° turns, sidestepping and the TUG. Gait performance during both forward and backward walking was also significantly poorer in those with high FOF, specifically in relation to gait speed and stride length. After controlling for falls history, FOF remained significantly associated with all gait and balance variables accounting for 13-34% of the variance in these outcomes.

The Berg Balance Scale (BBS) is a 14-item scale that is commonly used to assess balance in different positions and during movement in PwP (Lohnes and Earhart, 2010; Lindholm et al., 2014). It was demonstrated that FOF was strongly associated with BBS score in PwP when assessed by the ABC scale ($r=0.505$) (Lohnes and
Earhart, 2010) or by the FES (r=0.65) (Lindholm et al., 2014). However, as previously discussed, Moloney and French (2012) demonstrated that the BBS was less sensitive at accurately identifying fallers than the TUG-Cognitive. Therefore, there may be a greater association between FOF and postural stability when outcome measures that incorporate a dual-task are assessed.

1.9 The association between fear of falling and dual-task performance

There is evidence to support an association between FOF and dual-task performance in healthy, community-dwelling older adults. Donoghue et al. (2013) demonstrated that cognitive dual-task gait speed and stride length were significantly associated with FOF in adults (n=1307) over the age of 65 in Ireland. This association remained significant after adjusting for demographic details and physical, mental and cognitive function. Fear of falling was measured simply by asking whether the participants were fearful of falling and dual-task gait speed was measured by timing gait while reciting alternate letters of the alphabet. Using the ABC scale, Reelick et al. (2009) demonstrated that gait velocity was significantly lower when completing a cognitive dual-task in older people who were more fearful of falling. Additionally, Hadjistavropoulos et al. (2012) reported that FOF could predict performance of a motor dual-task in community-dwelling healthy older adults (n=107).

In this author’s knowledge, the research to investigate an association between FOF and dual-task performance in PwP is limited to one study (Rochester et al., 2008). The impact of personal, motor, cognitive and affective symptoms on dual-task walking in PwP (n=130) was investigated. Increased FOF was associated with reduced gait speed during both single and dual-task activities. It was demonstrated that, of all the symptoms assessed, FOF had the greatest impact on dual-task gait speed, explaining 10% of the variance in this measure.
However, dual-task gait speed was recorded while completing a motor task only (carrying a tray with two cups of water on it). As previously discussed, cognitive dual-tasks, when compared with motor dual-tasks, may have a greater impact on dual-task performance in PwP (Rochester et al., 2004; Galletly and Brauer, 2005). Therefore, the aim of this present study was to investigate the association of FOF with motor dual-task and cognitive dual-task performance in PwP.
CHAPTER 2 – METHODOLOGY

2.1 Aim and Objectives

2.1.1 Aim

The aim of this study was to assess the association between fear of falling (FOF) and dual-task performance in community-dwelling adults with Parkinson’s Disease (PD).

2.1.2 Objectives

The objectives of this study were:

a) To assess the level of FOF in a sample of community-dwelling adults with PD in Ireland.

b) To assess the association of motor dual-task performance with FOF in a sample of people with Parkinson’s Disease (PwP).

c) To assess the association of cognitive dual-task performance with FOF in a sample of PwP.

2.2 Study Design

This was an observational, cross-sectional study.

2.3 Subjects

The subjects were a convenience sample of 31 PwP who were attending the PD clinic or outpatient physiotherapy departments in the Health Service Executive (HSE) in South Tipperary between September 2013 and February 2014.

2.4 Sample Size

The sample size was calculated based on previous research regarding FOF and dual-task performance. A study of people with Multiple Sclerosis (n=84) demonstrated
strong inverse correlations between the Activities-specific Balance Confidence scale and both the TUG (Timed Up and Go) and the TUG-Arithmetic that were used in this study \(r=-0.61\) and \(r=-0.50\) respectively (Nilsagard et al., 2012). Conroy (2009) recommends that to find a strong correlation between two variables of 0.55 with a power of 90%, a sample size of 30 participants should be assessed. Therefore, a sample size of 30 PwP was chosen for this study.

2.5 Inclusion and Exclusion Criteria

Inclusion criteria for this study were:

- Diagnosis of idiopathic PD
- Independently mobile six metres with or without an aid
- A Mini-Mental State Examination score of >20/30

Exclusion criteria for this study were:

- A co-existing, unstable medical condition (e.g. unstable cardiac condition or pain) which prevented safe participation
- Inability to provide written informed consent.

2.6 Ethical Considerations

Ethical approval for this research study was granted by the Research Ethics Committee of the HSE South-East (Appendix A). There was a possibility that some participants may have had a cognitive impairment. If the principal investigator suspected this when obtaining consent for participation the principal investigator first went through the information sheet (Appendix B) with the potential participant and then asked them to repeat back what they understood. This was completed in order to assess whether the person had sufficient capacity to make an informed decision about participating rather
than excluding them. This approach was a Research Ethics Committee recommendation used in previous research (Muina-Lopez and Guidon, 2013).

As part of the informed consent process participants were assured that they could decline participation in the study or could withdraw from the study at any time without any consequences or influence on further treatment. All assessments were completed in a private room to ensure confidentiality. The outcome measures being used were part of routine physiotherapy assessments and did not pose any ethical issues. The data was coded by assigning an identification number to each participant and only the principal investigator had access to these participant identification codes which were stored in a separate file on a password encrypted computer. This was to further ensure participant confidentiality. General Practitioners of the participants identified by physiotherapists were contacted by telephone, with participant’s consent, to obtain their permission for participation.

2.7 Procedure

Participants who were identified by treating physiotherapists or geriatricians were posted an information sheet by the treating physiotherapist or the Consultant Geriatrician’s secretary with a self-addressed stamped envelope outlining the research study. Those who wanted to partake in the research study returned a signed form giving permission to allow the principal investigator to telephone them to arrange an appropriate time to attend for a one-off assessment. On arrival for testing the principal investigator obtained informed consent (Appendix C). All assessments were performed when the participants were in the self-reported ‘on-state’, within two hours of taking their antiparkinsonian medication.
Demographic data was obtained from the patient by the principal investigator and documented in the Data Collection Form (Appendix D). This included assessment of disease severity using the Hoehn and Yahr Scale (Appendix E). Following this, the research instruments were administered.

The MMSE was administered first to ensure sufficient cognitive ability (i.e. a score of >20/30) to complete the ABC scale, which was the second research instrument administered. The order in which the TUG and the TUG with dual-tasks were completed was randomly selected by the participant picking cards from an envelope. This was to prevent any fatigue or practice bias. The participants completed one practice trial of the TUG to familiarise themselves with the procedure (Campbell et al., 2003). They also completed one practice trial of the cognitive dual-task for the TUG-Arithmetic and the TUG-Literacy while seated to ensure they understood the task. Standardized instructions (Appendix F) were given at the start of each TUG trial. Each type of TUG was completed three times (Shumway-Cook et al., 2000; Campbell et al., 2003). The average score of the three trials was calculated. Subjects were advised to rest for as long as required between trials to reduce the risk of fatigue (Campbell et al., 2003). If a participant scored below 20 on the MMSE they were timed completing three trials of the TUG only. This was implemented to prevent the patient from feeling disappointed that they could not participate in the study. Those results were not included in the data analysis.

2.8 Research Instruments

2.8.1 Mini-Mental State Examination

The MMSE was first developed by Folstein et al. (1975) (cited in Mamikonyana et al., 2009). It is a simple and universally applicable scale of 30 questions to identify
cognitive impairment (Appendix G). A cut-off score of \( \leq 25 \) was recommended by the Movement Disorder Society (Dubois et al., 2007) when screening for dementia in PwP. It was chosen for administration in this research study as the ABC scale has been validated for use with PwP who have an MMSE score of \( >20 \) (Dal Bello-Haas et al., 2010).

2.8.2 Activities-specific Balance Confidence Scale

The ABC scale has been widely used in research trials to provide an estimate of FOF in people with PD (Mak and Pang 2009; Mak et al., 2012; Rochester et al., 2014). The participant rates how confident they are in their ability to complete 16 indoor and outdoor activities without falling or losing their balance (Appendix H). Mean scores across all 16 items were used to estimate the degree or level of FOF. The ABC scale demonstrated excellent test-retest reliability (ICC = 0.94) and excellent internal consistency in PwP (\( n=35 \)) ranging from Hoehn and Yahr Stages I-IV (Steffen and Seney, 2008). Shorter versions of the ABC scale have been developed (e.g. ABC-6), however, recent research reported that the 16-item scale demonstrated psychometric superiority over the shortened versions such as better reliability and no floor effect (Franchignoni et al., 2014). A lower score on the ABC scale indicates greater FOF. The ABC scale demonstrates high sensitivity (93%) and moderate specificity (67%) for discriminating prospective recurrent fallers from non-fallers in PwP when a cut off score of 69% is used (Mak and Pang, 2009). Similarly, Bryant et al. (2013) used a cut-off score of 69% to classify PwP into high and low levels of FOF.

The ABC scale was validated for use in people with PD with an MMSE score greater than 20 (Dal Bello-Haas et al., 2010). It was reported that some participants may need to be reminded to distinguish between their balance confidence versus their usual level of participation in each task (Dal Bello-Haas et al., 2010). Therefore, the principal
investigator was present to assist the patient with the ABC scale completion as required.

### 2.8.3 Timed Up and Go

To complete the TUG the participant sat on a standard arm chair with a seat height of 46 cm. The participant was instructed to stand from the chair, walk three metres to a line on the floor at a comfortable and safe pace, turn around and return to the chair (Podsiadlo et al., 1991). Timing (using a stopwatch) started when the investigator said ‘go’ and stopped when the participant’s buttocks touched the seat of the chair again. In the first reporting of the TUG by Podsiadlo et al. (1991), 10 healthy volunteers completed the TUG in 10 seconds or less. The average time to complete the TUG increases with age. Kenny et al. (2013) reported an average TUG of 7.8 seconds for community-dwelling older adults in Ireland aged 50 which increased gradually with age to an average of 15.9 seconds for those aged 85. The TUG is easy to set-up and implement in a clinical setting and has established validity and reliability as an outcome measure of functional mobility in people with PD (Morris et al., 2001; Brusse et al., 2005; Lim et al., 2005; Paul et al., 2012; Verheyden et al., 2014). Verheyden et al. (2014) demonstrated that community-dwelling PwP (n=38) took on average 15.7 seconds to complete the TUG in comparison with 10.9 seconds in healthy age-matched controls (n=19). The completion time for the TUG increased with disease severity as measured by the Hoehn and Yahr scale.

### 2.8.4 Timed Up and Go - Manual

The TUG-Manual was first described by Lundin-Olsson et al. (1998). The TUG-Manual was completed while carrying a glass of water in one hand. In this present study any participants who required bilateral upper limb support to walk were excluded from completing this outcome measure. Shumway-Cook et al. (2000)
demonstrated excellent inter-rater reliability (ICC:0.99) with the TUG-Manual in community-dwelling older adults. The TUG-Manual has been used in research studies with PwP (Galletly and Brauer, 2005; Moloney and French, 2012; Robinson et al., 2005). Galletly and Brauer (2005) reported an average time of 10.3 seconds to complete the TUG-Manual in PwP (n=16) versus an average time of 7.2 seconds in healthy age-matched controls (n=16).

2.8.5 Timed Up and Go - Arithmetic

The TUG-Cognitive was first described by Shumway-Cook et al. (2000). For this test the participant counts backwards in threes from a randomly selected number between 20 and 100 while completing the TUG. As two types of cognitive dual-task were being assessed in this present study, the author renamed the TUG-Cognitive as the TUG-Arithmetic for ease of interpretation. Galletly and Brauer (2005) reported significantly slower times (average 11.5 seconds) to complete the TUG-Arithmetic when PwP were compared with healthy age-matched controls (average 7.8 seconds). Moloney and French (2012) found a difference of 5.03 seconds between retrospective fallers and non-fallers in the completion of the TUG-Arithmetic in PwP.

2.8.6 Timed Up and Go - Literacy

The TUG was assessed with an additional cognitive task in PwP by Campbell et al. (2003). The participant was instructed to complete the TUG while repeating the days of the week backwards. For ease of interpretation, this task was called the TUG-Literacy in this research study. Both a word-based and arithmetic cognitive dual-task were included to have a comprehensive assessment of the association between FOF and cognitive dual-tasks as some adults in Ireland may have difficulties with numeracy (Central Statistics Office, 2013). Campbell et al. (2003) reported average time to complete the TUG-Literacy as 21.5 seconds in PwP (n=9) versus an average of 11.58
seconds in healthy age-matched controls (n=10). The performance of the cognitive dual-tasks (both the word-based and the arithmetic tasks) was measured by documenting if the participant made an error that interrupted the performance of the secondary task that required verbal cueing to restart as defined by Campbell et al. (2003).

2.9 Data Collection

Data was collected in private rooms in HSE health centres and hospitals in South Tipperary. The data was recorded in the Data Collection Form (Appendix D). Data was entered into Microsoft Excel initially and subsequently analysed using the Statistical Package for Social Sciences (SPSS) Version 21 software. The data was stored on an encrypted, password-protected HSE laptop.

2.10 Statistical Methods

Descriptive statistics were derived from the demographic and continuous data of each outcome measure. These included the mean, standard deviation and confidence intervals for the normally distributed data and the median and interquartile range for the non-normally distributed data. Kelly et al. (2012) recommends reporting the dual-task cost to facilitate comparison of research studies in relation to dual-tasking. The dual-task cost was calculated for each dual-task by using the following equation: (dual-task – single task)/single task x 100. The TUG was the single task and the TUG-Manual, the TUG-Literacy and the TUG-Arithmetic were the dual-tasks.

Data was analysed for normality by visually inspecting the histograms and assessing the mean and median. The data was also assessed for kurtosis and skewness and with the Shapiro-Wilk test for normality as the sample size was less than 50. Statistical
significance was set at $p<0.05$. The results indicated that the TUG-Manual was normally distributed and all other outcome measures were non-normally distributed.

As the aim of this study was to assess the association between FOF and dual-task performance, statistics to assess for correlation were used. The ABC scale data was non-normally distributed, therefore, the spearman rank correlation coefficient test was used to assess the association between the ABC scale and the dual-task outcome measures. The correlation coefficients were interpreted as suggested by Cohen (1988) where a strong correlation was considered 0.5 – 1.0, a moderate relationship was 0.3-0.49 and a weak relationship was 0.1-0.29. Linear regression analysis was also conducted to assess the strength of the relationship between the ABC scale and each dual-task outcome measure. Correlation statistics were also used to assess the association between the demographic details and the outcome measures.

Additionally participants were divided into a low and high FOF category (with a score of $>69$ and $<69$ respectively). The tests for normality demonstrated that within these groups the ABC scale and TUG-Manual were normally distributed, while the TUG, TUG-Arithmetic and TUG-Literacy were non-normally distributed. The groups were then compared using the Independent samples $t$-test for the normally distributed data and the Wilcoxon-signed ranks test for the non-normally distributed data. A chi-square analysis was used to assess the impact of gender on FOF category while a fisher’s exact test was used to assess the impact of Hoehn and Yahr stage and falls history on FOF category.
CHAPTER 3 - RESULTS

3.1 Participant flow through the study

Participants were recruited between September 2013 and February 2014. Fifty-two people were identified by the Geriatrician or physiotherapists as potentially eligible and were posted information letters. Thirty-seven people agreed to participate in the study. Four people were excluded as they did not fulfil the inclusion and/or exclusion criteria as outlined in Figure 3.1 and two people were unable to attend as they were unwell.

![Flow diagram of participants through the research study.](image-url)

Figure 3.1: Flow diagram of participants through the research study.
3.2 Participant Demographic Details

Demographic details of the participants are displayed in Table 3.1. Thirty-one community-dwelling adults with PD participated in the study (54.5% male). The mean age of participants was 69.5 years (±eight years). The median time since diagnosis was four years (interquartile range (IQR)=five years). Participants ranged from Stage I (n=8) to Stage IV (n=4) on the Hoehn and Yahr scale representing mild to severe PD severity (see Figure 3.2). The median Mini-Mental State Examination (MMSE) score was 28 (±3) indicating that the participants did not suffer from a severe cognitive impairment. All participants were assessed within two hours of taking anti-parkinsonian medication and were in the self-reported ‘on’ phase (i.e. medication resulting in improvement in motor symptoms).

<table>
<thead>
<tr>
<th>Table 3.1 Participant Demographic Details n=31</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
</tr>
<tr>
<td>Age (years)</td>
</tr>
<tr>
<td>MMSE</td>
</tr>
<tr>
<td>Time Since Diagnosis (years)</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Hoehn and Yahr</td>
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<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Walking Aid</td>
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<td></td>
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<tr>
<td></td>
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<tr>
<td>Falls History (previous 6 months)</td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: IQR=Inter-quartile range, MMSE=Mini-Mental State Examination, n=number of participants, SD=Standard Deviation.
All participants were able to perform the assessments with supervision only. Nineteen participants (61.3%) did not use any gait aid while seven (22.6%) participants used a walking stick and five (16.1%) used a walker. Twenty (64.5%) participants reported no falls in the previous six months. Four (12.9%) participants reported one fall, while seven (22.6%) reported more than two falls.

![Figure 3.2 Number of Participants in each Hoehn and Yahr Stage.](image)

### 3.3 Results of outcome measures

A summary of the results of each outcome measure can be seen in Table 3.2. The results of the normality tests indicated that the TUG-Manual data was normally distributed while the data recorded on all other outcome measures (ABC, TUG, TUG-Arithmetic and TUG-Literacy) was non-normally distributed. The median score on the ABC scale was 73.13 (IQR=31.25). The TUG (the single-task) took the shortest amount of time with a median of 11.46 seconds (IQR=5.97). The cognitive dual-tasks took longer to complete than the motor dual-task. The TUG-Arithmetic took the longest with a median of 19.32 seconds (IQR=14.28). The dual-task cost was also
calculated for each dual-task by using the following equation: \((\text{dual-task} - \text{single task})/\text{single task} \times 100\). The TUG-Manual had the lowest median dual-task cost of 25.6\% (IQR=18.4\%) and the TUG-Arithmetic had the highest median dual-task cost of 36.7\% (IQR=61.3\%).

### Table 3.2 Outcome Measure Results

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Median (IQR)</th>
<th>Mean (SD)</th>
<th>95% CI</th>
<th>DTC(%) Median(IQR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC</td>
<td>41.25–98.75</td>
<td>73.13 (31.25)</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>TUG (s)</td>
<td>5.92–38.04</td>
<td>11.46 (5.97)</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>TUG-Manual (s) (n=26)</td>
<td>7.69–27.62</td>
<td>n/a</td>
<td>14.57 (4.96)</td>
<td>12.56-16.57</td>
<td>25.6 (18.4)</td>
</tr>
<tr>
<td>TUG-Literacy (s)</td>
<td>7.25–59.85</td>
<td>16.82 (11.84)</td>
<td>n/a</td>
<td>n/a</td>
<td>32.4 (44)</td>
</tr>
<tr>
<td>TUG-Arithmetic (s)</td>
<td>7.01–57.01</td>
<td>19.32 (14.28)</td>
<td>n/a</td>
<td>n/a</td>
<td>36.7 (61.3)</td>
</tr>
</tbody>
</table>

Abbreviations: ABC=Activities-specific Balance Confidence scale, CI=Confidence Interval, DTC=Dual-task Cost, IQR=Inter-quartile range, s=seconds, SD=Standard Deviation, TUG=Timed Up and Go.

Note: n=26 for TUG-Manual (five participants required bilateral upper limb support to walk and could not complete this task).

### 3.4 Association between outcome measures and demographic details

The results of the correlation analysis for the association between the outcome measures and the demographic details can be seen in Table 3.3. Fear of falling was significantly associated with age, disease severity and time since diagnosis (all \(p<0.05\)). It was not significantly associated with falls history or MMSE score. Women reported significantly lower ABC scores than men (\(p=0.03\)). Completion times for all of the dual-task outcome measures increased significantly with age and disease severity (all \(p<0.05\)). Cognitive function (measured by the MMSE) was significantly associated with the cognitive dual-tasks but not with the motor dual-task. The TUG-
Literacy was the only outcome measure significantly associated with falls history, with a positive falls history associated with a higher completion time (p=0.04).

Table 3.3 Association between outcome measures and demographic details

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Hoehn and Yahr</th>
<th>Time since diagnosis</th>
<th>MMSE</th>
<th>Falls History (Yes/No)</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC</td>
<td>r=-0.384a</td>
<td>r=-0.632a</td>
<td>r=-0.43a</td>
<td>r=0.169a</td>
<td>p=0.08b</td>
<td>p=0.03b</td>
</tr>
<tr>
<td></td>
<td>p=0.03*</td>
<td>p=0.00*</td>
<td>p=0.02*</td>
<td>p=0.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TUG-Manual (n=26)</td>
<td>r=0.451c</td>
<td>r=0.55c</td>
<td>r=0.31c</td>
<td>r=-0.16c</td>
<td>p=0.62d</td>
<td>p=0.99d</td>
</tr>
<tr>
<td></td>
<td>p=0.02*</td>
<td>p=0.00*</td>
<td>p=0.12</td>
<td>p=0.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TUG-Literacy</td>
<td>r=0.536a</td>
<td>r=0.627a</td>
<td>r=0.144a</td>
<td>r=-0.48a</td>
<td>p=0.04b</td>
<td>p=0.44b</td>
</tr>
<tr>
<td></td>
<td>p=0.00*</td>
<td>p=0.00*</td>
<td>p=0.40</td>
<td>p=0.01*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TUG-Arithmetic</td>
<td>r=0.506a</td>
<td>r=0.631a</td>
<td>r=0.167a</td>
<td>r=-0.532a</td>
<td>p=0.05b</td>
<td>p=0.05b</td>
</tr>
<tr>
<td></td>
<td>p=0.00*</td>
<td>p=0.00*</td>
<td>p=0.37</td>
<td>p=0.00*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: a=Spearman rank correlation coefficient, ABC=Activities-Specific Balance Confidence Scale, b=Wilcoxon sum-rank test, c=Pearson correlation coefficient, d=Independent samples t-test, MMSE=Mini-Mental State Examination, n=number of participants, r=correlation coefficient. Note: *statistical significance set at p-value <0.05, n=26 for TUG-Manual (five participants required bilateral upper limb support to walk and could not complete this task).

3.5 Association between fear of falling and dual-task outcome measures

The results of the correlation analysis for the association between FOF and the dual-task outcome measures can be seen in Table 3.4 and in Figure 3.3. Based on the interpretation of correlation coefficients by Cohen (1988), FOF had a strong inverse correlation with the motor dual-task (TUG-Manual) (r=-0.504), a moderate inverse correlation with the TUG-Literacy (r=-0.343) and a weak inverse correlation with the TUG-Arithmetic (r=-0.282). The association between FOF and the TUG-Manual was the only association that was statistically significant (p=0.01). The TUG-Literacy showed a trend towards statistical significance (p=0.06), however, when the Spearman’s rank test was repeated after removing three outliers from the TUG-Literacy data, a statistically significant association was found (r=-0.382, p=0.045).
Removal of outliers did not affect the significance of the association between the ABC and the TUG-Manual or the TUG-Arithmetic.

### Table 3.4 Association between fear of falling and dual-task outcome measures

<table>
<thead>
<tr>
<th></th>
<th>TUG-Manual (n=26)</th>
<th>TUG-Literacy</th>
<th>TUG-Literacy (outliers removed)</th>
<th>TUG-Arithmetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC</td>
<td>a</td>
<td>a</td>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td></td>
<td>r=-0.504</td>
<td>r=-0.343</td>
<td>r=-0.382</td>
<td>r=-0.282</td>
</tr>
<tr>
<td></td>
<td>p=0.01*</td>
<td>p=0.06</td>
<td>p=0.045*</td>
<td>p=0.13</td>
</tr>
</tbody>
</table>

Abbreviations: a=Spearman rank correlation coefficient, ABC=Activities-specific Balance Confidence Scale, r=correlation coefficient, TUG=Timed Up and Go.
Note: *statistical significance set at p<0.05, n=26 for TUG-Manual (five participants required bilateral upper limb support to walk and could not complete this task).

Figure 3.3: Scatterplot diagram of the association between the Timed Up and Go - Manual and the Activities-specific Balance Confidence scale.

The association between FOF and the dual-task outcome measures was further examined using linear regression analysis (see Table 3.5). The TUG-Manual explained
24.9% of the variance in the ABC and was statistically significant (p=0.01). The TUG-Literacy and the TUG-Arithmetic explained 10.2% and 5.6% of the variance in the ABC respectively but were not statistically significant. After removal of outliers from each outcome measure the linear regression models were repeated and no change was demonstrated in the significance level of each model.

| Table 3.5 Results of linear regression analysis to assess the association between fear of falling and the dual-task outcome measures |
|---------------------------------|---------------------------------|---------------------------------|
|                                 | TUG-Manual (n = 26)             | TUG-Literacy                   | TUG-Arithmetic                 |
| ABC                             | r = 0.499                       | r = 0.319                      | r = 0.236                      |
|                                 | r² = 0.249                      | r² = 0.102                     | r² = 0.056                     |
|                                 | p = 0.01*                       | p = 0.08                       | p = 0.2                        |

Abbreviations: ABC=Activities-specific Balance Confidence scale, TUG=Timed Up and Go, r=correlation coefficient, r²=coefficient of determination.
Note: *statistical significance set at p<0.05, n=26 for TUG-Manual (five participants required bilateral upper limb support to walk and could not complete this task).

3.6 Fear of falling categories

Participants were divided into two groups using a cut-off score of 69 on the ABC. Those scoring less than 69 were considered to have a high level of FOF (high FOF) (n=14) and those scoring greater than 69 were considered to have a low level of FOF (low FOF) (n=17). There were no significant differences between the groups in age, time since diagnosis, falls history or cognitive function as can be seen in Table 3.6. Women were four times more likely to be in the high FOF group (Odds Ratio (OR)=4.32, 95% Confidence Interval (CI)=0.95-19.58), however, this was not statistically significant. Participants with more advanced disease severity (Hoehn and Yahr Stages III-IV) were significantly more likely to be in the high FOF group (p=0.00) (OR=23.83, 95% CI=2.48-229.4).
Table 3.6 Comparison of demographic details between participants with low and high levels of fear of falling

<table>
<thead>
<tr>
<th></th>
<th>Low FOF (n=17)</th>
<th>High FOF (n=14)</th>
<th>Odds ratio (CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y) Mean (SD)</td>
<td>67.35 (9.01)</td>
<td>72.14 (6.96)</td>
<td>4.32 (0.95-19.58)</td>
<td>0.12a</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>5 (29%)</td>
<td>9 (64%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MMSE</td>
<td>27.47 (1.9)</td>
<td>26.93 (2.17)</td>
<td></td>
<td>0.05b</td>
</tr>
<tr>
<td>Hoehn and Yahr</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage I - II</td>
<td>11</td>
<td>1</td>
<td>23.83 (2.48-229.4)</td>
<td>0.47a</td>
</tr>
<tr>
<td>Stage III - IV</td>
<td>6</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Since Diagnosis (y)</td>
<td>Median (IQR)</td>
<td>3 (5)</td>
<td>5.5 (6)</td>
<td>0.118c</td>
</tr>
<tr>
<td>Falls History</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>13</td>
<td>7</td>
<td>3.25 (0.75-15.07)</td>
<td>0.15d</td>
</tr>
<tr>
<td>Yes</td>
<td>4</td>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: a=Independent Samples T-test, b=Chi-square test, c=Wilcoxon sum-rank test, CI=Confidence Interval, d=Fisher’s exact test, MMSE=Mini-Mental State Examination, FOF=fear of falling, MMSE=Mini-Mental State Examination, y=years.
Note: *statistical significance set at p<0.05.

3.7 Comparison of outcome measures between fear of falling categories

Those in the high FOF category took longer to complete the single task and dual-tasks than those in the low FOF category as can be seen in Table 3.7 and Figure 3.4. However, this was only statistically significant for the TUG and the TUG-Manual (p=0.04 and p=0.00 respectively).

Table 3.7 Comparison of outcome measures between participants with low and high levels of fear of falling

<table>
<thead>
<tr>
<th></th>
<th>Low FOF (n=17)</th>
<th>High FOF (n=14)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC</td>
<td>Mean (SD)</td>
<td>87.02 (8.32)</td>
<td>56.52 (6.07)</td>
</tr>
<tr>
<td>TUG</td>
<td>Median (IQR)</td>
<td>10.46 (4.83)</td>
<td>13.93 (7.09)</td>
</tr>
<tr>
<td>TUG-Manual</td>
<td>Mean (SD)</td>
<td>12.32 (3.39)</td>
<td>17.63 (5.24)</td>
</tr>
<tr>
<td>TUG-Literacy</td>
<td>Median (IQR)</td>
<td>13.02 (13.65)</td>
<td>18.42 (9.73)</td>
</tr>
<tr>
<td>TUG-Arithmetic</td>
<td>Median (IQR)</td>
<td>18.38 (17.03)</td>
<td>19.59 (10.06)</td>
</tr>
</tbody>
</table>

Abbreviations: a=Independent samples t-test, b=Wilcoxon-signed ranks test, ABC=Activities-Specific Balance Confidence Scale, FOF=fear of falling, IQR=Inter-quartile Range, n=number of participants, SD=Standard Deviation, TUG=Timed Up and Go. Note: * Statistical significance set at p<0.05.
Figure 3.4: Clustered bar chart of summary scores from outcome measure results.
Abbreviations: FOF=Fear of Falling, TUG=Timed Up and Go.
Note: * Statistical significance set at $p<0.05$. Mean reported for TUG-Manual (data normally distributed), median reported for TUG, TUG-Literacy and TUG-Arithmetic (data non-normally distributed).
CHAPTER 4 - DISCUSSION

The aim of this study was to assess the association between fear of falling (FOF) and motor dual-task and cognitive dual-task performance in people with idiopathic Parkinson’s Disease (PwP) in Ireland. Results from this study demonstrated greater levels of FOF in 31 community-dwelling PwP than previously published normative data. Additionally, it was found that FOF was significantly associated with the performance of a motor dual-task. There was a moderate association between FOF and a word-based cognitive dual-task and a weak association with an arithmetic cognitive dual-task.

The Activities-specific Balance Confidence (ABC) was used to estimate the level of FOF, with lower scores representing greater FOF. The median score on the Activities-specific Balance Confidence (ABC) scale was 73% (IQR=31.25) in this study of PwP with an average age of 69.5 years. This is lower than a previously reported score of 92% in 278 healthy older adults, despite a higher average age of 76 years (Herman et al., 2009). Results of the current study are similar to previously published research regarding FOF in PwP. Both Mak et al. (2012) and Lohnes and Earhart (2010) reported a mean score of 74% on the ABC scale in samples of 57 and 89 community-dwelling PwP respectively. Dal-Bello Haas et al. (2010) reported a much higher mean score of 91% in PwP. However, the participants in that study had comparatively lower PD severity with the majority of participants in Hoehn and Yahr stages I-II. Conversely, Maloney and French (2012) reported a lower average score of 52% on the ABC-6 (an abbreviated version of the ABC scale) in PwP (n=37) in Ireland. However, those participants had more advanced PD with no participants in Hoehn and Yahr Stage I and 15 participants in Hoehn and Yahr Stage IV. Similar to the findings of Dal-Bello Haas et al. (2010), ABC scale score significantly increased with disease severity (r=-}
0.632) indicating that increased FOF was associated with increased disease severity. Fear of falling also increased significantly with age and time since diagnosis which is similar to previous research (Donoghue et al., 2013; Lindholm et al., 2014). Women reported significantly higher levels of FOF on the ABC scale than men. After categorisation, women were four times more likely to be in the high FOF category than men, however, this was not statistically significant. Previous research findings reported that women tend to have a more sedentary lifestyle, are more likely to experience falls and report greater perceived consequences of falling, such as a loss of identity (Rahman et al., 2011; LeBouthillier et al., 2013; TILDA, 2014). This may explain the reason for the gender difference in the reported levels of FOF in this study.

Forty-five percent of PwP in this study were considered to have a high level of FOF (high FOF) when a cut-off score of 69 on the ABC scale was implemented. This is consistent with a previously reported prevalence of 44% of high FOF in 79 PwP (Bryant et al., 2013). Similar to the findings of Bryant et al. (2013), participants with high FOF tended to be older and had a longer duration of PD with greater disease severity than those with low FOF. However, in this present study, these results were only statistically significant for disease severity (Hoehn and Yahr stage). The significant impact of disease severity on FOF may be attributed to the reduced lower limb muscle strength, postural instability and gait difficulties that are associated with advancing PD severity (Adkin et al., 2003; Franchigoni et al., 2005; Stevens-Lapsley et al., 2012) These factors have demonstrated significant associations with increased FOF in previous research in PwP (Mak et al., 2012).

This research study also demonstrated that PwP took longer to complete both single and dual-tasks than previously published normative data. The mean time for completion of the Timed Up and Go (TUG) was 11.46 (±5.97) seconds on average in
this study. This compares with approximately 9.7 seconds in a normative study of Irish people with an average age of 70 (Kenny et al., 2013). The basal ganglia have an important role in the control of learned, repetitive sequences of movement which is known as movement automaticity. As PD causes neural degeneration specifically in the basal ganglia, this may result in reduced movement automaticity with greater conscious attention required for an individual task (Trail et al., 2008). This may contribute to the longer completion times for relatively easy tasks in PwP. The completion time for the TUG in this research study is consistent with averages of between 9.98 seconds (Paul et al., 2012) and 15.7 seconds (Verheyden et al., 2014) reported previously in PwP.

The addition of each of the dual-tasks resulted in increased completion times when compared with the single task only. This reduction in performance is defined as dual-task interference (Kelly et al., 2012). With the addition of a dual-task, the participant was required to concentrate on two tasks at once. The increased completion time for the dual-tasks may be explained by one of the theories of dual-task interference. The capacity theory proposes that when performing dual-tasks there is competition for information processing resources which can result in a deterioration of performance in one or both tasks (Pashler and Johnston, 1998; Kelly et al., 2012).

The completion time for all of the dual-tasks was also longer in this study of PwP than previously published normative data. For example, the mean completion time for the TUG-Manual was 14.57 (±4.96) seconds in this study in comparison with an average of 7.2 (±0.8) in healthy controls (n=16) (Galletly and Braeur, 2005). Similarly, the average completion time for the TUG-Literacy was 16.82 (IQR=11.84) seconds in this study in comparison with 11.58 (±2.63) seconds in healthy older adults (n=10) (Campbell et al., 2003). Bloem et al. (2006) reported that when completing either
motor or cognitive dual-tasks, PwP attempted to perform all tasks simultaneously. In contrast, when completing complex dual-tasks, young and age-matched healthy controls prioritised walking over the performance of the dual-task. This was termed a ‘posture first strategy’ in healthy controls to maximise safety while PwP adopted a ‘posture second’ strategy (Bloem et al., 2006). In the case of this research study, this issue with task prioritisation in PwP may partly explain the longer completion times for the dual-tasks than those previously reported in healthy controls.

In relation to task complexity, the dual task cost was calculated for each outcome measure as: (dual-task – single task)/(single task x 100). Reporting of the dual-task cost may facilitate the comparison of research studies regarding dual-tasking (Kelly et al., 2012). The results indicated that the motor dual-task was the easiest with the shortest completion time and the lowest dual-task cost when compared with the cognitive dual-tasks. This was consistent with the results of previous research studies in PwP which reported that motor dual-tasks were easier than cognitive dual-tasks (Rochester et al., 2004; Galletly and Brauer, 2005). The TUG-Manual completion time in this study was greater than a previous study of PwP (n=16) with a mean of 10.3 (±2.7) seconds (Galletly and Braeur, 2005). However, participants in the latter study had relatively mild PD with an average score on the Unified Parkinson’s Disease Rating Scale of 14.4 out of a possible 108 (a lower score indicates less disease severity). In contrast, the participants in this present study varied from mild to severe PD with six participants in Hoehn and Yahr Stage IV which indicates severe disability (Hoehn and Yahr, 1967). Additionally, time to complete the TUG-Manual was found to be significantly associated with increased disease severity in this present study (r=0.55, p=0.00). Moloney and French (2012) also included participants ranging from mild to severe on the Hoehn and Yahr scale and reported similar TUG-Manual times
of 11.72 (±6) seconds in non-fallers and 14.6 (±13.3) seconds in fallers in PwP (n=36).

In contrast, Robinson et al. (2005) reported higher average TUG-Manual completion times of 21.86 and 22.05 in non-fallers and fallers respectively in PwP (n=40). However, the TUG-Manual was assessed with the participant carrying a full glass of water in the study by Robinson et al. (2005). The original procedure for the TUG-Manual described by Lundin-Olsson et al. (1998) states that the glass should contain five centilitres of water with the surface of the liquid five centimetres from the top of the glass. This was the procedure implemented in the present study and the more difficult task of a full glass of water in the trial by Robinson et al. (2005) may explain the reason for the large difference in the reported results. This also provides more evidence that completion time increases with the complexity of the dual-task.

Similar to the results of previous research (Galletly and Braeur, 2005; Moloney and French, 2012) the TUG-Arithmetic was the most difficult dual-task with a median completion time of 19.32 (IQR=14.28) seconds and the highest dual-task cost. The result for the TUG-Arithmetic in this research study was much higher than a previously reported average time of 7.8 (±1.3) seconds in healthy controls (Galletly and Brauer, 2005). In relation to TUG-Arithmetic completion times in PwP, Moloney and French (2012) reported an average completion time of 12.09 (IQR=9.8) and 17.14 (IQR=17.6) seconds in non-fallers and fallers respectively. Conversely, Galletly and Brauer (2005) reported a lower average completion time of 11.5 (±2.7) seconds in 16 PwP of mild severity. As discussed for the other dual-task results, the differences in the research findings may be attributed to differences in the disease severity of the participants across research studies.

Additionally, it may be necessary to consider the reliability of the cognitive dual-task outcome measures: the TUG-Literacy and the TUG-Arithmetic. Interquartile ranges of
11.84 seconds and 14.28 seconds were reported for the TUG-Literacy and the TUG-Arithmetic in this study. Maloney and French (2012) reported inter-quartile ranges of 9.8 and 17.6 seconds for the TUG-Arithmetic in non-fallers and fallers respectively. These relatively large interquartile ranges suggest that the measures lack precision (Plichta-Kellar and Kelvin, 2013). The variability of the data may be reduced with larger sample sizes in future research studies. However, the test-retest reliability of these outcome measures in PwP, particularly those with motor fluctuations, should also be considered. Paul et al. (2012) completed a research study of the test-retest reliability of various outcome measures in PwP. It was reported that the test-retest reliability of the TUG-Arithmetic improved from poor to excellent reliability when participants with disabling dyskinesias were excluded from the data. Therefore, this approach may need to be considered in future studies of PwP. Additionally, the current instructions for the TUG cognitive dual-tasks do not advise the participant to focus on one task over another. Therefore, it may also be useful to assess if altering the instructions when completing the cognitive dual-tasks results in improved reliability in this population.

The association between FOF and dual-task performance was assessed in this research study. It was found that FOF had a strong inverse association with the motor dual-task (the TUG-Manual) \((r=-0.504)\). This suggests that increased anxiety levels associated with FOF may result in a more cautious gait and increased completion time for tasks. This is similar to previous research in PwP as Rochester et al. (2008) reported that FOF was moderately associated with gait speed \((r=0.308)\) when completing a motor dual-task in PwP \((n=130)\). In this present study FOF explained 25% of the variance in the TUG-Manual, in comparison with 10% of the variance in the motor task assessed by Rochester et al. (2008). In the latter study participants were timed while walking
and carrying a tray with two cups of water on it. This task would be considered more
difficult than the TUG-Manual assessed in this study as participants were only required
to carry one glass of water and may explain the discrepancy in the results. The
association between FOF and the motor dual-task was also further supported by a
statistically significant difference between the completion time for the TUG-Manual
when the groups were divided into those with low FOF and high FOF (p=0.00). Participants with low FOF completed the TUG-Manual more quickly than those with high FOF.

Fear of falling had a significant moderate association with the TUG-Literacy when outliers were removed. A weak non-significant association was demonstrated between FOF and the TUG-Arithmetic, regardless of whether outliers were included or excluded. Furthermore, linear regression analysis demonstrated that the TUG-Literacy and the TUG-Arithmetic explained 10.2% and 5.6% respectively of the variance in the ABC scale score. Notably, moderate to strong significant associations were demonstrated between the cognitive dual-tasks and cognitive function (MMSE score) (r=-0.48 for TUG-Literacy and r=-0.532 for TUG-Arithmetic) in comparison with a weak non-significant association between the motor dual-task and cognitive function (r=-0.16). It may be the case that performance of the cognitive tasks relied more on cognitive function and, therefore, was not as influenced by FOF as the motor dual-task. Kelly et al. (2012) propose that cognitive impairments may limit the ability to use cognitive strategies, such as concentrating on taking larger steps, to compensate for gait abnormalities during dual-task walking. Additionally, a review by Yogev-Seligmann et al. (2008) reported that people who have impairments of executive function may have difficulty allocating and shifting attention in dual-task situations. For example, consistent with the findings in this present study, Plotnik et al. (2011)
reported that executive function and attention impairments were associated with cognitive dual-task walking deficits in PwP.

When participants were compared based on their level of FOF, it was found that participants with high FOF demonstrated increased completion times for the dual-task outcome measures when compared with those with low FOF (recall Fig.3.4). Bryant et al. (2013) reported similar results in 79 PwP with high FOF significantly associated with reduced gait speed and stride length during forward and backward walking, even after controlling for falls history. Participants with high FOF also took significantly longer to complete a 5-step test, 360° turns and the TUG in that research study. The increased completion time for the dual-tasks in the high FOF group in this research study may be an adaptation to stabilise postural sway. Reelick et al. (2009) reported that FOF was associated with gait speed in healthy older adults but that participants with high FOF did not demonstrate an increase in trunk sway as had been expected by the authors, suggesting that they reduced their gait speed in order to minimize postural sway. Similarly, Donoghue et al. (2013) propose that gait adaptations (reduced gait velocity) during dual-task walking by healthy older adults who had FOF may be stabilising strategies to reduce the risk of falls.

Bryant et al. (2013) suggest that PwP may develop FOF as a result of the physical deficits associated with PD. Alternatively; the anxiety associated with FOF may result in gait impairments. The cross-sectional design of this research study does not allow conclusions to be drawn as to whether a high level of FOF resulted in impairments in dual-task performance or impairments in dual-task ability resulted in increased FOF. A longitudinal, cohort study of PwP may provide more insight into the cause and effect relationship between FOF and dual-task performance. This type of study design may also inform whether the longer completion times for dual-tasks by people who
had higher levels of FOF in this research study actually act as a stabilising strategy and reduce future falls risk. However, a strong correlation was previously found between FOF and activity avoidance in PwP (Rahman et al., 2011). Furthermore, Bryant et al. (2014) recently reported that FOF was associated with activity of daily living (ADL) limitations and physical inactivity in PwP of mild to moderate disease severity (n=83). While these reductions in physical activity due to FOF may reduce the risk of falls in the short-term, in the long term this may result in further deteriorating function and increase the risk of future falls (TILDA 2011). A number of research studies have demonstrated that, after controlling for other variables such as disease severity, FOF is not associated with a history of falls in PwP (Mak et al., 2012; Nilsson et al., 2012; Lindholm et al., 2014). However, a high level of FOF is predictive of sustaining recurrent falls in the next 12 months (Mak and Pang, 2009).

It must be noted that with appropriate intervention FOF is modifiable. A single blind randomised controlled trial of PwP (n=51) has shown that balance training with augmented feedback resulted in significant improvements in ABC scale score and balance and gait performance when compared with lower limb strength training (Shen and Mak, 2014). The balance training group had further improvements in all outcome measures at the three and 12 month follow-up. The authors proposed this may be attributable to increased activity levels due to the improvement in walking skills and reduced FOF. This demonstrates that FOF is modifiable in PwP and should be targeted to prevent further deteriorating function.

There have also been developments in research regarding dual-task training in PwP. In the past PwP were advised to avoid dual-task activities in order to reduce falls risk (Royal Dutch Society for Physical Therapy (Koninklijk Nederlands Gnootschap voor Fysiotherapie) Guidelines, 2004). However, there have been a number of pilot studies
in recent years regarding dual-task training in PwP that have demonstrated improvements in dual-task ability. Brauer and Morris (2010) demonstrated that dual-task ability significantly improved in some, but not all, variables after a single 20 minute training session in PwP (n=20). Similarly, Canning et al. (2008) reported that three dual-task training sessions with five PwP resulted in increased walking velocity during dual-task completion with no adverse effect.

In contrast, Bo Foreman et al. (2013) reported that no improvements were observed in dual-task ability in seven PwP (average age 68 years) after three sessions of dual-task training in one week. However, while a younger group of seven healthy controls (average age=25 years) demonstrated an improvement, no improvement was seen in seven healthy age-matched controls either. This suggests that the training duration may have been insufficient to have a training effect in this age group. This theory is supported by Yogev-Seligmann et al. (2012) when it was demonstrated that three dual-task training sessions per week for four weeks resulted in improvements in gait speed and gait variability in PwP in both trained and untrained tasks. Furthermore, these improvements were retained one month after training.

It is clear from the research discussed that both dual-task assessment and training may be of interest to physiotherapists treating PwP as dual-task deficits are especially evident in this population and may respond well to appropriate training. However it must be noted that all of the dual-task training trials focused on participants with mild to moderate PD severity (Hoehn and Yahr stage I-III), therefore, these findings are not generalizable to all PwP. It has been proposed by Morris et al. (2010) that people with mild to moderate PD may benefit from learning new skills, such as completing dual-task training. In contrast, people with severe PD or those with a cognitive impairment may benefit more from compensatory methods such as dual-task avoidance.
The moderate to strong associations between FOF and dual-task performance observed in this research study may support future research to investigate the addition of cognitive behavioural therapy to dual-task training in PwP of mild to moderate severity. Rahman et al. (2011) suggests that cognitive behavioural therapy techniques in addition to exercise and multi-factorial falls prevention programs with PwP may help to reduce FOF and minimise activity avoidance in this population. Cognitive behavioural therapy interventions were reported to have beneficial results in community-dwelling older adults without PD who were fearful of falling and had reduced their activity levels as a result (van Haastregt et al., 2007). It may also be beneficial to assess the long-term impact of combining balance training with augmented feedback and dual-task training on FOF, activity avoidance and prospective falls in PwP of mild to moderate severity.

Limitations of this research study

- The relatively large interquartile ranges reported for the cognitive dual-tasks in this study suggest that these results may lack precision (Plichta-Kellar and Kelvin, 2013). Secondary to the findings of Paul et al. (2012), future studies may exclude PwP with disabling dyskinesias from completing these outcome measures as this may result in improved test-retest reliability. Alternatively, it may be beneficial to assess if altering the instructions for PwP to focus on one task over another results in improved cognitive dual-task reliability in this population.

- Participants were only assessed during the self-reported “on-state” when their medication was at its optimal level. The association between FOF and dual-task ability may differ in the “off-state”.
• As this was an observational, cross-sectional research study it cannot be concluded whether FOF results in poorer dual-task performance or impaired dual-task performance results in FOF.

• Multiple regression analysis to investigate the contribution of FOF to dual-task performance while controlling for baseline demographic variables was not performed due to the small sample size.

• The performance of the cognitive dual-tasks was measured by documenting if the participant made an error that interrupted the performance of the secondary task that required verbal cueing to restart as defined by Campbell et al. (2003). However, this data was not analysed as it was deemed inaccurate by the researcher in this study. Participants often made errors in the cognitive tasks that did not require verbal cueing to restart and therefore did not fulfil the criteria. Future research studies could record the number of correct or incorrect responses as an alternative method of measuring cognitive dual-task performance as used by Fuller et al. (2013).

**Recommendations for future research**

• A reliability study of cognitive dual-task outcome measures in a large sample of PwP, particularly in relation to those with disabling dyskinesias and the “on and off states” associated with PD symptoms.

• A longitudinal, cohort study of PwP investigating the development of FOF and/or dual-task impairment overtime to identify the cause and effect nature of this association.
• A randomised-controlled trial to investigate the impact of the addition of cognitive behavioural therapy training to the recently identified benefits of dual-task training programs for PwP.

• A randomised-controlled trial to investigate the long-term impact of balance and dual-task training on fear of falling, physical activity levels and quality of life in PwP.
Conclusion

In conclusion, fear of falling and dual-task difficulties are common among PwP and are easily assessed in the clinical setting. Fear of falling was significantly associated with increasing age, duration and severity of PD. Women reported significantly higher levels of fear of falling than men. High levels of fear of falling were reported by 45% of participants in this research study based on a score of less than 69 on the ABC scale.

Poorer dual-task performance was demonstrated in this study of PwP than previously reported normative data. The motor dual-task was considered the easiest with the shortest completion time and the lowest dual-task cost, while the arithmetic cognitive dual-task was considered the most difficult. Completion times for all of the dual-task outcome measures increased significantly with age and disease severity. Cognitive function (measured by the MMSE) was significantly associated with the cognitive dual-tasks but not with the motor dual-task.

Fear of falling was associated with dual-task performance in PwP, explaining six to 25 percent of the variance in FOF depending on the type of dual-task assessed. A weak non-significant association was demonstrated between FOF and the TUG-Arithmetic. However, a moderate significant association was demonstrated between FOF and the TUG-Literacy when outliers were excluded, while a strong significant association was demonstrated between FOF and the TUG-Manual. The findings from this research study suggest that FOF and impairments in dual-task ability are common in PwP and are easily assessed in the clinical setting. Future research studies could focus on the long-term impact of balance and dual-task training on reducing FOF and improving dual-task performance in PwP, particularly those of mild to moderate disease severity.

Word Count: 12,295 words (excluding references and appendices).
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older people. National Institute of Clinical Excellence, United Kingdom.


tasks in Parkinson's Disease: which characteristics are important? Movement Disorders 23(16):2312-2318.


Appendix  A – Ethics Form and Letter of Ethical Approval

STANDARD APPLICATION FORM

For the Ethical Review of

Health-Related Research Studies, which are not Clinical Trials of Medicinal Products For Human Use

as defined in S.I. 190/2004

DO NOT COMPLETE THIS APPLICATION FORM

IF YOUR STUDY IS A CLINICAL TRIAL OF A MEDICINAL PRODUCT

Title of Study: Is there an association between fear of falling and dual-task performance in Parkinson’s Disease?

Principal Investigator: Eimear O’ Connell

Applicant’s Signature:______________________________________

For Official Use Only – Date Stamp of Receipt by REC:
TABLE OF CONTENTS MANDATORY / OPTIONAL

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SECTION B STUDY DESCRIPTORS MANDATORY

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SECTION E DATA PROTECTION MANDATORY

SECTION F HUMAN BIOLOGICAL MATERIAL OPTIONAL

SECTION G RADIOCATIVE MATERIAL / DIAGNOSTIC OR THERAPEUTIC IONISING RADIATION OPTIONAL

SECTION H MEDICAL DEVICES OPTIONAL
SECTION I MEDICINAL PRODUCTS / COSMETICS / FOOD AND FOODSTUFFS OPTIONAL

SECTION J INDEMNITY MANDATORY

SECTION K COST AND RESOURCE IMPLICATIONS AND FUNDING MANDATORY

SECTION I ETHICAL ISSUES MANDATORY

This Application Form is divided into Sections.

Sections A, B, C, D, E, J, K, L are Mandatory.

Sections F, G, H, and I are optional. Please delete Sections F, G, H, and I if these sections do not apply to the application being submitted for review.

IMPORTANT NOTE: Please refer to Section I within the form before any attempt to complete the Standard Application Form. Section I is designed to assist applicants in ascertaining if their research study is in fact a clinical trial of a medicinal product.

IMPORTANT NOTE: This application form permits the applicant to delete individual questions within each section depending on their response to the preceding
questions. Please respond to each question carefully and refer to the accompanying Guidance Manual for more in-depth advice prior to deleting any question.

SECTION A GENERAL INFORMATION

IMPORTANT NOTE: This application form permits the applicant to delete individual questions within each section depending on their response to the preceding questions. Please respond to each question carefully and refer to the accompanying Guidance Manual for more in-depth advice prior to deleting any question.

A1 Title of the Research Study:

Is there an association between fear of falling and dual-task performance in Parkinson’s Disease?

A2 Principal Investigator(s):

Title: Ms. Name: Eimear O’Connell

Qualifications: BACHELOR OF SCIENCE IN PHYSIOTHERAPY (1st Class Honours)

Position: BASIC GRADE PHYSIOTHERAPIST

Dept: PHYSIOTHERAPY DEPARTMENT

Organisation: HEALTH SERVICE EXECUTIVE

Address: Physiotherapy Department, St. Patrick’s Hospital, Cashel, Co. Tipperary

Tel: 06270338 E-mail: Eimear.oconnell@hse.ie
A3 (a) Is this a multi-site study? Yes

A3 (b) Please name each site where this study is proposed to take place and state the lead investigator for each site:

<table>
<thead>
<tr>
<th>Site:</th>
<th>Lead Investigator:</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Tipperary General Hospital, Clonmel, Co, Tipperary</td>
<td>Eimear O’ Connell</td>
</tr>
<tr>
<td>Outpatient physiotherapy department, Our Lady’s Hospital, Cashel, Co. Tipperary</td>
<td>Eimear O’ Connell</td>
</tr>
<tr>
<td>Day Hospital, St. Patrick’s Hospital, Cashel, Co. Tipperary</td>
<td>Eimear O’ Connell</td>
</tr>
</tbody>
</table>

A3 (c) For any of the sites listed above, have you got an outcome from the research ethics committee (where applicable)?

No

A4. CO-INVESTIGATORS:

NAME OF SITE

Royal College of Surgeons in Ireland

Title: Prof Name: MARIE GUIDON
QUALIFICATIONS: POST. GRAD. DIP. STATISTICS, MSC, PHD.
POSITION: Head RCSI School of Physiotherapy
ORGANISATION: ROYAL COLLEGE OF SURGEONS IN IRELAND
Address: Royal College of Surgeons in Ireland, 123 St. Stephen’s Green, Dublin 2.

ROLE IN RESEARCH: Academic Supervisor
A5. Lead contact person who is to receive correspondence in relation to this application or be contacted with queries about this application.

Title: Ms. Name: EIMEAR O’ CONNELL

Address: Physiotherapy Department, St. Patrick’s Hospital, Cashel, Co. Tipperary

Tel (work): 06270338 Tel (mob.): 0879665378

E-mail: Eimear.oconnell@hse.ie

A6. Please provide a lay description of the study.

People with Parkinson’s Disease have a greater risk of falls than other people of a similar age. They often report a fear of falling and a difficulty with completing two tasks at once. This may lead to increased falls.

This study is being conducted to find out the level of fear of falling in a sample of people with Parkinson’s Disease in Ireland and to ascertain if this has an impact on being able to do two tasks at the same time. This may help physiotherapists and people with Parkinson’s Disease by providing more information about why people with Parkinson’s Disease find it difficult to do two tasks at once and help to guide future physiotherapy treatment.

A7 (a) Is this study being undertaken as part of an academic qualification? Yes

A7 (b) If yes, please complete the following:

Student Name: Eimear O’ Connell Course: Master of Science in Neurology and Gerontology

Institution: Royal College of Surgeons in Ireland

Academic Supervisor: Professor Marie Guidon, Head RCSI School of Physiotherapy
B1. Provide information on the study background.

People with Parkinson’s Disease (PD) are 9 times more likely to be recurrent fallers than healthy controls (Bloem et al., 2001). In the last decade attention has been drawn to the ability of people with PD to complete two tasks at once, which is known as dual-tasking. People with PD consistently demonstrate poorer dual-task ability than healthy age-matched controls (Kelly et al., 2012). Additionally people with PD subjectively report that fear of falling is associated with the reduced ability to dual task (Bloem et al., 2001).

Fear of falling in people with PD has been reported to be associated with dual-task performance when a motor task was performed, accounting for 10% of the variance in dual-task performance (Rochester et al., 2008). However, cognitive tasks have been shown to have a greater impact on dual-task performance than motor tasks in people with PD. Therefore, this study aims to further investigate the association between fear of falling and dual-task performance when both motor and cognitive tasks are included.

B2. List the study aims and objectives.

Aim

- to assess the association of fear of falling and dual-task performance in community-dwelling adults with Parkinson’s Disease (PD)

Objectives

- To investigate the prevalence of fear of falling in an Irish sample of community-dwelling adults with PD
- To investigate the association of a motor dual-task performance with fear of falling
- To investigate the association of cognitive dual-task performance with fear of falling
B3. List the study endpoints (if applicable).

**Outcome Measures:**

1. **Mini-Mental State Examination** – this test will be used to assess the level of cognitive impairment
2. **Timed Up and Go** – the timed up and go will be conducted to measure functional mobility under single and dual-task conditions by measuring it in isolation and also when performing a variety of dual-tasks, namely carrying a cup, counting backwards, or reciting the days of the week backwards.
3. **Activities-specific Balance Confidence Scale** – this self-report questionnaire will be used to investigate fear of falling.

B4. Provide information on the study design.

The proposed study design is an observational, cross-sectional study. Testing will take place in three Health Service Executive (HSE) physiotherapy sites in South Tipperary.

B5. Provide information on the study methodology.

A convenience sample of 40 participants will be recruited. They will be invited to attend for assessment at a time that is convenient for them and informed consent will be obtained prior to the assessment. This assessment will take approximately 30 to 45 minutes. Outcome measures will be assessed within two hours of taking anti-parkinsonian medication (Maloney and French, 2012 (unpublished research dissertation)). Demographic data will be documented first (Age, Sex, Number of falls in the last 6 months, Hoehn and Yahr stage, type of walking aid (if any), time since last anti-parkinsonsian medication taken). Then, the following research instruments will be administered:

**Mini-Mental State Examination (MMSE)**

The MMSE (see Appendix G) will be administered first to ensure sufficient cognitive ability to complete the Activities-Specific Balance Confidence Scale (ABC) which will be subsequently administered. The MMSE is a simple and universally applicable scale of 30 questions and is recommended as the primary screening instrument for dementia.
in PD by the Movement Disorder Society (Dubois et al., 2007). It was chosen for implementation in this research study as the ABC has been validated for use in people with PD with an MMSE score of $\geq 20$ (Dal Bello-Haas et al., 2010). A score of 25 or below on the MMSE is proposed by the Movement Disorder Society to indicate the presence of a cognitive impairment in a patient with PD (Dubois et al., 2007).

Activities-Specific Balance Confidence Scale (ABC)

The ABC is widely used in research trials to assess fear of falling in people with PD (Mak and Pang, 2009; Mak et al., 2012). The participant rates how confident they are to complete 16 indoor and outdoor activities without falling or losing their balance. The ABC demonstrated excellent test-retest reliability (ICC: 0.94) and excellent internal consistency in a sample of 35 people with PD ranging from Hoehn and Yahr stages one to four (Steffen and Seney, 2008). The ABC demonstrates high sensitivity (93%) and moderate specificity (67%) at discriminating fallers from non-fallers in PD (Mak and Pang, 2009).

Dal Bello Haas et al. (2010) reported that, when completing the ABC, some participants may need to be reminded to distinguish between their balance confidence versus their usual level of participation in each task. Therefore, the principal investigator will be present to assist the patient with scale completion as required.

Timed Up and Go (TUG) (see Appendix F)

TUG-basic

The timed up and go (TUG) test was first developed by Podsiadlo and Richards (1991) (cited in Nordin et al. (2006)). The TUG is a valid and reliable outcome measure of functional mobility in people with Parkinson’s Disease (Morris et al., 2001). It is easy to set-up and implement in a clinical setting. To complete the TUG the participant will be instructed to stand from a chair, walk 3 metres at a comfortable speed, cross a line on the floor, turn around, walk back and sit down again (Podsiadlo and Richards (1991) (cited in Nordin et al., 2006)).

Each TUG trial will be timed using a stopwatch. Timing will begin when the subjects back is no longer in contact with the back of the chair and stop when their buttocks touch the seat of the chair again.
TUG-manual

The TUG-manual was first described by Lundin-Olsen et al. (1998) (cited in Shumway-Cook et al., 2000). It was previously used in a study of people with PD (Galletly and Braeur, 2005). The participant is requested to complete the TUG-basic while carrying a glass of water in one hand. In this present study any participants who require bilateral upper limb support to walk will be excluded from completing this outcome measure.

TUG-arithmetic

The TUG-arithmetic was first described by Shumway-Cook et al. (2000) and was previously used in a sample of people with PD (Galletly and Braeur, 2005). For this test the participant counts backwards in threes from a randomly selected number between 20 and 100 while completing the TUG-basic.

TUG-literacy

The TUG-literacy was previously assessed in people with PD by Campbell et al. (2003). The participant is instructed to complete the TUG while repeating the days of the week backwards.

The time taken to complete each trial of the TUG will be measured. It will also be recorded if the participant makes an error or not while completing the additional cognitive tasks. An error will be defined as an interruption of the performance of the secondary cognitive tasks that requires verbal cueing to restart as used by Campbell et al. (2003).

The order in which the TUG tasks will be completed will be randomly selected by the participant picking a card from an envelope. This is to prevent any fatigue or practice bias. Each type of TUG will be completed three times as completed by Shumway-Cook et al. (2000) and Campbell et al. (2003). Subjects will be instructed to rest for as long as required between each trial to minimise the risk of fatigue. This procedure was implemented by Campbell et al. (2003) in a sample of people with PD.
B6. What is the anticipated start date of this study?

September 2013

B7. What is the anticipated duration of this study?

Data Collection for the study is proposed to take five months (September 2013 to January 2014).

B8 (a) How many research participants are to be recruited in total?

40

B8 (b) Provide information on the statistical approach to be used (if appropriate) / source of any statistical advice.

Data will be entered into Microsoft Excel initially and transferred to the Statistical Package for the Social Sciences (SPSS) software. Descriptive statistics including the mean, standard deviation and confidence intervals will be presented for the demographic data and the continuous data obtained from the outcome measure assessment. Data will be analysed for normality using Kolmogorov-Smirnov tests. As the aim of this study is to assess the association between fear of falling and dual-task performance, correlational statistical tests will be used. The statistical method chosen will depend on whether the data collected from the ABC and dual-tasks is normally distributed or not. If the data is normally distributed parametric tests will be employed. A Pearson test will be used to assess for a correlation between the ABC and each of the dual-tasks assessed. If the data is non-normally distributed non-parametric tests will be employed ie. a Spearman test. The level of statistical significance will be set at $p<0.05$. Statistical advice will be sought from the academic supervisor and a statistician in the Royal College of Surgeons in Ireland as required.

B8 (c) Please justify the proposed sample size and provide details of its calculation (including minimum clinically important difference).

The proposed sample is a convenience sample of 40 community-dwelling adults with Parkinson’s Disease. This sample size was calculated based on previous research
regarding fear of falling and dual-task activities. A study by Nilsagard et al. (2012) demonstrated a strong correlation of r=-0.5 between fear of falling and dual task ability in 84 people with Multiple Sclerosis using the Activities-specific Balance Confidence scale and the Timed Up and Go – Arithmetic proposed for use in this present study. Conroy (2009) recommends that to find a correlation between two variables of between 0.45 and 0.55 with a power of 90%, a sample size of between 30 and 48 subjects should be assessed. Therefore, a sample size of 40 people with PD has been chosen for this study.

**B8 (d) Where sample size calculation is impossible (e.g. It is a pilot study and previous studies cannot be used to provide the required estimates) then please explain why the sample size to be used has been chosen.**

Not applicable

**SECTION C study PARTICIPANTS**

**SECTION C IS MANDATORY**

**IMPORTANT NOTE:** This application form permits the applicant to delete individual questions within each section depending on their response to the preceding questions. Please respond to each question carefully and refer to the accompanying *Guidance Manual* for more in-depth advice prior to deleting any question.
C1.1 How many research participants are to be recruited? At each site (if applicable)? And in each treatment group of the study (if applicable)?

<table>
<thead>
<tr>
<th>Name of site:</th>
<th>Predicted number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our Lady’s Hospital, Cashel / Day Hospital, St. Patrick’s Hospital, Cashel.</td>
<td>15</td>
</tr>
<tr>
<td>South Tipperary General Hospital</td>
<td>25</td>
</tr>
</tbody>
</table>

C1.2 How will the participants in the study be selected?

Participants who are identified by a Geriatrician working in the PD clinic in South Tipperary General Hospital as fulfilling the inclusion and exclusion criteria will be posted an information sheet about this study with their standard appointment letter for the PD clinic. This information sheet will be accompanied with a stamped, self-addressed envelope. Participants who are identified by community physiotherapists will be given an information sheet and a stamped, self-addressed envelope by their treating physiotherapist who is not the principal investigator.
C1.3 How will the participants in the study be recruited?

The information sheet instructs those who wish to take part in the study to sign and return the enclosed form in the stamped-addressed envelope provided giving permission to the principal investigator to telephone them to arrange an appropriate time to attend for assessment. Confidential treatment rooms in HSE sites in Clonmel and Cashel (whichever site is more convenient for the patient) will be used for the assessments.

C1.4 What are the main inclusion criteria for research participants? (please justify)

The inclusion criteria for this research proposal are:

- Diagnosis of PD
- Independently mobile six metres with or without an aid in order to complete the outcome measures
- An MMSE score of >20/30 in order to have sufficient cognition to complete the Activities-Specific Balance Confidence Scale Questionnaire.

C1.5 What are the main exclusion criteria for research participants? (please justify)

Participants will be excluded if they have a co-existing, unstable medical condition (e.g. unstable cardiac condition) which would prevent safe participation or are unable to provide written informed consent.

C1.6 Will any participants recruited to this research study be simultaneously involved in any other research project?

Not to my knowledge
**SECTION C2 PARTICIPANTS – INFORMED CONSENT**

C2.1 (a) Will informed consent be obtained? Yes

C2.1 (b) If no, please justify.

Answer

C2.1 (c) If yes, how will informed consent be obtained and by whom?

Informed consent will be obtained by the principal investigator when the participants attend for assessment. There is the possibility that some of the participants may have a cognitive impairment. If the principal investigator suspects a cognitive impairment when obtaining consent for participation the principal investigator will first go through all of the information with the potential participant and then ask them to repeat back what they understand. This will inform judgement as to whether the person has sufficient capacity to make an informed decision about participating rather than excluding them. This approach has been used in previous research (Muina-Lopez and Guidon, 2013).

C2.1 (d) Will participants be informed of their right to refuse to participate and their right to withdraw from this research study?

Yes, this will be documented in the participant information sheet.

C2.1 (e) If no, please justify.

Not applicable

C2.1 (f) Will there be a time interval between giving information and seeking consent? Yes

C2.1 (g) If yes, please elaborate.
Participants will receive the information sheet regarding the study either in the post or from their treating physiotherapist and will be advised to return a signed form giving permission to the research investigator to contact them by telephone to arrange an appointment time convenient to them. On attending for assessment they will be asked to complete an informed consent form.

C2.1 (h) If no, please justify.

not applicable.

SECTION C3 adult participants – CAPACITY

C3.1 (a) Will all adult research participants have the capacity to give informed consent? Yes

C3.1 (b) If no, please elaborate.

C3.1 (c) If no, is this research of such a nature that it can only be carried out on adults without capacity?

C3.1 (d) What arrangements are in place for research participants who may regain their capacity?

SECTION c4 participants under the age of 18

C4.1 (a) Will any research participants be under the age of 18 i.e. Children?

No

C4.1 (b) If yes, please specify:

Persons < 16 Yes / No
Persons aged 16 – 18 Yes / No

Children in care Yes / No

C4.2 Is this research of such a nature that it can only be carried out on children? Yes / No

C4.3 Please comment on what will occur if the researcher discovers that a child is at risk during the course of this study?

Answer

C4.4 Will each child receive information according to his/her capacity of understanding regarding the risks and benefits of the study? Please elaborate and provide copies.

Answer

C4.5 Will the explicit wish of the child who is capable of forming an opinion and assessing information to refuse to participate or to be withdrawn from the study be considered by the lead investigators, co-investigators and principal investigator? Please elaborate.

Answer

C4.6 Please comment on the involvement (if any) of parents / legal guardians of the child in the consent process.

Answer

C4.7 Please explain your approach to reviewing assent where research subjects reach the age of 18 during the course of the study.

Answer
Please confirm if any of the following groups will participate in this study. This is a quick checklist for research ethics committee members and it is recognised that not all groups in this listing will automatically be vulnerable or lacking in capacity.

C5.1 Patients Yes

C5.2 Unconscious patients No

C5.3 Current psychiatric in-patients No

C5.4 Patients in an emergency medical setting No

C5.5 Relatives / Carers of patients No

C5.6 Healthy Volunteers No

C5.7 Students No

C5.8 Employees / staff members No

C5.9 Prisoners No

C5.10 Residents of nursing homes No

C5.11 Pregnant women No

C5.12 Women of child bearing potential No

C5.13 Breastfeeding mothers No

C5.14 Persons with an acquired brain injury No

C5.15 Intellectually impaired persons No

C5.16 Persons aged > 65 years Yes

C5.17 If yes to any of the above, what special arrangements have been made to deal with issues of consent and assent (if any)?
The information sheet and consent form will be clear and concise. Prospective participants will be invited to ask any questions and seek additional clarification on any aspect of the study prior to filling in the consent form.

Additionally if the research investigator suspects a cognitive impairment when obtaining consent for participation the principal investigator will first go through all of the information with the potential participant and then ask them to repeat back what they understand. This will inform judgement as to whether the person has sufficient capacity to make an informed decision about participating rather than excluding them. This approach has been used in previous research (Muina-Lopez and Guidon, 2013).

**SECTION D research PROCEDURES**

**SECTION D IS MANDATORY**

**IMPORTANT NOTE:** This application form permits the applicant to delete individual questions within each section depending on their response to the preceding questions. Please respond to each question carefully and refer to the accompanying Guidance Manual for more in-depth advice prior to deleting any question.

D1. What research procedures or interventions (over and above those clinically indicated and/or over and above those which are part of routine care) will research participants undergo whilst participating in this study?

None. All proposed assessments are part of routine care for people with PD

D2. If there are any potential harms resulting from any of the above listed procedures, provide details below:

There is a low risk of falling when the outcome measures are being completed. Therefore, the physiotherapist conducting the research will stand close to participants at all times to ensure their safety. If a fall does occur the assessment will be discontinued. If the patient sustains an injury they will be referred for review by their GP or local medical team as per local HSE Falls Guidelines. The expected risk of
falling is low considering that all the proposed assessments are regularly used by the research investigator in routine practice.

There is a low risk of fatigue when completing the outcome measures as participants will be requested to complete three trials of each TUG to ensure the results obtained are reliable. Participants will be advised to rest for as long as is necessary between trials to prevent this. This procedure was previously implemented by Campbell et al. (2003) to reduce the risk of fatigue when completing outcome measures with people with PD.

D3. What is the potential benefit that may occur as a result of this study?
There may be no direct benefit to the participant for taking part in this study, however, further information regarding the strength of the association between fear of falling and dual-task performance will assist physiotherapists working with future patients with PD. If a strong association is identified, this may support the addition of cognitive behavioural therapy techniques to currently recommended dual-task training programs for people with PD (Yogeves-Seligmann et al., 2012).

Alternatively, a poor association may reveal patients who have poor perceived balance despite good dual-task performance. A qualitative study of community-dwelling adults with PD found that F.O.F. was identified as a barrier to participating in regular exercise (Ellis et al., 2013) which may result in further deteriorating function. Similarly, it has been found in a prospective study of a large sample of community-dwelling older adults that individuals who limit their activities due to a F.O.F. are at a high risk of becoming fallers (Friedman et al., 2002). This would highlight the importance of identifying people with PD clinically that despite good performance on objective measures of balance or mobility, may be at risk of reduced activity levels and subsequent falls due to fear of falling.

D4 (a) Will the study involve the withholding of treatment?

No.

D4 (b) Will there be any harms that could result from withholding treatment?

Not applicable
D4 (c) If yes, please elaborate.

not applicable

D5. How will the health of participants be monitored during and after the study?

If any problems are identified when completing, or after, the assessments, the principal investigator will be responsible for contacting the patient's consultant or general practitioner (GP) to inform them.

D6 (a) Will the interventions provided during the study be available if needed after the termination of the study? n/a

D6 (b) If yes, please state the intervention you are referring to and state who will bear the cost of provision of this intervention?

Answer

D7. Please comment on how individual results will be managed.

The results will be discussed with the individual participant at the end of the assessments if they wish. Patient confidentiality will be maintained at all times. The results will be coded and only the research investigator will have access to this code. The study records will be kept in the Physiotherapy Department in St. Patrick's Hospital, Cashel. The computer records will be stored on an encrypted password-protected HSE laptop which will be stored in a locked filing cabinet in St. Patrick’s Hospital, Cashel. The information will be destroyed after 5 years.

A summary of the individual participant’s results will be sent to their GP, treating physiotherapist or Geriatrician if the patient wishes. Additionally if any deficits are identified when completing the assessment they will be reported in writing to the GP, treating physiotherapist or Geriatrician as appropriate.
D8. Please comment on how aggregated study results will be made available.

This research study will be reported in the form of a research dissertation for the completion of a Master of Science in Neurology and Gerontology in the Royal College of Surgeons in Ireland. The dissertation will be kept in the Mercer Library in the Royal College of Surgeons in Ireland following completion. It is proposed that the results of the research study may also be submitted for consideration for publication in research journals or for presentation at conferences.

D9. Will the research participant's general practitioner be informed the research participant is taking part in the study (if appropriate)? The GPs of the research participants who are recruited from the caseload of community physiotherapists will be informed by telephone call or letter that their patient is taking part in the study.

D10. Will the research participant's hospital consultant be informed the research participant is taking part in the study (if appropriate)?

The Geriatrician in the Parkinson’s Disease Clinic will be informed by telephone call or letter that their patient is taking part in the study.

SECTION E data protection

SECTION E IS MANDATORY

IMPORTANT NOTE: This application form permits the applicant to delete individual questions within each section depending on their response to the preceding questions. Please respond to each question carefully and refer to the accompanying Guidance Manual for more in-depth advice prior to deleting any question.

SECTION E1 data processing - consent

E1.1 (a) Will consent be sought for the processing of data? Yes

E1.1 (b) If no, please elaborate.

Answer
### SECTION E2 data processing - GENERAL

#### E2.1 Who will have access to the data which is collected?

The research investigator Eimear O’Connell and the academic supervisor Prof. Marie Guidon.

#### E2.2 What media of data will be collected?

Hard copies of the assessments will be collected on site, identified by the ID code only. This information will then be transferred to Excel and will be stored on an encrypted HSE password-protected laptop computer which will be stored in St. Patrick’s Hospital in Cashel.

#### E2.3 (a) Would you class the data collected in this study as anonymous, irreversibly anonymised, pseudonymised, coded or identifiable data?

Coded. When the participant enters the study they will be given an identification code. This will only be documented in one excel document with the patient’s name. All other documentation will identify the patient by the identification code only. During data input and analysis the data will be identified only by the identification code. The file containing the participants’ names and identity codes will be stored separately on the hard drive of the encrypted HSE password-protected laptop computer. Only the research investigator will have access to this file.

#### E2.3 (b) If ‘coded’, please confirm who will retain the ‘key’ to re-identify the data?

The research investigator Eimear O’Connell.

#### E2.4 Where will data which is collected be stored?

Hard copies will be stored in a locked filing cabinet in the physiotherapy department of St. Patrick’s Hospital, Cashel. The computer data will be stored on the hard drive of an encrypted HSE password-protected laptop computer which will be stored in St. Patrick’s Hospital, Cashel.
**E2.5 Please comment on security measures which have been put in place to ensure the security of collected data.**

Hard copies will be stored in a locked filing cabinet in the physiotherapy department of St. Patrick's Hospital, Cashel. The computer data will be stored on the hard drive of an encrypted HSE password-protected laptop computer which will be stored in St. Patrick’s Hospital in Cashel.

**E2.6 (a) Will data collected be at any stage leaving the site of origin?**

Yes

**E2.6 (b) If yes, please elaborate.**

Data that is collected in South Tipperary General Hospital will be taken by the research investigator to St. Patrick's Hospital on the same day it is collected. It will be stored in a locked filing cabinet in St. Patrick's Hospital. The participants name will not be included on the data collection forms that will be transferred from South Tipperary General Hospital to St. Patrick’s Hospital. The identification code only will be marked on the data collection forms.

**E2.7 Where will data analysis take place and who will perform data analysis (if known)?**

Data analysis will take place in St. Patrick’s Hospital, Cashel by the research investigator Eimear O’Connell.

**E2.8 (a) After data analysis has taken place, will data be destroyed or retained?**

It will be retained.

**E2.8 (b) Please elaborate.**

It will be retained until the submission of the thesis and dissemination of results which may include submission for publication. In accordance with the Data Protection Act (1988), the information will not be kept for longer than is necessary.
E2.8 (c) If destroyed, how, when and by whom will it be destroyed?

It will be destroyed by Eimear O’Connell after the submission of the thesis and dissemination of results. It will be destroyed in accordance with local HSE standards for destroying confidential data.

E2.8 (d) If retained, for how long, for what purpose, and where will it be retained?

The information will be kept for no longer than is necessary for submission of the thesis and dissemination of results which may include submission for publication. It will be stored in a locked filing cabinet in St. Patrick’s Hospital, Cashel.

E2.9 Please comment on the confidentiality of collected data.

Each participant will be assigned an identification code on entering the study. All hard copies and computer-based files will have this code only and not the patient's name. There will be one Excel file that will have the patient's name and their code. The research investigator only will have access to this file. The file containing the participants’ names and identity codes will be stored on the hard drive of the encrypted HSE password-protected laptop computer.

E2.10 (a) Will any of the interview data collected consist of audio recordings / video recordings? No

E2.10 (b) If yes, will participants be given the opportunity to review and amend transcripts of the tapes?

Answer

E2.11 (a) Will any of the study data collected consist of photographs/ video recordings? No

E2.11 (b) If yes, please elaborate.

Answer
SECTION e3 ACCESS TO HEALTHCARE RECORDS

E3.1 (a) Does the study involve access to healthcare records (hard copy / electronic)? No

E3.1 (b) If yes, please elaborate.

Answer

e3.1 (c) Who will access these healthcare records?

Answer

E3.1 (d) Will consent be sought from patients for research team members to access their healthcare records? Yes / No

E3.2 (a) Who or what legal entity is the data controller in respect of the healthcare records?

Answer

E3.2 (b) What measures have been put in place by the data controller which may make access to healthcare records permissible without consent?

Answer

SECTION f HUMAN BIOLOGICAL MATERIAL

f1 Bodily Tissue / Bodily Fluid Samples - general

F1 1 (a) Does this study involve human biological material? No

If answer is No. Please delete following questions in Section F.
G1.1 (a) Does this study/trial involve exposure to radioactive materials or does this study/trial involve other diagnostic or therapeutic ionising radiation? No

H1 (a) Is the focus of this study/trial to investigate/evaluate a medical device? No

If the answer to question H1 (a) is No, please delete the following questions in this Section.

I1.1 (a) Does this study involve a medicinal product? No

If the answer to question I1.1 (a) is No, please delete the following questions in this Section.

I2.1 (a) Does this study involve a cosmetic? No
If the answer to question I 2.1 (a) is No, please delete the following questions in Sub-Section I 2.

**SECTION I.3 FOOD AND FOOD SUPPLEMENTS**

I3.1 (a) Does this study involve food or food supplements? No

If the answer to question I 3.1 (a) is No, please delete the following question in Sub-Section I 3.

**SECTION J INDEMNITY**

SECTION J IS MANDATORY

**IMPORTANT NOTE:** This application form permits the applicant to delete individual questions within each section depending on their response to the preceding questions. Please respond to each question carefully and refer to the accompanying Guidance Manual for more in-depth advice prior to deleting any question.

J1 (a) Is each site in which this study is to take place covered by the Clinical Indemnity Scheme (CIS)? Yes

J1 (b) If the answer is ‘no’ for any site, what other arrangements are in place in terms of indemnity / insurance?

J2 (a) Is each member of the investigative team covered by the Clinical Indemnity Scheme (CIS)? No

J2 (b) If no, do members of the investigative team not covered by the Clinical Indemnity Scheme (CIS) have either current individual medical malpractice insurance (applies to medical practitioners) or current professional liability insurance either individually or as provided by their hosting/employing institution (generally applies to allied healthcare professionals, university employees, scientists engineers etc.)?

Professor Marie Guidon is covered by the RCSI Insurance Scheme
J3 (a) Who or what legal entity is the sponsor of this research study?

The research investigator Eimear O’Connell

J3 (b) What additional indemnity arrangements has the sponsor put in place for this research study in case of harm being caused to a research participant (if any)?

None

SECTION k COST AND RESOURCE IMPLICATIONS and funding

SECTION K IS MANDATORY

IMPORTANT NOTE: This application form permits the applicant to delete individual questions within each section depending on their response to the preceding questions. Please respond to each question carefully and refer to the accompanying Guidance Manual for more in-depth advice prior to deleting any question.

K1 (a) Are there any cost / resource implications related to this study? Yes

K1 (b) If yes, please elaborate.

Stationary and stamps will cost approximately €35.00. This cost will be covered by the principal investigator. There will be minimal telephone costs which have been discussed with local management.

K2 (a) Is funding in place to conduct this study? No

K2 (b) If no, has funding been sought to conduct this study? No

K2 (c) Please state the source of funding (industry, grant or other) and the amount of funding.

Answer
K2 (d) Is the study being funded by an external agency? No

K2 (e) Is the external agency a ‘for profit’ organisation? No

K2 (f) Do any conflicts of interest exist in relation to funding? Please elaborate.

Not applicable

K2 (g) Please provide additional details in relation to management of funds.

Not applicable

K3. Please provide details of any payments (monetary or otherwise) to investigators.

No payments will be made

K4. Please provide details of any payments (monetary or otherwise) to participants.

No payments will be made

SECTION 1 ETHICAL ISSUES

SECTION L IS MANDATORY

L1. Please identify any particular additional ethical issues that this project raises and discuss how you have addressed them.

There is the possibility that some of the participants may have a cognitive impairment. If the principal investigator suspects a cognitive impairment when obtaining consent for participation the principal investigator will first go through all of the information with the potential participant and then ask them to repeat back what they understand. This will inform judgement as to whether the person has sufficient capacity to make an informed decision about participating rather than excluding them. This approach has been used in previous research (Muina-Lopez and Guidon, 2013).
As part of their informed consent participants will be assured that they can decline participation in this study or can withdraw from the study at any time without any consequences or influence on further treatment. Assessment of cognitive function will be completed in a private room to ensure confidentiality. The other tests to be conducted are part of a routine physiotherapy assessment and do not pose any ethical issues.

If a participant scores below 20 on the MMSE they will be invited to complete three trials of the basic timed up and go test only. This test is part of a routine physiotherapy assessment in people with PD and will give information regarding the patient’s functional mobility. Additionally, this may prevent the patient from feeling disappointed that they could not participate in the study. This information will not be included in the results of the study but will be sent to the treating physiotherapist or consultant for their information.

PLEASE ENSURE THIS APPLICATION FORM IS FULLY COMPLETED AS INCOMPLETE SUBMISSIONS WILL NOT BE REVIEWED.
15th October 2013

Ms. Eimear O’ Connell
Physiotherapist
St. Patrick’s Hospital
Cashel
Co. Tipperary

Study Title: Is there an association between fear of falling and dual-task performance in Parkinson’s Disease?

STUDY STATUS: APPROVED

Dear Ms. O’ Connell

The Research Ethics Committee Coordinator REC, HSE, South East reviewed the above study.

Expeditied ethical approval has been granted for the above study and constitutes full ethical approval.

The following documents were reviewed and approved:

1. Ethics Application Form
2. Research Proposal
3. Participant Information Sheet
4. Participant Consent Form

The following documents were received
1. Signed Hard Copy of Declaration Page
2. CV of Chief Investigator

In addition this study will be outlined at the next planned Research Ethics Committee Meeting for the HSE, South Eastern Area by the Research Ethics Committee Coordinator and any comments made at this meeting in relation to your study shall be communicated to you in writing.

It is a requirement of the REC, HSE, South East that you send copy of your study to the Research Ethics Office on completion.
Yours sincerely,

Caroline Lamb  
Ms Caroline Lamb  
Research Ethics Committee Coordinator  
Health Service Executive, South Eastern Area

The Research Ethics Committee, HSE, South East is a recognized Ethics Committee under Regulation 7 of the European Communities (Clinical Trials on Medicinal Products for Human use) Regulations 2004 and as such is authorized to undertake ethical review of clinical trials of all descriptions and classes for the Republic of Ireland.

The Research Ethics Committee, HSE, South East issues ethical approval on the basis of information provided. It is the responsibility of the researcher to notify the Research Ethics Office of any changes to a study to ensure that the approval is still relevant.
Appendix B - Participant Information Sheet

Is there association between fear of falling and dual-task performance in Parkinson’s Disease?

Principal Investigator’s Name: Eimear O’ Connell.

Principal Investigator’s Title: Chartered Physiotherapist in South Tipperary Community Care and M.Sc. in Neurology and Gerontology student in Royal College of Surgeons in Ireland.

Telephone Number of Principal Investigator: 062-70338.

You are invited to participate in a research study about fear of falling and the ability to do two tasks at once which will be taking place in South Tipperary. The purpose of this information leaflet is to give you all the information you need to help you to decide if you would like to take part in the study and to make sure that you know what is involved.

If you wish you may discuss the study with your family, friends or doctor before deciding whether to participate. This research study has been granted ethical approval by the Research Ethics Committee, HSE, South East.

You are not obliged to take part in this study. If you decide not to take part this will not affect your physiotherapy or medical treatment in any way. If you decide to take part now but change your mind at a later date, you can pull out of the study without any further consequences.
Why is this study being done?

People with Parkinson’s Disease have a greater risk of falls than other people their age. They often report a fear of falling and a difficulty with completing two tasks at once. This may lead to increased falls.

This study is being conducted to find out the level of fear of falling in a sample of people with Parkinson’s Disease in Ireland and to check if this has an impact on being able to do two tasks at once. This may help physiotherapists and people with Parkinson’s Disease by providing more information about why people with Parkinson’s Disease find it difficult to do two tasks at once and help to guide future research and treatment.

Who is organising this study?

Eimear O’Connell, a Chartered Physiotherapist in South Tipperary Community Care, is carrying out this study. Her supervisor is Prof. Marie Guidon in the Royal College of Surgeons in Ireland. The study is part of a Masters Degree research project.

How will the study be carried out?

The study will take place between September 2013 and January 2014. During this time we hope to meet 30 volunteers. If you agree to participate you will be asked to attend for a one-off assessment in Cashel or Clonmel (whichever location is more convenient for you). This could be on a day when you are attending an appointment with your physiotherapist or consultant. The assessment will take between 30 and 45 minutes.

What will happen in the study?

We will look at your ability to walk while doing another task and ask you to complete some questionnaires about fear of falling and your memory. As part of the assessment you will be asked to carry out tasks while walking such as adding and subtracting, carrying a cup and a word game. You will be supervised at all times to ensure your safety. You should wear comfortable clothing and comfortable footwear. At the end the physiotherapist (Eimear O’Connell) will explain the results to you. If you wish you will receive a summary of the results in the post at the end of the research study.
What other treatments are available?

No other treatments are available. If you decide not to participate in the study you will continue to be seen as normal by your medical team or local physiotherapist.

Benefits:

There may be no direct benefit to you for taking part in this study, however, the study results may benefit the assessment and treatment of future patients.

Risks:

There is a small risk that you might lose your balance and fall during the different tests. However, we feel that this is a very low risk as you will be supervised at all times by an experienced physiotherapist in a safe environment. There is a small risk that you may become tired from completing the tests. You will be advised to rest regularly between tests for as long as required to prevent this.

What if something goes wrong during the study?

If you experience any problems when you are in the study or if we discover any health issue, Eimear O’ Connell will be responsible for contacting your consultant or general practitioner (GP) to inform them.

Will there be any costs involved?

Unfortunately we do not have money available to reimburse you for any expenses.

What do you have to do?

As a participant it is important for you to follow the instructions provided to help with your safety at all times during the study. You should tell the physiotherapist about any changes in your health that may affect your ability to take part. If you cannot attend for your assessment please contact Eimear O’ Connell at 062-70338 to inform her.

What are the researcher’s responsibilities to you?

The researcher should be professional and courteous at all times and conduct the study in the manner approved by the Ethics committee. If the assessment causes you any distress you should not continue.
Confidentiality Issues

Your assessment will be conducted in private. Your results will be coded: this means your name will not appear on the assessment forms. Only Eimear O’ Connell will have access to this code. The study records will be kept in a safe secure location and the computer records will be stored on a password protected laptop computer and in a locked filing cabinet in the Physiotherapy Department. The information will be destroyed after 5 years.

If you need more information

If you have any other questions about the study you can contact the researchers:

Eimear O’ Connell, Physiotherapy Department, St. Patrick’s Hospital, Cashel, Co. Tipperary.

Telephone Number: 062-70338.

Prof. Marie Guidon, Head of School of Physiotherapy, Royal College of Surgeons in Ireland, 123 St. Stephen’s Green, Dublin 2.

Telephone Number: 01 402 2397

If you would like to take part:

Please fill in the slip at the bottom of this information form, tear it off and return it in the stamped addressed envelope supplied to: Eimear O’ Connell, Physiotherapy Department, St. Patrick’s Hospital, Cashel, Co. Tipperary.

Please ensure that you provide a telephone number so that you can be contacted to arrange an appointment for your assessment

Name:______________________________________________________________

Telephone Number:________________________________________________

Preferred Location for Assessment:  Clonmel  [ ]
                                      Cashel  [ ]
Appendix C - Participant Consent Form

Title: Is there an association between fear of falling and dual-task performance in Parkinson’s Disease?

Please tick the appropriate answer:

I confirm that I have read and understood the Information Leaflet attached and that I have had ample opportunity to ask questions, all of which have been answered satisfactorily.

☐ Yes  ☐ No

I understand that my participation in this study is entirely voluntary and that I may withdraw at any time, without giving reason, and without this decision affecting my future treatment or medical care.

Yes  ☐ No

I understand that my identity will remain confidential at all times.

Yes  ☐ No

I am aware of the potential risks of this research study.

Yes  ☐ No

I have been given a copy of the Information Leaflet and this Consent Form for my records.

Yes  ☐ No

I wish to receive a summary of the results of study when it has been completed

Yes  ☐ No

Future use of anonymous data:

I agree that I will not restrict the use to which the results of this study may be put. I give my approval that unidentifiable data concerning me may be stored or electronically processed for the purpose of scientific research and may be used in related or other studies in the future. (This would be subject to approval by an independent body – the local HSE Ethics Committee.)

Participant Signature:______________________________________________________________

Date:________________

Name in Block Letters:______________________________________________________________
To be completed by the Principal Investigator:

I the undersigned agree that I have taken the time to fully explain the nature and purpose of this study to the above participant in a manner that he or she can understand. I have explained the risks and possible benefits of the study and have invited questions on any aspect of the study that concerned them.

Signature: ___________________________________________Date: _______________________

Name in Block Letters: ____________________________________________________________

Qualification: _________________________________________________________________
____
Appendix D - Data Collection Form

Is there an association between fear of falling and dual-task performance in people with Parkinson’s Disease?

<table>
<thead>
<tr>
<th>I.D. Code:</th>
<th>Date:</th>
</tr>
</thead>
</table>

**Demographics:**

<table>
<thead>
<tr>
<th>Age:</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
</table>

**Parkinson’s Disease Information:**

<table>
<thead>
<tr>
<th>Hoehn and Yahr Stage:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of falls in the last 6 months:</td>
<td></td>
</tr>
<tr>
<td>Currently taking antiparkinsonian medication</td>
<td>Yes</td>
</tr>
<tr>
<td>Time since last antiparkinsonian medication taken</td>
<td></td>
</tr>
<tr>
<td>Walking aid</td>
<td>Yes</td>
</tr>
<tr>
<td>Type of walking aid</td>
<td></td>
</tr>
<tr>
<td>ABC score</td>
<td></td>
</tr>
<tr>
<td>Timed Up and Go: Basic Trial 1</td>
<td></td>
</tr>
<tr>
<td>Timed Up and Go: Basic Trial 2</td>
<td></td>
</tr>
<tr>
<td>Test Description</td>
<td>Time Taken</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Timed Up and Go: Basic Trial 3</td>
<td></td>
</tr>
<tr>
<td>I.D. number:</td>
<td></td>
</tr>
<tr>
<td>Timed Up and Go: manual Trial 1</td>
<td></td>
</tr>
<tr>
<td>Timed Up and Go: manual Trial 2</td>
<td></td>
</tr>
<tr>
<td>Timed Up and Go: manual Trial 3</td>
<td></td>
</tr>
<tr>
<td>Timed Up and Go: arithmetic Trial 1</td>
<td></td>
</tr>
<tr>
<td>Timed Up and Go: arithmetic Trial 2</td>
<td></td>
</tr>
<tr>
<td>Timed Up and Go: arithmetic Trial 3</td>
<td></td>
</tr>
<tr>
<td>Timed Up and Go: literacy Trial 1</td>
<td></td>
</tr>
<tr>
<td>Timed Up and Go: literacy Trial 2</td>
<td></td>
</tr>
<tr>
<td>Timed Up and Go: literacy Trial 3</td>
<td></td>
</tr>
<tr>
<td>MMSE Score</td>
<td></td>
</tr>
</tbody>
</table>
Appendix E - Hoehn and Yahr Scale*

**Stage I:** Unilateral involvement only, usually with minimal or no functional impairment.

**Stage II:** Bilateral or midline involvement, without impairment of balance.

**Stage III:** First sign of impaired righting reflexes. This is evident by unsteadiness as the patient turns or is demonstrated when he is pushed from standing equilibrium with the feet together and eyes closed. Functionally the patient is somewhat restricted in his activities but may have some work potential depending upon the type of employment. Patients are physically capable of leading independent lives, and their disability is mild to moderate.

**Stage IV:** Fully developed, severely disabling disease; the patient is still able to walk and stand unassisted but is markedly incapacitated.

**Stage V:** Confinement to bed or wheelchair unless aided.

Appendix F - Timed Up and Go (TUG)

A line is marked 3 metres away from a chair. The participant sits on a standard armchair (approximate seat height of 46cm, approximate arm height 65cm), stands up, walks 3 metres, turns around, walks back to the chair and sits down. The participant wears their regular footwear and uses their customary walking aid. No physical assistance is given. They start with their back against the chair, their arms resting on the armrests and their walking aid at hand.

Instructions to the participant:

TUG-basic

‘Stand up from the chair, walk 3 metres at a comfortable speed, cross the marked line on the floor, turn around, walk back and sit down again’.

TUG-manual

‘Stand up, pick up the glass and then walk at a comfortable speed to cross the marked line on the floor, turn around, walk back to the chair, put the glass down and sit down’.

TUG-arithmetic

‘Count backwards in threes from the number that I give you while you stand up and walk at a comfortable speed to cross the marked line on the floor, turn around, walk back to the chair and sit down.’

TUG-literacy

‘Repeat the days of the week backwards starting with Sunday while you walk at a comfortable speed to the marked line, turn around, walk back to the chair and sit down again.’
## Appendix G - Mini-Mental State Examination

<table>
<thead>
<tr>
<th></th>
<th>Maximum Score</th>
<th>Actual Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I.D. Number:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Date:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Orientation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the (year)(season)(date)(day)(month)?</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Where are we: (state)(city)(hospital)?</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>What (street) do you live on? What (country)?</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Registration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name three objects (apple, penny, table): 1 second to say each then ask patient all three after you have said them. Give 1 point for each correct answer. Than repeat them until all three are learned (for later checking).</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Attention and Calculation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serial 7s. Give 1 point for each correct answer. Stop after 5 answers. Spell ‘WORLD’ backwards. ‘DLROW’. Score whichever is highest.</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><strong>Recall</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ask for the three objects repeated above. Give 1 point for each correct.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Language</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Show 2 objects (pencil and watch) ask for their names.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Repeat the following: ‘No ifs, ands or buts’.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Follow a 3 stage command: ‘Take a paper in your right hand, fold it in half and put it on the floor’</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Have the patient read and obey the following: ‘CLOSE YOUR EYES’</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Have the patient write a sentence of his or her own choice.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Have the patient copy the following design:</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Total Score</strong></td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>
Appendix H - The Activities-specific Balance Confidence (ABC) Scale*

Instructions to Participants: For each of the following, please indicate your level of confidence in doing the activity without losing your balance or becoming unsteady from choosing one of the percentage points on the scale form 0% to 100%. If you do not currently do the activity in question, try and imagine how confident you would be if you had to do the activity. If you normally use a walking aid to do the activity or hold onto someone, rate your confidence as it you were using these supports. If you have any questions about answering any of these items, please ask the administrator. For each of the following activities, please indicate your level of self-confidence by choosing a corresponding number from the following rating scale:

0% 10 20 30 40 50 60 70 80 90 100%

   no confidence  completely confident

“How confident are you that you will not lose your balance or become unsteady when you…

1. …walk around the house? ____ %
2. …walk up or down stairs? ____ %
3. …bend over and pick up a slipper from the front of a wardrobe floor ____ %
4. …reach for a small can off a shelf at eye level? ____ %
5. …stand on your tiptoes and reach for something above your head? ____ %
6. …stand on a chair and reach for something? ____ %
7. …sweep the floor? ____ %
8. …walk outside the house to a car parked in the driveway? ____ %
9. …get into or out of a car? ____ %
10. …walk across a car park to the shopping centre? ____ %
11. …walk up or down a ramp? ____ %
12. …walk in a crowded shop where people rapidly walk past you? ____ %
13. …are bumped into by people as you walk through the mall? ____ %
14. … step onto or off an escalator while you are holding onto a railing? ____ %
15. … step onto or off an escalator while holding onto parcels such that you cannot hold onto the railing? ____ %
16. …walk outside on icy footpaths? ____ %

Appendix I - Draft Correspondence

Eimhear O’ Connell,
Physiotherapy Department,
St. Patrick’s Hospital,
Cashel,
Co. Tipperary.

Date:

To whom it may concern,

I am conducting a research study with people with Parkinson’s Disease as part of a Masters Degree in Neurology and Gerontology in the Royal College of Surgeons in Ireland. I am investigating the association between fear of falling and dual-task performance in this group.

I would greatly appreciate if you would be interested in assisting me by identifying patients with Parkinson’s Disease in your area who may be appropriate for participation. I will post information sheets to identified participants and organise for them to attend with me for an assessment at a time that is convenient for them.

If you would like any more information regarding this research study, please do not hesitate to contact me at the address above or by telephone on 062-70338 or by email at eimear.oconnell@hse.ie.

Kind regards,

_____________________
Eimhear O’ Connell,
Chartered Physiotherapist.