

**‘Steady As You Go’**  
**Peer-led, community-based fall prevention**  
**Exercise classes for older adults:**  
**Falls, Injuries, and Costs**

**Birgit Maria Wurzer**

A thesis submitted for the degree of

**Master of Physiotherapy**

at the University of Otago, Dunedin,

New Zealand

June 2013

## ABSTRACT

---

Falls are common in older adults and are a major concern for individuals and health care funders. Interventions addressing strength and balance have been shown to be effective in fall prevention. Steady As You Go (SAYGO) is a community-based, peer-led, fall prevention exercise class adapted from the home-based Otago Exercise Programme (OEP) in New Zealand. It has been operating since 2003, and currently more than 40 classes are operating in the Otago region. Although this programme has been shown to increase and maintain strength and balance, and decrease fall incidence, information regarding circumstances and consequences of falling, costs associated with injurious falls, and class attendance is unknown. The aim of this study was to investigate the rate of falls, circumstances and consequences of fall events, types and costs of medical treatment sought following falls, and class attendance over 12 months in older adults participating in the SAYGO programme.

Two hundred and ten participants from 17 existing SAYGO peer-led groups were recruited into a prospective cohort study. Fall rate in the previous year and data regarding years of participation in the SAYGO were obtained via a baseline questionnaire. Over the 12-month study period, the number of falls and fallers was collected via monthly fall calendars. Data about circumstances and consequences of falls were gathered via standardised fall event questionnaires. Information regarding types and costs associated with medical treatment sought after an injurious fall was gathered via phone-administered questionnaires. Follow-up phone calls were conducted to gather incomplete or missing fall and injury data. Negative binomial regression analysis adjusting for age, sex, number of medications, and total months of follow-up was used to examine whether long-term participation in SAYGO influenced fall incidence. Class attendance was monitored on a weekly basis and mean attendance was calculated. All analyses were conducted on participants that completed the 12-month study period except for the negative binomial regression analysis, for which the whole cohort was included.

One hundred and seventy four older adults completed the 12-month follow-up (mean age 77.5 [SD 6.5] years, 160 females, 14 males). Mean years of SAYGO participation

was 4.3 years (SD 2.5). Crude rate of falls for those that completed the 12-month follow-up was 0.85 per person year (PY). Exclusion of participants who fell more than five times decreased the crude fall rate from 0.85 to 0.69 falls per PY. Out of 148 total falls, 45% resulted in minor injuries, and 18% were classified as injurious falls that resulted in the participant seeking medical attention (all females). Six fractures (4%) were reported and none were femoral. Falls one year prior to the study and falls over the 12-month study period were highly correlated ( $r=0.897$ ,  $p<0.001$ ). Higher number of medications predicted more falls (incidence rate ratio [IRR] 1.29, 95% CI 1.04-1.61,  $p=0.019$ ). Long-term SAYGO participation ( $\geq 3$  years) resulted in lower fall incidence (IRR 0.91, 95% CI 0.84-0.98,  $p=0.02$ ). The majority of falls occurred outdoors and more people fell in winter. The total estimated cost for all injurious falls was NZ\$6,946. The average attendance rate over the 12-month follow-up was 73% with 31.5 classes attended out of 41.7 on average.

Findings of this study suggest that sustained participation in SAYGO reduces fall incidence. Additionally, only a minority of falls resulted in the participant seeking medical treatment, suggesting that participation in the SAYGO classes may decrease the severity of fall-related injuries. More falls and injuries occurred outdoors, supporting other evidence that this cohort may be more active and robust than others in this age range. The SAYGO programme appears to be a low cost, effective fall prevention model with high attendance rates. Prospective, controlled studies on community translation of fall prevention exercise programmes into peer-led models are needed to confirm and extend these findings.

## **ACKNOWLEDGEMENTS**

---

First and foremost, I would like to thank my supervisors, Assoc. Prof. Leigh Hale and Dr. Debra Waters, for the opportunity to undertake this study. Your advice, guidance, constructive comments, and encouragement have been invaluable, and I could not have completed this project without your ongoing support and motivation.

A special thanks to Margaret Dando from Age Concern Otago for your assistance and incredible help in the coordination of this project.

To David Jackson, thank you for helping with the set up of the database and initial data collection.

To Nicolas, thank you very much for taking the time to provide helpful feedback, and for always showing me the positive side of things.

To the Physiotherapy New Zealand Otago Branch, thank you for partial funding of this project through the Education fund.

To the peer-leaders, thank you for all your help and ongoing commitment to these classes – you are doing an amazing job.

A big thank you to all the lovely senior citizens for your participation in this study – I have really enjoyed working with you all!

To my family and friends in Austria and New Zealand, who have encouraged and helped me through these past two years – vielen Dank!

Last but not least, to my husband Dayle – thank you for your ongoing support, for always being there for me, and for helping me make my dreams come true.

# TABLE OF CONTENTS

---

ABSTRACT .....	ii
ACKNOWLEDGEMENTS .....	iv
TABLE OF CONTENTS .....	v
LIST OF TABLES .....	viii
LIST OF FIGURES .....	ix
<b>1. INTRODUCTION .....</b>	<b>1</b>
1.1 Study aim and research questions .....	4
1.2 Glossary .....	5
<b>2. LITERATURE REVIEW .....</b>	<b>7</b>
2.1 Older adults and falls .....	7
2.1.1 The definition of a fall .....	8
2.1.2 Recording of falls .....	9
2.1.3 Rate of falls.....	9
2.2 Risk factors for falling .....	11
2.2.1 Intrinsic factors .....	11
2.2.2 Extrinsic factors.....	13
2.2.2.1 Medications .....	13
2.2.2.2 Location of falls .....	13
2.2.2.3 Temperature and seasonal variation.....	14
2.3 Consequences of falling.....	15
2.3.1 Non-injurious falls.....	15
2.3.2 Injurious falls.....	16
2.3.2.1 Hip fractures.....	19
2.3.2.2 Fractures and seasonal variations.....	20
2.3.3 Psychological consequences.....	22
2.4 Fall prevention strategies .....	23
2.4.1 Exercise as a single intervention .....	24
2.4.2 Multifactorial interventions .....	24
2.4.3 Other interventions .....	25
2.4.4 Otago Exercise Programme (OEP).....	27
2.4.5 ‘Steady As You Go’ (SAYGO) programme .....	28

2.5	Cost of falling .....	30
2.5.1	Cost-effectiveness of fall prevention interventions .....	32
2.5.2	Estimated cost of the SAYGO programme .....	33
2.6	Programme adherence – sustained participation .....	34
2.7	Rationale for this thesis.....	36
<b>3.</b>	<b>METHODS.....</b>	<b>37</b>
3.1	Study design.....	37
3.2	Ethical considerations .....	38
3.3	Study participants .....	38
3.3.1	Recruitment .....	38
3.3.2	Inclusion criteria .....	40
3.3.3	Exclusion criteria.....	41
3.4	Procedure .....	41
3.4.1	Rate of falls.....	42
3.4.2	Classification of falls .....	42
3.4.3	Circumstances and consequences of falls.....	42
3.4.4	Types and estimated costs of medical treatment .....	43
3.4.5	Class attendance .....	43
3.5	Data entry.....	44
3.6	Data analysis .....	44
<b>4.</b>	<b>RESULTS.....</b>	<b>47</b>
4.1	Baseline data .....	47
4.1.1	Baseline characteristics of participants .....	47
4.1.2	Characteristics of individual groups .....	49
4.1.3	Ethnicity .....	50
4.1.4	Characteristics of participants who completed the follow-up .....	50
4.2	Descriptive analysis of fall diaries.....	53
4.3	Rate of falls .....	54
4.4	Circumstances of falls (location, prior activity, seasonality).....	54
4.5	Self-reported injuries following a fall.....	56
4.6	Types and estimated costs of medical treatment .....	59
4.7	Class attendance.....	61
4.8	Summary of key results .....	62

<b>5. DISCUSSION.....</b>	<b>63</b>
5.1 Rate of falls .....	63
5.2 Severity of injuries after a fall .....	69
5.3 Circumstances of falls (location, prior activity, seasonality).....	72
5.4 Types and associated costs of medical treatment .....	74
5.5 Class attendance.....	76
5.6 Strengths and limitations .....	77
5.6.1 Strengths .....	77
5.6.2 Limitations.....	78
5.7 Further research .....	80
5.8 Clinical implications .....	81
<b>6. CONCLUSION.....</b>	<b>82</b>
<b>REFERENCES .....</b>	<b>85</b>
<b>APPENDICES.....</b>	<b>97</b>
Appendix A .....	97
Appendix B.....	101
Appendix C.....	105
Appendix D .....	111
Appendix E.....	115
Appendix F.....	118
Appendix G .....	120

## LIST OF TABLES

---

<b>Table 1</b> Characteristics of cohort .....	48
<b>Table 2</b> Baseline characteristics of individual groups .....	49
<b>Table 3</b> Location and prior activities of falling .....	55
<b>Table 4</b> Fallers with and without seeking medical treatment .....	58
<b>Table 5</b> Types of medical treatment sought and unit costs of healthcare resources .....	59
<b>Table 6</b> Self-reported personal costs incurred from injurious falls .....	60
<b>Table 7</b> Additional medical help required .....	60



## LIST OF FIGURES

---

<b>Figure 1</b> Flowchart of study process.....	39
<b>Figure 2</b> Participants categorised by age .....	51
<b>Figure 3</b> Participants categorised by years of attending SAYGO .....	51
<b>Figure 4</b> Participants categorised by number of medical conditions.....	52
<b>Figure 5</b> Participants categorised by medication intake .....	52
<b>Figure 6</b> Participants categorised by weekly alcohol consumption.....	52
<b>Figure 7</b> Non-fallers, fallers, and frequent fallers .....	53
<b>Figure 8</b> Location of falls and injuries.....	55
<b>Figure 9</b> Fallers per month (seasonal variance).....	56
<b>Figure 10</b> Falls resulting in injuries.....	57
<b>Figure 11</b> Class attendance .....	61

# 1. INTRODUCTION

Each year, approximately 30% of older adults aged 65 years and older and 50% of those aged 80 years and over will experience a fall (Campbell et al., 1989, Campbell et al., 1990, Gillespie et al., 2012, Tinetti et al., 1988). Those who fall once are 2-3 times more likely to fall again within the following year (O'Loughlin et al., 1993, Todd and Skelton, 2004). The risk factors for falling in older adults have been extensively researched (Lord et al., 2007, Rubenstein and Josephson, 2002), and a combination of extrinsic (precipitating) and intrinsic (predisposing) risk factors have been identified (Todd and Skelton, 2004). Intrinsic risk factors include advanced age (Luukinen et al., 1994, Nevitt et al., 1989, O'Loughlin et al., 1993), a previous history of falling (O'Loughlin et al., 1993, Tinetti et al., 1988), gait and balance deficits (O'Loughlin et al., 1993), and cognitive impairments (Tinetti et al., 1988). Examples of extrinsic risk factors are environmental hazards (Letts et al., 2010), footwear and clothing (Lord and Bashford, 1996, Lord et al., 2000), and increased medication use (Leipzig et al., 1999). The consequences following a fall can be detrimental and may result not only in physical injury, but can also lead to psychological costs (e.g. loss of confidence, decreased quality of life, or fear of falling), potentially resulting in loss of independence and admission to residential homes (Cummings et al., 2000, Tinetti and Powell, 1993a, Tinetti and Williams, 1997).

The literature suggests that between 5% and 30% of community-dwelling older adults who fall each year sustain a serious injury, such as a fracture, head injury, or serious laceration (American Geriatrics Society et al., 2001, Koski et al., 1998). The definition and classification of the severity of injuries, however, varies between different studies

and a consensus of a definition is important to be able to make comparisons (Gillespie et al., 2012, Schwenk et al., 2012).

Injuries resulting from falls in older adults are not only a concern for the individual; they are also a significant public health issue resulting in high costs to the healthcare system (Davis et al., 2010, Heinrich et al., 2010, Scuffham et al., 2003, Stevens et al., 2006, Todd and Skelton, 2004, Watson et al., 2011a, Watson et al., 2011b, Sartini et al., 2009). However, little information is available on costs of falls that do not result in hospitalisation (Garrett et al., 2008). Worldwide, the proportion of older people is growing exponentially and expected to continue more rapidly, with the fastest growing population being people 80+ years old (Tinetti et al., 1994, Yamashita et al., 2012). With these data in mind, an increase in the number of falls and subsequent injuries is predicted due to longer exposure to fall risk. Hence, associated costs resulting from falling will rise considerably over the coming decades (Moller, 2005, Sartini et al., 2009, Todd and Skelton, 2004). It has been suggested that a main consequence of falls with respect to costs are fractures (Heinrich et al., 2010), specifically hip fractures (Borgstrom and Kanis, 2008), and costs can also be incurred from other injuries due to hospital and subsequent nursing home admissions (Todd and Skelton, 2004).

Falls in the older population are thus a major concern worldwide, and effective, low cost fall prevention interventions targeting wider communities have an important place in fall prevention. Numerous fall prevention interventions exist, and exercises to increase muscle strength and improve balance are known to be effective for community-dwelling older adults (Gillespie et al., 2012). Whilst previous findings suggested that peer-education alone for the prevention of falls in older adults is inconclusive (Gillespie et al., 2012), many advantages have been described for peer-education models. These include decreasing communication barriers, influencing behaviour through positive role models, as well as cost-effectiveness and sustainability in the delivery of a programme (Peel and Warburton, 2009). In New Zealand, the unique ‘Steady As You Go’ (SAYGO) model, a peer-led strength and balance exercise programme, focuses on peer-led exercises, rather than peer-led education alone.

The SAYGO programme administered by Age Concern instructors in Otago has modified and adapted the well known home-based exercise intervention, the Otago Exercise Programme (OEP) (Campbell et al., 1997), and implemented this modified

programme in the community setting on a weekly basis for 10 weeks, taught by a paid, trained instructor. Following the initial 10 weeks, a potential peer-leader from the group is identified and approached to continue and lead the class. Consenting peer-leaders are then trained in a one day 'Train the Trainer' workshop, previously funded by the Accident Compensation Corporation (ACC), and conducted by the School of Physiotherapy at the University of Otago (Waters et al., 2011). The peer-led SAYGO strength and balance classes have been operating in and around Dunedin since 2003 and are generally held at venues such as community or church halls. These classes are typically funded by 'gold coin' (USD\$2 equivalent) donations from the participants, making the implementation low cost.

Previous research evaluated measures of strength and balance and fall incidence over 12 months in participants attending these peer-led exercise classes (Waters et al., 2011). The findings suggested that the functional measures tested were significantly better in the peer-led group compared to a seated exercise control group ( $p=0.02$ ). Additionally, at baseline, function was higher in the peer-led group compared to the control group. At the 12-month follow-up, function increased in the peer-led group while there was a decrease in function in the control group. Furthermore, the results showed a trend towards a 27% decrease in falls in the peer-led group compared to the control group, despite the study not being statistically powered for falls as the primary outcome measure. In summary, these peer-led classes have been shown to have numerous benefits such as increasing and then maintaining strength and balance, decreasing fall incidence, and possible psychosocial benefits. However, little research has been undertaken on the SAYGO peer-led, community-based fall prevention exercise model. No data regarding circumstances and consequences of falling, or class attendance exist to date. This identified gap in knowledge has led to the current study, and the aim of the present study is outlined in the following section.

## **1.1 STUDY AIM AND RESEARCH QUESTIONS**

---

Whilst there is some evidence that the SAYGO exercise model, which addresses strength and balance, is an effective intervention in fall prevention, prospective data on circumstances and consequences of falls, costs associated with injurious falls, and class attendance rate have not yet been collected, analysed and reported.

Therefore, the aim of this prospective study was to investigate the impact of participation in the SAYGO peer-led fall prevention classes on rate of falls, circumstances and consequences of falls, costs associated with injurious falls, and class attendance over a 12-month study period.

The following research questions were adopted to address the aim of this study:

### **Primary research questions**

Does participation in the SAYGO peer-led, community-based exercise programme for older adults:

- Lower the rate of falls over a 12-month follow-up compared with the literature?
- Result in less severe injuries after a fall than reported in the literature?

### **Secondary research questions**

- What are the circumstances leading to falls (location, prior activity, seasonality)?
- What types of medical treatments are sought after an injurious fall in participants attending the SAYGO classes and what are the estimated costs associated with those treatments?
- What is the attendance rate of the SAYGO exercise classes?

## 1.2 GLOSSARY

---

Age Concern Otago: Age Concern Otago is part of Age Concern New Zealand, a charitable organisation that promotes the rights, wellbeing and quality of life of older people (Age Concern, 2012).

Community dweller: “Older people living independently in their own homes or in a communal setting without health care facilities” (Todd and Skelton, 2004, p. 28).

Fall: “An unexpected event in which somebody comes to rest on the ground, floor, or lower level” (Lamb et al., 2005, p. 1619).

Incidence rate (IR): Rate at which new cases of disease/health outcome of interest (e.g. falls) occur in the population investigated and taking into consideration the length of time of exposure (number of new cases in one year period divided by total person time at risk) (Webb and Bain, 2011).

Incidence rate ratio (IRR): Ratio of two incidence rates (Webb and Bain, 2011).

Injurious fall: A fall resulting in an injury where medical attention was sought subsequently. This definition was one of the main three definitions of injurious falls identified in a recent meta-analysis (Schwenk et al., 2012).

Medical treatment: Any type of medical assistance or healthcare required (e.g. hospitalisation, General Practitioner, physiotherapist, nurse).

Multifactorial interventions: Strategies consisting of several interventions, and participants receiving different combinations of interventions, based on an individual assessment (Gillespie et al., 2009).

Non-injurious fall: A fall resulting in a minor injury without seeking medical treatment (Schwenk et al., 2012).

Older adult: A person aged 65 years or older; this is the age at which someone becomes eligible for government services for older adults in New Zealand (Work and Income, 2013).

Peer-leader: A former participant of the ‘Steady As You Go’ exercise classes trained to lead the group in their communities.

Person time: Person time (e.g. person year) describes the length of time of exposure of people who have been observed for varying periods of time. It is the total sum of the length of time each individual has been exposed, observed, or at risk (Public Health Agency of Canada, 2006).

Rate of falls: The rate of falls is the total number of falls per unit of person time that falls were monitored (e.g. falls per person year) (Gillespie et al., 2012).

Risk ratio (RR): Cumulative incidence in one group divided by the cumulative incidence in a reference group (Webb and Bain, 2011).

## **2. LITERATURE REVIEW**

The following chapter includes a summary of the relevance of fall research in older adults. A particular focus will be on falls in community-dwelling older adults, as this is the population under investigation. The review will include the epidemiology of falls, the main risk factors, and consequences of falls. Furthermore, a review of interventions to prevent falls in community-dwelling older adults will be presented, with a special focus on the Steady As You Go programme (SAYGO), the intervention under investigation in this project. Cost of falling, cost-effectiveness of interventions, and estimated cost of the SAYGO model will be outlined. Finally, the current literature regarding programme adherence and sustained participation will be reviewed, followed by presenting the justification for the current study.

### **2.1 OLDER ADULTS AND FALLS**

---

Falls in older adults is a well-known problem worldwide (Skelton et al., 2004, Stevens et al., 2010). Incidence figures for falls in the community setting are largely dependent on self-reporting as the majority of falls do not come to the attention of any medical service (Graham and Firth, 1992). Falls count as the most serious and frequent home accident among older people. Approximately 30% of individuals aged over 65 years fall each year with an increase of falls with older age (Campbell et al., 1990, Gillespie et al., 2012, Tinetti et al., 1988). It is thought that 50% of adults over 80 years of age fall each year and those who fall once are 2-3 times more likely to fall again within the following year (Campbell et al., 1990, O'Loughlin et al., 1993, Todd and Skelton, 2004). Approximately half of those who fall experience multiple falls (Todd and



Skelton, 2004, Campbell et al., 1990, Nevitt et al., 1989, Tinetti et al., 1988, O'Loughlin et al., 1993). Falls can have a significant impact on health and threaten independence and quality of life (Salkeld et al., 2000), which is discussed in Section 2.3 Consequences of falling (p. 15). Previous research has also suggested that people with certain disabilities (e.g. Parkinson's disease, Multiple Sclerosis) (Cameron et al., 2011, Nilsagård et al., 2009) or cognitive impairments (Tinetti et al., 1988, Sosnoff et al., 2011) are likely to fall more often than non-disabled older adults.

In most developed countries in the world the proportion of older people aged 60 years and over is growing exponentially, with the fastest growing portion of the population being people aged 80 years and over (Tinetti et al., 1994, Yamashita et al., 2012). According to Statistics New Zealand (Statistics New Zealand, 2007) 495,600 people aged 65 years and over were recorded in the 2006 Census of Population and Dwellings. It was suggested that this population makes up 12.3% (1 in 8) of all New Zealanders, compared with 8.5% (1 in 12) in the early 1970s. A recent report by the United Nations predicted that the global population aged 65+ years will triple to about 2 billion by the year 2050 (Statistics New Zealand, 2007). Older people make up a large and increasing percentage of the population and as people's life expectancy increases, the risk of falling and subsequent injuries will also increase (Watson et al., 2011a, Todd and Skelton, 2004, Campbell et al., 1990a, Rubenstein and Josephson, 2002). Falls in this growing population are a major concern, not only to the individuals, but also to healthcare funders, and effective and low cost fall prevention interventions targeting wider communities are in demand.

### **2.1.1 The definition of a fall**

It has been well documented in the literature that fall trials are difficult to design, and that methodology could be improved considerably by clearly defining the outcome of interest: falling (Lamb et al., 2005). Numerous definitions of a fall exist (Gillespie et al., 2012), for example dating back to 1987, a fall was defined as “unintentionally coming to the ground or some lower level and other than as a consequence of sustaining a violent blow, loss of consciousness, sudden onset of paralysis as in stroke or an epileptic seizure” (Gibson et al., 1987). More recently, the Prevention of Falls Network Europe (ProFaNE) (Lamb et al., 2005, p. 1619) collaborators, in conjunction with

international experts in the field, have recommended the use of a consensus definition of a fall in order to facilitate comparisons of research findings: “An unexpected event in which somebody comes to rest on the ground, floor, or lower level”. A recent Cochrane review (Gillespie et al., 2012) endorsed the use of the ProFaNE definition in fall research.

### **2.1.2 Recording of falls**

ProFaNE collaborators and the authors of the above mentioned Cochrane review have recommended that the collection of fall data should be via prospective daily recording and a minimum of monthly reporting (Lamb et al., 2005, Gillespie et al., 2012). This method more likely avoids reporting bias that might occur in retrospective designs, in which participants have to remember falls over a prolonged period (Lord et al., 2007, Campbell et al., 1989). Telephone or face to face interviews to gather missing data and to gather further details of falls and injuries have also been recommended (Lamb et al., 2005). It has been acknowledged that, even with the most rigorous reporting methodology, falls are most likely under-reported, and that data regarding circumstances around the fall event can be incomplete or inaccurate (Lord et al., 2007). Older people are often distressed after a fall and may not remember the predisposing factors that led to their accident. It has been further suggested that denial is a factor in under-reporting with older adults blaming their event on external factors, and hence not counting the specific fall as a ‘true’ fall, or simply forgetting fall events, particularly if the event does not result in an injury (Lord et al., 2007).

### **2.1.3 Rate of falls**

In order to describe how common falls are in different populations, the incidence rate of falls is often reported. Fall incidence rises steadily with age, and tends to be highest among individuals 80 years of age and older (Campbell et al., 1989). These incidence rates are based on self-reported data, which not only may underestimate the true incidence of falls, but also may over-represent the proportion of individuals who report multiple falls (Rubenstein and Josephson, 2002). As previously reported in Section 2.1

Older adults and falls (p. 7) approximately 30% of those aged over 65 years fall each year with an increase of falls with older age. For community-living people, the incidence rate for falls has been estimated to range between 0.52 and 0.68 falls per person year (PY) (Luukinen et al., 1994, Campbell et al., 1990, Vikman et al., 2011). Similarly, Rubenstein and Josephson (2002), who included 14 studies of community-based populations, calculated a mean of 0.77 falls per PY (range 0.2 to 1.6 falls per PY). Fall rates among institution residents are known to be much higher than among community-dwelling older adults (Rubenstein and Josephson, 2002); however, underreporting of falls in the community setting is more likely as people often do not seek medical treatment. It is suggested that the fall incidence rate may also differ between populations. For example, people receiving home-help are thought to be a population that presents a high prevalence of mobility limitations and impairments, and with regard to risk of falling, seem to be between the categories of community-dwellers and older people living in residential care (Vikman et al., 2011). Fall incidence increases with age (Campbell et al., 1990, Rubenstein and Josephson, 2002), and a previous history of falls is also associated with an increased risk of falling (Nevitt et al., 1989, Tinetti et al., 1988, Tinetti and Speechley, 1989). Fall rates between males and females have been reported to be different with a significantly increased relative risk of falling in women compared to men, even after controlling for physical and social variables (Campbell et al., 1990a).

Methodological differences including the use of different study populations, lack of clarity and consistency in definitions (Schwenk et al., 2012), variability in periods of follow up, and the inevitable difficulties of retrospective recall of events make comparisons between studies difficult (Gillespie et al., 2012, Lamb et al., 2005, Todd and Skelton, 2004). Recommendations have been made to report standardised data in future research, for example, fall events should be reported as the total number of falls, fallers, the number of people sustaining a fall-related fracture and the rate of falls (falls per person year) (Gillespie et al., 2012, Lamb et al., 2005). With regard to analysis, it was recommended that results should be analysed using appropriate statistical methods (e.g. negative binomial regression, survival analysis) and group comparisons should be stated as incidence rate ratios and risk ratios with 95% confidence intervals (Robertson et al., 2005, Gillespie et al., 2012).

In the following two sections, risk factors (Section 2.2 p. 11-15) and consequences of falling (Section 2.3 p. 15-22) are reviewed.

## **2.2 RISK FACTORS FOR FALLING**

---

Todd and Skelton (2004) suggested that in order to maximise the effectiveness of proposed fall prevention interventions, it is important to identify those people most at risk of falling. The reasons why older adults fall have been extensively researched and found to be multi-factorial (Lord et al., 2007, Rubenstein and Josephson, 2002). Different classifications of risk factors for falling exist (Deandrea et al., 2010, Lord et al., 2007); however, previous literature suggests that not many reviews of risk factors for falls have used standard meta-analytic techniques (Ganz et al., 2007, Rubenstein and Josephson, 2002).

Several studies have shown that the risk of falling, for both community and residential care dwellers, increases exponentially as the number of risk factors increases (Nevitt et al., 1989, Tinetti et al., 1988). Numerous fall risk factors exist and it is difficult to determine definitive risk factors for falling (Todd and Skelton, 2004); rather, falling appears to be caused by a combination of extrinsic (precipitating) and intrinsic (predisposing) risk factors. Intrinsic risk factors may be more important among people aged 80 years and over (Feder, 2000), whereas falls among older people aged <75 years are more likely due to extrinsic factors (Todd and Skelton, 2004). People with a fall history in the previous year are 2-3 times more likely to fall again within the following year (O'Loughlin et al., 1993, Todd and Skelton, 2004). Additionally, frailer older adults have a higher incidence of falls, especially medically related falls, compared to healthier older adults and environmentally related falls are more common in community dwellers than in institutionalised populations (Rubenstein and Josephson, 2002).

### **2.2.1 Intrinsic factors**

The most frequently reported intrinsic risk factors in the literature are advanced age (Luukinen et al., 1994, Nevitt et al., 1989, O'Loughlin et al., 1993), a previous history of falling (O'Loughlin et al., 1993, Tinetti et al., 1988), gait and balance limitations

(O'Loughlin et al., 1993), and cognitive impairments (Tinetti et al., 1988). Additionally, having multiple co-morbidities increases the risk of falling by impacting directly on physiological systems (e.g. visual, sensory, vestibular, musculoskeletal, neurological systems) (Gibson et al., 1987, Lord et al., 2007, Lord et al., 2002, Tinetti, 2003, Tinetti and Speechley, 1989). According to Lawlor et al. (2003), frail, older people with numerous chronic illnesses have a 32% increased risk of falling. Furthermore, the frequency of falling increases with being female (O'Loughlin et al., 1993), and having functional limitations (Speechley and Tinetti, 1991, Vanweel et al., 1995).

Physical parameters are considered one group of factors that place an older adult at a high risk of falling. The known decline in strength, endurance, and muscle power with age result inevitably in physical functioning dropping below the threshold where activities of daily living become difficult or even impossible to carry out (Skelton, 2001a). Fallers are thought to be less active, which may inadvertently cause further muscle atrophy (Skelton, 2001a), thus putting a person at a higher risk of falling, resulting in a downward spiral of reducing mobility and balance. Although it is generally thought that fall rates are lower in vigorous older people than in frailer ones, it has been reported that environmental hazards contribute to falls in older vigorous people more than in older frail adults (Lord et al., 2007). These authors suggest that this appears to be due to increased exposure to risk. Interesting to note is that increased physical activity was associated with a decreased risk of falls, but an increased risk of suffering a serious injury as a result of a fall (Tinetti et al., 1994).

Psychological factors, such as fear of falling, cognitive impairment, or depression are associated with impaired stability and falling in older adults (Lord et al., 2007, Friedman et al., 2002). Reduced physical and functional activity is known to be associated with fear and anxiety about falling. Up to 70% of recent fallers and up to 40% of those not reporting recent falls acknowledge fear of falling (Tinetti et al., 1994, Tinetti et al., 1988). Up to 50% of people who are fearful of falling restrict or eliminate social and physical activities because of that fear (Tinetti et al., 1988). Friedman et al. (2002) suggested that fear of falling predicts falls at one year follow-up, and vice-versa. Furthermore, the authors indicated that the use of four or more medications is associated with a 9-fold increased risk of fear of falling and also predicts fear of falling.

### **2.2.2 Extrinsic factors**

The extent of impact that environmental factors have on the risk of falling among older people is uncertain (Todd and Skelton, 2004). Whilst some studies have reported that between 30% and 50% of falls among community-dwelling older people are due to environmental causes (Lord et al., 2007), others suggested that only 20% of falls are due to major external factors that would most likely cause any healthy adult to fall (Feder, 2000, Lord et al., 2000). Extrinsic risks include environmental hazards (for example poor lighting, slippery floors, or uneven surfaces), footwear, and clothing (Lord and Bashford, 1996, Lord et al., 2000), and are contributory factors in a substantial proportion of falls in older adults (Lord et al., 2007). Additionally, it has been suggested that someone's living status may also be related to falling. Whilst living alone may imply greater functional ability in the elderly, it has been shown to be a risk factor for falls and injuries and outcomes can be worse, especially if the person cannot rise from the floor (Wickham et al., 1989). The most commonly reported precipitating extrinsic risk factors are environmental hazards (Letts et al., 2010) and medication use (Leipzig et al., 1999).

#### **2.2.2.1 Medications**

Whilst various classes of medication have been found to predispose older people to falls (Lord et al., 2007, Morency et al., 2012), it is largely accepted that risk of falling is significantly increased if a person is on more than four medications, irrespective of the type of medication (Campbell et al., 1989). However, Lord et al. (2007) suggested that methodological limitations and the multifactorial nature of fall aetiology have made it somewhat difficult to establish causal relationships between medications and falls.

#### **2.2.2.2 Location of falls**

It has been suggested that the location of fall is related to age, sex, and frailty (Lord et al., 2007). Campbell et al. (1990) and Luukinen et al. (1996) suggested that frailer people with limited mobility suffer more falls within their homes compared with vigorous people, who seem to fall more frequently outdoors. Falls in more vigorous

older adults may be due to increased exposure to risk, especially outdoors (Lord et al., 2007). Looking at differences in falling between sexes, Campbell et al. (1990) suggested that men are more likely to fall during higher level of activity and outside in comparison to women. Whilst some reported that 50% of falls in older community-dwelling people occur in their homes (Campbell et al., 1990, Lord et al., 1992, Tinetti, 2003), another study suggested that more than half of the falls occurred outdoors, away from home, in a population of healthy, community-dwelling older females (Hill et al., 1999). More recently, Morencey et al. (2012) suggested that 30% of falls occurred outdoors (960 falls out of a total of 3270 falls) and 36% occurred indoors. For a further 34% of falls, the location was not specified, leaving the location for a third of the falls inconclusive. Vikman et al. (2011) found that 97% of falls occurred indoors amongst old people in Sweden receiving home help services. Overall, it appears that the location of falls is largely dependent on a person's age, frailty, level of activity, and possibly gender.

### **2.2.2.3 Temperature and seasonal variation**

The association between seasonal variations and fall risk is ambiguous (Lord et al., 2007). Luukinen et al. (1996) demonstrated a higher incidence of outdoor falls connected to extreme cold periods among community-dwelling people 70+ years of age. Similarly, Campbell et al. (1988) described an association between low temperatures and fall incidence among women. The association between colder weather and increased falls may be because people tend to hurry more in colder weather, and mild hypothermia and slowed responses are more common (Lord et al., 2007). In contrast, Vikman et al. (2011) suggested that the monthly fall incidence was significantly associated with daylight periods, but not associated with temperature in people aged 65+ living in a Swedish community. Additionally, there are controversial opinions whether there is an association between indoor falls and temperature. Whilst Luukinen et al. (1996) found no association between indoor falls and temperature, others suggested that lower temperatures inside people's homes increase falls risk (Campbell, J, personal communication, February 16, 2012). More recently, Morencey et al. (2012) suggested that 47% of outdoor falls were associated with rain, falling temperatures or freezing rain.

A seasonal variance in hip fracture incidence, with a higher incidence connected to winter conditions, has previously been reported (Douglas et al., 2000) and numerous other studies have also reported on the association between hip fracture incidence and seasonal variations (Douglas et al., 2000, Emaus et al., 2011, Gronskag et al., 2010, Lin and Xiraxagar, 2006, Modarres et al., 2012, Murray et al., 2011). These associations will be described in more detail in Section 2.3.2.2 Fractures and seasonal variations (p. 20-22).

## **2.3 CONSEQUENCES OF FALLING**

---

As discussed in the previous sections, fall incidence increases with age (Campbell et al., 1990, O'Loughlin et al., 1993, Todd and Skelton, 2004) and falls and fall-related injuries among older people are major issues for health and social care providers because of rapidly increasing life expectancy (Campbell et al., 1990a, Rubenstein and Josephson, 2002, Stevens et al., 2010, Tinetti, 2003, Todd and Skelton, 2004, Watson et al., 2011a). The outcomes following a fall can be detrimental, not only causing physical injury, but also leading to psychological consequences (e.g. loss of confidence, decreased quality of life, or fear of falling). These factors can lead to loss of independence and admission to residential homes (Cummings et al., 2000, Tinetti and Powell, 1993a, Tinetti and Williams, 1997, Tinetti and Williams, 1998) even without the occurrence of a serious injury (American Geriatrics Society, 2011, American Geriatrics Society et al., 2001, Tinetti, 2003). Falls are a major cause of morbidity and mortality in older people and consequent injuries are both age and gender related (Hartholt et al., 2011, Stevens and Sogolow, 2005).

### **2.3.1 Non-injurious falls**

The majority of non-injurious falls (75%-80%) are not reported to health professionals (Age Concern, 1997), and hence, the actual number of falls may be higher than reported in the literature due to underreporting (Todd and Skelton, 2004). Important to note is that a non-injurious fall can still be fatal if the person is unable to get up from the floor and cannot get help (Tinetti et al., 1994). Almost 50% of people who fall require help to



get up after at least one fall (Todd and Skelton, 2004). This is consistent with previous findings by Tinetti and Powell (1993a) who found that approximately 47% of non-injured fallers are not able to get up from the floor without assistance.

### **2.3.2 Injurious falls**

To date, no classification system for injurious falls has been developed, and a recent meta-analysis found there was considerable heterogeneity in definitions of injurious falls (Schwenk et al., 2012). These authors looked at the range of definitions and methods used to measure and report injurious falls in randomised controlled trials (RCTs) and reported that no standardised definition, measurement, or documentation of injurious falls exists (Schwenk et al., 2012). This highlights the difficulty of comparing studies. Schwenk et al. (2012) suggested that three main categories of injurious fall definitions emerged from the meta-analysis. First, the majority of included RCTs had definitions that were based on symptoms and healthcare use (46%), followed by definitions based on symptoms only, accounting for 39%, and the remaining 17% of studies used definitions based on healthcare use only. The authors reported that the most frequent definitions originate from a study by Campbell et al. (Campbell et al., 1997) which sub-classifies falls according to their severity (serious and moderate) by using both symptomatic outcomes (e.g. fractures, sprains) as well as healthcare utilisation (e.g. medical assistance required). However, whilst this was the most frequently used definition, it was only used by six included studies (15%).

In contrast, ProFaNE collaborators recommended that the most rigorous definition of a serious fall-related injury is a peripheral fracture that is radiologically confirmed, and is the only feasible measure of injury that could be recommended (Lamb et al., 2005). Vertebral fractures are not generally a consequence of falling and were therefore excluded from the ProFaNE recommendation. In contrast to Schwenk et al. (2012), Lamb et al. (2005) suggested that classifications of any other injuries (soft tissue or organ injuries) were considered not satisfactory, and that injury severity classed according to resource use (visit at ED) was rejected, as treatment protocols vary within and between countries. Drawing a distinction between a major and minor soft-tissue injury is also problematic, as there is no widely accepted approach, and injury self-report is prone to recall bias (Lamb et al., 2005). Schwenk et al. (2012) further

suggested that the definition of a serious injury (hip or other fracture, head or internal injury) would represent the highest accurate endpoint, but would require larger sample sizes for adequate power, due to the low incidence of these falls. Due to the lack of consensus on defining an injurious fall as described above, a large range of reported injuries exists in the literature.

Despite the difficulties in comparing fall-related injuries, it has been reported that between 10% and 60% of older adults suffer injuries from falls (Bergland and Wyller, 2004, Hill et al., 1999, Lord et al., 2007, Vikman et al., 2011), 5-15% suffer serious injuries (American Geriatrics Society et al., 2001, Vikman et al., 2011), and 2-16% suffer fractures (Bergland and Wyller, 2004, Gibson et al., 1987, Hill et al., 1999, Lord et al., 2007, Tinetti, 1987, Tinetti et al., 1988). Approximately 20-30% of those who fall, suffer injuries that reduce mobility and independence, which subsequently increase the risk of premature death (Lamb et al., 2005, Tinetti and Speechley, 1989, Todd and Skelton, 2004).

The Centres for Disease Control and Prevention (CDC) indicate that one out of five falls (20%) causes a serious injury, such as a fracture or head trauma that requires medical attention, and that 20-30% of people who fall suffer moderate to severe injuries, such as lacerations, hip fractures, or head traumas (Centres for Disease Control and Prevention, 2012). Similarly, Bergland and Wyller (2004) found that 24% resulted in a serious injury in community-dwelling elderly women (mean age 80.8 years) in Norway. Further, the CDC reported that in 2010, people aged  $\geq 75$  years had the highest rate of nonfatal fall injury episodes for which a healthcare professional was contacted (115 per 1000 population) (Centres for Disease Control and Prevention, 2012).

A meta-analysis conducted in New Zealand (Robertson et al., 2002) investigating four interventions of muscle strengthening and balance exercises to prevent falls and delivered at home by trained health professionals, found that approximately 22% of all falls resulted in seeking medical attention. Further research from New Zealand (Garrett et al., 2008) investigated minor falls in community-dwelling older adults aged 75+ years with a previous fall history (n=202) over a six month period. The results showed that a total of 97 falls were reported (2.4 falls per PY), of which 60% (n=58) resulted in injury, and 19% (n=18) required medical attention. In contrast, findings by Hill et al. (1999), who investigated frequency, circumstances, and consequences of falls among

healthy, community-dwelling older women (mean age 74.1 years), reported that 49% experienced a fall, 16% sought medical treatment, 10% suffered strains or other moderate injuries, and 26% had minor injuries (e.g. grazes, bruises). Findings of Harthold et al. (2011) reported that 70% of fall-related injuries were to the upper or lower limb consisting of 60% fractures, 21% superficial injuries and 8% open wounds in an older Dutch population presenting at the emergency department (ED).

Close et al. (1999) reported that falls account for 14% of ED admissions and 4% of all hospital admissions, whereas in frequent fallers, Lord et al. (1992) reported that 20% are either hospitalised, in full time care or have died at one year follow-up. It is suggested that older adults are five times more often hospitalised for fall-related injuries than they are for injuries from other causes (Cryer 1998), that approximately 1.6 million older adults are treated in ED due to non-fatal injuries in the United States (Stevens, 2005a), and that falls are the leading cause of injury deaths among people 65 years and older (Lord et al., 1992, Tinetti, 2003).

Fall-associated fractures in older people are known to be a significant source of morbidity (Sattin 1992) and mortality (Keene 1993) and fractures as a result of falling are recorded as more than 50% of serious accidental injury admissions and 39% of fatal injuries (Todd and Skelton, 2004). However, it has also been suggested that the proportion of falls resulting in fractures is generally fairly low (Todd and Skelton, 2004, Gillespie et al., 2012, Rubenstein and Josephson, 2002, Luukinen et al., 1995, O'Loughlin et al., 1993), accounting for less than 10% (Campbell et al., 1990, Tinetti et al., 1988, Centres for Disease Control and Prevention, 2012). The findings of Hill et al. (1999) reported that fractures occurred in 9% of accidental falls in community-dwelling older females in comparison to Bergland and Wyller (2004) who found that 13% of falls resulted in fractures in community-dwelling elderly women (mean age 80.8 years) in Norway. Overall, these findings are similar to more recent research findings which suggest that between 5% and 15% of community-dwelling older adults who fall each year do sustain a serious injury, such as a fracture, head injury, or serious laceration (American Geriatrics Society et al., 2001). In comparison, Koski et al. (1998) found that major injuries are sustained in 32% of fallers (n=120) among the home-dwelling elderly (aged  $\geq 70$  years) in a rural setting in Finland, out of which 48% (n=58) sustained a fracture. However, their classification of a major injury was more extensive, such as fractures, joint dislocations, lacerations requiring sutures, and intracranial

injuries, which could be a reason for the higher percentage of injurious falls. Additionally, both disabled and independent elderly were included, suggesting that the higher number could be due to the increased risk of falling in people with disabilities.

Gender differences and injurious falls have also been described in the literature, suggesting that older women sustain more injuries compared to older men. For example, Stevens et al. (2005) investigated gender differences for non-fatal unintentional fall-related injuries among older adults aged  $\geq 65$  years treated in ED. Their findings suggested that fall-related injuries affected the health of older women more in comparison to men (1.8 times higher hospitalisation rates), with the most noticeable being fracture rates (2.2 times higher than for men). The authors suggested that all fall-related injuries increased with advancing age, with up to four to five times higher rates in the age group of  $\geq 85$  years compared with those aged 65-74 years.

### **2.3.2.1 Hip fractures**

Hip fractures are one of the most common injuries resulting in hospitalisation following a fall (Lord et al., 2007) and the majority of hip fractures occur indoors (Emaus et al., 2011, Douglas et al., 2000). In 2001, there were about 327,000 hospital admissions for hip fractures in the United States (Stevens, 2005a). Whilst previous research suggested that at least 95% of hip fractures are caused by falls (Tinetti et al., 1988, Tinetti, 1987), others indicated that hip fractures comprise approximately 25% of fractures resulting from falls in the community (Nevitt et al., 1989, Todd and Skelton, 2004). It was reported that out of the ~300,000 hip fractures occurring annually in the United States, about 55.2% (~165,000) result from falls (Alexander et al., 1992), and a further 24% of all hip fractures are due to unknown causes, possibly suggesting being the result of unrecorded falls (Frick et al., 2010). The incidence of hip fracture is higher in residential settings than in community settings, with rates of up to 0.08 per person year (PY) (Todd and Skelton, 2004).

After decades of increasing hospitalisation rates for hip fractures, in many countries including New Zealand and Australia, recent research suggests that the rate of fall-related hip fractures in older people is now declining (Hartholt et al., 2010, Stevens and Rudd, 2010a, Langley et al., 2011, Nymark et al., 2006, Leslie et al., 2009). Whilst

some suggest that the reasons for this decline are unknown (Leslie et al., 2009), others proposed that an improvement in measures of physical status and functional abilities could be contributing to the reduction of fall-related hip fractures (Langley et al., 2011, Stevens and Rudd, 2010a). Frick et al. (2010) noted that studies, which report on fall-related hip fractures are largely restricted to elderly women or institutionalised older people, which may differ from other populations, for example older adults living in the community setting. These authors combined several data sources and calculated that 2% of fallers in community-dwelling adults aged 65+ experienced hip fractures (Frick et al., 2010), which is slightly higher than previous findings of 0.2-1.5% (Lord et al., 2007).

Despite some evidence of an overall decline in hip fractures, the annual incidence of hip fractures rises exponentially between the ages of 50 and 90+ years (from 0.58 to 34.92 per 1000 PY in men, and from 0.87 to 58.22 per 1000 PY in women) (Emaus et al., 2011). Gronskag et al. (2010) reported an overall hip fracture incidence rate as being 13.1 per 1000 PY among elderly women, with a mean of 2.1 (age 65-69) and 49.7 (aged 90+) per 1000 PY respectively. Both studies investigated hip fracture incidence in a Norwegian population. Hip fractures can have significant detrimental consequences. About 50% of people who fracture their hips as a result of a fall will never become functional walkers again, and 20% of those are expected to die within the following six months (Freeman et al., 2002). Others reported even higher figures suggesting 25-75% of community-dwelling older adults do not recover to the level of function prior to their fall-related hip fracture (Rubenstein and Josephson, 2002).

### **2.3.2.2 Fractures and seasonal variations**

The focus of the literature regarding a seasonal effect in association with injuries has mainly been in association with hip fractures (Douglas et al., 2000, Emaus et al., 2011, Gronskag et al., 2010, Lin and Xiraxagar, 2006, Modarres et al., 2012). Slipping on ice and snow has been suggested to be a causal mechanism behind the seasonal effect on falling (Bulajic-Kopjar, 2000). Preventions targeting this causal mechanism are likely to reduce the risk of fracture, but the size of the effect is difficult to estimate (Bulajic-Kopjar, 2000).

In a population in Taiwan, approximately 32% of total hip fractures among seniors aged 75 years or older and 17.2% among those aged 65-74 years were attributable to the season effect (Lin and Xiraxagar, 2006). More recently, Modarres et al. (2012) suggested that correlation coefficients between weather (e.g. temperature, snow depth, rainfall depth, or day length) and hip fracture rate was significant in a population in Montreal, Canada, aged 40-74 years and 75+ years, respectively. Data regarding seasonal variations and hip fractures from Norway suggested that seasonal variation was significant in fractures occurring outdoors only (Emaus et al., 2011) and that there were higher rates during the winter months (Gronskag et al., 2010).

Bulajic-Kopjar (2000) investigated seasonal variations in the incidence of all types of fall-related fractures among older adults in Norway. Their results showed that the risk of sustaining a fall-related fracture was higher in the colder seasons (October through March) among people aged 65-79 years (risk ratio [RR] 1.39, 95% confidence interval [CI]) and in people aged  $\geq 80$  years (RR 1.17, 95% CI). It was suggested that slipping on ice and snow explains the excessive incidence of hip and arm fractures during winter months, and that seasons affect the incidence of all fractures in older adults. In contrast, Douglas et al. (2000) noted that there is evidence against snow and ice on the ground as being the main reason for the seasonal variation. These authors investigated the seasonal variation of hip fracture admissions in Scotland, Hong Kong, and New Zealand and found a significant seasonal variation in all three countries, with the highest amplitude of seasonal variation in Scotland, followed by Hong Kong, and the least noted in New Zealand. The peak of hip fractures was slightly beyond the coldest time of the year both in Scotland and New Zealand.

The fact that there is no snow or ice in Hong Kong is evidence against snow and ice on the ground being the central reason for the seasonal variation amplitude of hip fractures (Douglas et al., 2000). The authors suggested that one of the explanations for the seasonal variation could be that with advancing age, impaired coordination is more marked in winter in comparison to summer (Douglas et al., 2000). Additionally, it is commonly accepted that older people feel the cold more; hence, they are more likely to put on extra clothes and winter shoes, which may be environmental factors contributing to more falls, and winters are darker and colder, and this may add to the number of falls in this season (Douglas et al., 2000). However, the association between fractures and seasonality is poorly understood and remains controversial. It appears that a

combination of factors, such as environmental risk factors (e.g. slippery or icy surface), and other factors (e.g. poor light, darkness, or low temperature), may play a role.

### **2.3.3 Psychological consequences**

The psychological and social effects of falling can be significant, despite being less apparent when compared to fall-related physical injuries (Spinks and Wasiak, 2009, Cummings et al., 2000, Hartholt et al., 2011, Rubenstein and Josephson, 2002). Depression and fear of falling (FoF) are common effects of repeated falls and have previously been described under the term ‘post-fall syndrome’ (Spinks and Wasiak, 2009). Social and psychological consequences can result in self-restricted activity levels, which again may result in reduction in physical function, social interactions, and loss of independence (Spinks and Wasiak, 2009, Tinetti et al., 1994, Vellas et al., 1997) even among individuals without a serious injury (Spinks and Wasiak, 2009). Spinks and Wasiak (2009) suggested that FoF is considered to be a significant psychological consequence of falling with odds ratios (OR) ranging from 1.58 to 3.90. However, FoF was also identified in older people without a history of falls and there is some uncertainty which one comes first: fear of falling or the actual fall. Additionally, psychological consequences can occur, even when there has been no injury after a fall event (Spinks and Wasiak, 2009). Being unable to get up after falling is also known to be a significant psychological stressor related to falls (Alexander et al., 1997, Fleming and Brayne, 2008) and falling does not only affect the person itself, but also puts a strain on their family (Tinetti and Williams, 1997). Therefore, psychological consequences can have a negative effect on an older person’s quality of life, and should not be underestimated (Cummings et al., 2000, Feder, 2000, Spinks and Wasiak, 2009, Tinetti and Powell, 1993a, Tinetti, 1987, Tinetti and Williams, 1998).

A wide range of consequences of falling in older adults exists, from the obvious physical injury, to the not so obvious psychological effects. Therefore, interventions which aim to reduce fall incidence and decrease the severity of injuries from falls, by targeting people at risk of falling, are in demand. The following section gives an overview of the many fall prevention strategies available, with a focus on interventions targeting community-dwelling older adults, and a special focus on the SAYGO programme, the intervention under investigation in the current study.

## 2.4 FALL PREVENTION STRATEGIES

---

Due to the increasing risk of falling with age, and the costs associated with falling, which will be described in Section 2.5 Cost of falling (p. 30-31), the prevention of falls and injuries is of particular importance. Extensive research is available measuring the effects of different fall prevention programmes and numerous Cochrane reviews have reviewed different interventions (Gillespie et al., 2009, Gillespie et al., 2012, McClure et al., 2008). A variety of interventions exist, ranging from group to individualised exercise programmes (Gillespie et al., 2012, Lord et al., 2007), reduction of home hazards, and Vitamin D supplementation (Lord et al., 2007). However, in recent years, an increased number of studies separate fall prevention interventions in older people living in the community from those in nursing care facilities and hospitals. The rationale being that participant characteristics and the environment warrant different types of interventions (Gillespie et al., 2009).

McClure et al. (2008) undertook a review to assess the effectiveness of population-based interventions for reducing fall-related injuries among community-dwelling older adults. Meta-analysis was not possible due to the heterogeneity of the studies included, therefore data were extracted independently. Studies were included in this review if they reported changes in medically treated fall-related injuries following implementation of a community-based intervention. Six studies were included; there were no randomised controlled trials (RCTs). The results showed that there were significant decreases in fall-related injuries reported in all six studies, with a calculated relative reduction in fall-related injuries between 6% and 33%. The authors suggested, despite methodological limitations of included studies, the findings support the population-based approach to fall-related injury prevention is effective and could form a basis of public health practice.

The Cochrane reviews have contributed to numerous fall prevention guidelines internationally, and more recently the CDC have produced a fall prevention package (STEADI – Stopping Elderly Accidents, Deaths and Injuries) (Centres for Disease Control and Prevention, 2012). There is evidence of effectiveness for different approaches in community-dwelling older people, and particularly subgroups, but this evidence may not be applicable to other populations, such as people with dementia who were excluded from most studies (Gillespie et al., 2012). The current review focuses



purely on fall prevention strategies for community-dwelling older adults, as this was the population under investigation in the present study.

### **2.4.1 Exercise as a single intervention**

A recent Cochrane review, which included 159 trials with a total of 79,193 participants, evaluated the effectiveness of fall prevention interventions for older adults living in the community (Gillespie et al., 2012). Most commonly, exercise as a single intervention was tested (n=59). Rate ratio (RaR) and 95% confidence interval (CI) was used to compare the rate of falls (falls per person year) between intervention and control groups. For risk of falling, risk ratio (RR) and 95% CI based on the number of people falling (fallers) in each group was used. Multiple-component group exercise significantly reduced rate of falls (RaR 0.71, 95% CI 0.63-0.82) and risk of falling (RR 0.85, 95% CI 0.76-0.96), as did multiple-component home-based exercise (RaR 0.68, 95% CI 0.58-0.80 and RR 0.78, 95% CI 0.64-0.94). Tai Chi also resulted in significant reduction of risk of falling (RR 0.71, 95% CI 0.57-0.87). The findings of Gillespie et al. (2012) also suggested that exercise interventions significantly reduced the risk of sustaining a fall-related fracture (RR 0.34, 95% CI 0.18-0.63). Results of a meta-analysis (Robertson et al., 2002) including four studies (n=1016) of community-dwelling older adults aged 65-97 years in New Zealand, showed that the exercise programmes were most effective in older adults 80+ years of age who had a fall in the previous year, followed by those aged 65-79 years with a fall in the previous year, and those 80+ years of age (Robertson et al., 2002).

### **2.4.2 Multifactorial interventions**

There is strong evidence that multifactorial programmes, such as exercise interventions targeting muscle strength and balance improvement, review of medication intake, improving eye sight, and including risk factor screening and assessment are beneficial falls prevention interventions in community-dwelling older adults (Todd and Skelton, 2004, Gillespie et al., 2009, Gillespie et al., 2012, Lamb et al., 2005). These multifactorial interventions are complex, and their effectiveness may be dependent on

factors yet to be identified (Gillespie et al., 2012). In a recent Cochrane review (Gillespie et al., 2012), multifactorial interventions were tested in 40 trials, and were the second most tested interventions followed by exercise as a single intervention. This review's results showed that multiple-component group exercise significantly reduced both rate of falls (RaR 0.71, 95% CI 0.63-0.82), and risk of falling (RR 0.85, 95% CI 0.76-0.96), similarly to multiple-component home-based exercise (RaR 0.68, 95% CI 0.58-0.80; and RR 0.78, 95% CI 0.64-0.94). Additionally, multifactorial interventions, which included individual risk assessment, reduced rate of falls (RaR 0.76, 95% CI 0.67-0.86), but not risk of falling (RR 0.93, 95% CI 0.86-1.02). For example, findings of a randomised controlled trial conducted by Clemson et al. (2004) suggested that participants in the 'Stepping on' programme experienced a 31% reduction in falls in comparison to the control group. This fall prevention programme is a multifaceted community-based programme aimed to improve fall self-efficacy, encourage behavioural change, and reduce falls via education and exercise.

### **2.4.3 Other interventions**

Interventions that include home safety assessment and modification are effective in both reducing rate of falls and risk of falling, more so in people with increased risk of falling, including those with severe visual impairment according to the most recent Cochrane review (Gillespie et al., 2012). This review also suggested that anti-slip shoe devices were beneficial in reducing rate of falls in icy conditions, and that certain medical procedures warrant a place in fall prevention, such as cataract surgery, insertion of a pacemaker, as well as review of medication and gradual withdrawal of psychotropic medication (Gillespie et al., 2012). Review of medication, particularly for those on four or more medicines as well as withdrawal of psychotropic medications has also been suggested by others to be feasible (Todd and Skelton, 2004). In contrast, cognitive behavioural interventions to increase knowledge about fall prevention alone or Vitamin D supplementation alone do not seem to be beneficial fall prevention interventions for community-dwellers. However, Vitamin D may be beneficial in people with lower Vitamin D levels before treatment (Gillespie et al., 2012) and plays a part in fall prevention, particularly in residential care facilities (Lord et al., 2007).

Another fall prevention model, a peer-education model, has been described previously (Gillespie et al., 2012, Peel and Warburton, 2009), but peer-education alone for the prevention of falls in older adults is inconclusive (Gillespie et al., 2012). However, many advantages have been described for peer-education models, which include decreasing communication barriers, influencing behaviour through positive role models, as well as cost-effectiveness and sustainability in the delivery of the programme (Peel and Warburton, 2009). Peel et al. (2009) reviewed the evidence available for effectiveness of peer-education in fall prevention and suggested that there is limited evidence that increased awareness through education will change behaviour, which would in turn result in decreases in fall incidence and consequent injuries.

Peer-led models are well established for delivering health and social welfare information and there is growing evidence of older people's involvement as peer-leaders (Peel and Warburton, 2009). In New Zealand, 75,600 older adults aged 65 years or older reported undertaking voluntary work (for or through an organisation, group, or marae), and it has been suggested that community and voluntary sectors make a significant contribution to the economic and social well-being (Statistics New Zealand, 2007). Advice is more likely accepted from others, such as peer-leaders, who have similar characteristics (e.g. age, previous experience, life circumstances, culture, religion) (Allen, 2004, Johns, 2007). Previous research suggested that translation of a professionally-led health programme for fall prevention called 'A Matter of Balance' (a cognitive-behavioural programme previously found to be efficacious) into a volunteer lay-leader (VLL) model was successful, which makes it more widely accessible (Healy et al., 2008). The VLL model achieved comparable outcomes to those who participated in the original randomised controlled trial by improved scores compared to baseline measures for at least two measures of fear of falling. This VLL programme has been shown to be effective in reducing the fear of falling among a community-dwelling older adult population. Participants showed significant increases in falls efficacy, falls management, and falls control at 6 weeks, 6 months, and 12 months as compared to baseline scores. The findings of this study indicate that it is possible to train volunteers/peers to successfully run fall prevention programmes. Disadvantages of this model however, include considering peer-leaders as substitutes to health professionals, peer-leaders overstepping their boundaries, and difficulties in recruitment, retention, and training of volunteers (Peel and Warburton, 2009). Furthermore, a model such as

the peer-led model relies on a strongly committed body of support, and the demands on the person who is responsible for recruitment and training should not be undervalued (Allen, 2004).

In New Zealand, the unique ‘Steady As You Go’ (SAYGO) model, a peer-led strength and balance exercise programme, focuses on peer-led exercises, rather than peer-led education alone. The exercises were derived from the home-based Otago Exercise Programme (OEP) (Campbell et al., 1997). This peer-led fall prevention model is the intervention under investigation in the current study, and the following two sections centre on the OEP and the SAYGO, particularly focusing on its aim, delivery, and previous research.

#### **2.4.4 Otago Exercise Programme (OEP)**

The Otago Exercise Programme (OEP) is a home-based, individualised exercise programme aimed to increase lower limb strength and improve balance (Campbell et al., 1997). In New Zealand, the development and delivery of this nationwide fall prevention intervention was funded by the Accident Compensation Corporation (ACC) (Campbell and Robertson, 2010). The programme consists of numerous exercises to increase muscle strength and to improve balance using increasingly difficult movements. It takes between 20 to 30 minutes to complete. For strength training, ankle cuff weights are used to progress exercises. Balance exercises are increased in difficulty by progressing from exercises using support with a wide base of support to free-standing activities and reducing base of support. The older adult completes the exercises at home and is encouraged to do them three times weekly and to take a walk at least twice a week. A physiotherapist, or a nurse (trained by a physiotherapist), teaches the older adult the exercises and has follow-up visits at intervals to monitor and support the older adult. These visits are at weeks 1, 2, 4, and 8 of the programme with a ‘booster visit’ every six months. At these visits the physiotherapist checks that the exercises are performed safely and weights are increased if appropriate. People are eligible for the programme if they are aged 80 years or older and living in the community (Campbell and Robertson, 2010). Previous research has consistently shown that the OEP is effective in reducing falls delivered as a home-based programme (Campbell et al., 1997, Campbell et al., 1999, Robertson and et al, 2001b).

### **2.4.5 ‘Steady As You Go’ (SAYGO) programme**

It appears that two different fall prevention interventions are called ‘Steady As You Go’ (SAYGO) (Robson et al., 2003, Waters et al., 2011): one in Alberta, and one in New Zealand. The SAYGO in Alberta includes a multifactorial approach to fall prevention with a focus on cognitive-behavioural and environmental changes in comparison to the SAYGO in New Zealand, which focuses on strength and balance exercises. The current study investigated the SAYGO programme in New Zealand.

The SAYGO programme administered by Age Concern instructors in Otago, has modified and adapted the home-based OEP (Campbell et al., 1997), and implemented this for older adults aged 65 years or older in the community setting on a weekly basis for 10 weeks. Following the initial 10 weeks, a potential peer-leader from the group is identified and approached to continue and lead the class. Training of the peer-leaders takes place during a one-day ‘train the trainer’ workshop, which has previously been funded by the Accident Compensation Corporation (ACC) and is conducted by the University of Otago (School of Physiotherapy) annually. Course objectives for the ‘train the trainer’ workshops include understanding that falls are a major public health problem for older people, recognising the risk factors leading to falls, recognition of which factors have the potential to be modified, and the importance of long-term exercise. Additionally, prospective peer-leaders are taught to develop observational skills to ensure safety and correct performance of the programme, how to hold the classes, what exercises to do, and how to administer those exercises (L. Inglis, personal communication, March 5, 2012). The peer-led SAYGO strength and balance classes have been operating in and around Dunedin since 2003. Currently, over 40 groups exist, each consisting of approximately 10 participants (M. Dando, personal communication, September 30, 2012). People who are 65 years or older (Maori/Pacific Peoples 55+ years) can participate and have to have medical clearance from their general practitioner. All people go through the SAYGO 10-week classes before joining the peer-led classes and Age Concern Otago continues ongoing support for the peer-leaders and their classes (Dando, M, personal communication, September 30, 2012).

Previous research from New Zealand evaluated the benefits of SAYGO in a quasi-experimental study with a 12-month follow-up on measures of strength, balance, and falls (Waters et al., 2011). Five existing peer-led classes (n=52, mean attendance in

SAYGO = 3 years), five new 10-week Age Concern Otago classes (n=41), and one comparison group outside of Dunedin (n=25) participated in the study. The exercises for the peer-led group and the Age Concern Otago group were adapted from the OEP, and the exercises for the comparison group were seated flexibility, range of motion, and seated aerobic exercises. The intervention lasted one hour per week for 10 weeks.

The results showed that all functional measures of gait and balance (functional reach test, 30-second chair stand, timed up and go, Activity-specific Balance Confidence) in both intervention groups (peer-led and Age Concern Otago group) were significantly greater ( $P=0.02$ ) than in the comparison group (seated exercise group). Furthermore, the functional measures of the ongoing peer-led group, even after a 6-8 week break over the Christmas period, were significantly better at baseline compared with the new peer-led group (Age Concern Otago class) and the control group (seated exercise group). At the follow-ups (10 weeks, 6 and 12 months) there were no statistically significant differences in functional measures between the peer-led and the Age Concern Otago group ( $P>0.05$ ). Additionally, a tendency for a 27% decrease in falls for the peer-led group compared with the control group was also identified at 12-month follow-up (incidence rate ratio [IRR] 0.73, 95% CI 0.48-1.1,  $p=0.124$ ). However, the study was not a randomised controlled trial, and was not statistically powered for falls as the primary outcome measure.

Many fall prevention interventions for older adults exist, which have been reviewed and described in detail in the previous sections. Aims of these interventions are not only to reduce falls and injuries for the individuals, but also to decrease the burden of falling on the healthcare system due to the associated fall-related costs. The following sections will provide an overview of the financial burden of falling and the cost-effectiveness of fall prevention interventions (Sections 2.5 and 2.5.1, p. 30-33), followed by a brief outline of the estimated cost associated with the SAYGO programme (Section 2.5.2, p. 33). However, economic evaluations regarding the cost-effectiveness of the SAYGO programme were not part of this project and beyond the scope of this Master's thesis.

## 2.5 COST OF FALLING

---

Falls and fall-related injuries among older people are a significant public health issue as they are considered a major medical and socioeconomic burden to the health-care system worldwide (Heinrich et al., 2010, Scuffham et al., 2003, Stevens et al., 2006, Todd and Skelton, 2004, Watson et al., 2011a, Watson et al., 2011b, Sartini et al., 2009, Davis et al., 2010). Falls account for the majority of overall healthcare costs due to fall-related injury (Scuffham et al., 2003) and the main consequence of falls with respect to costs are fractures (Heinrich et al., 2010), specifically hip fractures (Borgstrom and Kanis, 2008). With the predicted increase in number of older adults, it is expected the number of falls and fall-related injuries, and associated costs resulting from falling, will rise considerably over the coming decades (Moller, 2005, Sartini et al., 2009, Todd and Skelton, 2004). Because of this, efforts should be directed to fall prevention programmes aimed at reducing fall-related fractures and fall-related costs (Heinrich et al., 2010).

Data about the percentages of total healthcare costs for fall-related injuries is controversial. Heinrich et al. (2010) for example, conducted a systematic review which investigated the evidence of the economic burden of falls in older adults. They included 32 studies and reported that national fall-related costs of prevalence-based studies ranged between 0.85% and 1.5% of the total healthcare expenditures within the USA, Australia, and Europe. Conversely, others reported the annual treatment and care cost of fall-related injuries to be equivalent to 5% of the total health budget in Australia (Watson et al., 2011b), and were reported as high as 21% of total healthcare expenses in Dutch older adults presenting at the emergency department (Hartholt et al., 2011).

Comparisons between studies from different countries with different healthcare systems and different currencies are challenging. For example, falls in older adults have cost the United Kingdom National Health Service and Personal Social Service an estimated £981 million in 1999 (Scuffham et al., 2003). More recent data reported the cost of US\$23.3 billion due to non-fatal and fatal falls (Davis et al., 2010). These authors conducted a systematic review (n=17 studies) to determine international estimates of the economic burden of falls in community-dwelling people aged 60 years or older, and reported mean costs ranging from US\$3,476 per faller to US\$10,749 per injurious fall and US\$26,483 per fall which required hospitalisation (Davis et al., 2010). In Australia,

the annual treatment and care cost of fall-related injuries was recently estimated at AUS\$558.5 million (Watson et al., 2011b). In Europe, the average cost for fall-related hospitalisation was estimated to be €5,479 in the community population in Italy (Sartini et al., 2009), compared with healthcare costs in Dutch older adults presenting at the emergency department due to a fall, which totalled €474.4 million (Hartholt et al., 2011). In the United States, the cost of treating fall-related injuries in the year 2000 was estimated to be US\$19 billion, and two-thirds of overall medical costs were due to falls requiring hospitalisation (Stevens et al., 2006).

In New Zealand, the cost to the ACC of injuries from falls in the home in 2010 was approximately NZ\$272 million (Accident Compensation Corporation, 2011). However, this figure represents only indoor falls, and is not exclusively for falls in older adults, and therefore comparison with other studies is not possible. Hall et al. (2003) investigated the hospital and personal costs after a fall in older adults discharged to the community in Australia. The hospital costs accounted for 80% of the total costs, followed by 16% for community costs and 4% personal costs. The estimated fall-related costs for the three-month period following the fall was approximately AUS\$325,000 (mean cost per patient ~AUS\$4,500).

Little information is available on costs of falls that do not result in hospitalisation (Garrett et al., 2008). These authors therefore investigated community-based costs resulting from minor falls in New Zealanders aged 75+ years with a previous fall history (n=202). Six month data on falls and costs were collected and unit costs of health care were gathered from health providers. The results showed that the total cost of falls was estimated at NZ\$7,597 with a median healthcare cost of NZ\$151.93, and personal cost of NZ\$8 per fall. The authors suggested that the costs of minor falls in older adults are high and that larger studies are needed to confirm their findings (Garrett et al., 2008). The economic cost of falls is likely greater than assumed and there is a need for a consensus on methodology for economic fall studies to enable accurate comparisons between different countries (Davis et al., 2010). Data regarding costs of falling varies between countries, and it is challenging and remains difficult to make comparisons between studies and draw definite conclusions. As described above, costs of falling appear to be mainly gathered from injuries resulting in hospitalisation, and there is a paucity of data on costs regarding injuries not resulting in medical treatment or hospitalisation.



### **2.5.1 Cost-effectiveness of fall prevention interventions**

There is a need for fall prevention interventions to be feasible, sustainable, and cost-effective to be practical for widespread use (Rubenstein and Josephson, 2006). Whilst Todd and Skelton (2004) suggested that there is no evidence that successful fall prevention interventions actually decrease healthcare costs, more recent literature indicates that fall prevention programmes have the potential to be cost-effective in community-dwelling older adults (Davis et al., 2010a, Gillespie et al., 2012), in nursing home residents (Heinrich et al., 2013), and in hospital orthopaedic inpatients (Galbraith et al., 2011).

Robertson et al. (2001c) investigated the cost-effectiveness of implementing a New Zealand home-based exercise programme for women aged 80+ years in the community over a two-year period. Costs of implementing the intervention, costs of utilising healthcare following a fall, and total healthcare service costs were collected. The authors reported that 27% of total hospital costs were related to falls, but there were no significant differences in health service costs between the intervention and control group. Implementing the exercise programme cost NZ\$314 (per fall prevented for one year), NZ\$265 (per fall prevented for two years), and NZ\$475 and NZ\$426 per fall prevented that resulted in a moderate or serious injury for one and two years respectively. While the programme did not result in net savings, the authors did not consider the programme to be expensive to deliver (Robertson et al., 2001c). However, it was suggested that there was potential for cost savings by preventing falls and injuries in the age group 80+ years, and therefore, the age and level of frailty of participants, as well as the setting, may affect cost-effectiveness of this programme.

Frick et al. (2010) combined results from existing literature from a previous Cochrane review (Gillespie et al., 2009) to evaluate which fall prevention interventions are the most cost-effective. Seven interventions were reported as being effective for preventing falls in older adults, these were: 1) medical management (withdrawal) of psychotropics, 2) group Tai Chi, 3) Vitamin D supplementation, 4) muscle and balance exercises, 5) home modifications, 6) multifactorial individualised programmes, and 7) multifactorial individualised treatments for high-risk frail elderly people. The results showed that withdrawal of psychotropics and group Tai Chi were the least costly and most effective options followed by Vitamin D supplementation and home modifications; however, it

was further suggested that medical management of psychotropics and Tai Chi were also the least studied. The most recent Cochrane review (Gillespie et al., 2012), which investigated fall prevention interventions for older adults living in the community, also conducted an economic evaluation. They reported that 13 trials provided economic evaluations, of which three indicated cost savings for their interventions during the trial period to particular subgroups of older people at high risk of falling. One trial of the OEP showed cost savings in people aged 80 years or older resulting from fewer hospital admissions (Robertson et al., 2001a), another trial of a home safety programme delivered to participants with a previous fall (Cumming et al., 1999), and a multifactorial intervention for older adults with  $\geq 4/8$  targeted risk factors also showed cost savings (Tinetti et al., 1994). The authors suggested that strategies need to be targeted at particular subgroups of older people to obtain maximum value for money (Gillespie et al., 2012).

Therefore, it appears that the OEP is one of the few interventions that showed cost-effectiveness if delivered to a specific subgroup (aged  $\geq 80$  years). This is of particular interest, as the intervention under investigation in the current study, the SAYGO exercise programme, was derived from the OEP. However, in order to establish the cost-effectiveness of fall prevention interventions such as SAYGO, economic evaluations should be conducted according to recently published guidelines (Davis et al., 2011, Gillespie et al., 2012).

### **2.5.2 Estimated cost of the SAYGO programme**

Little information is available on the costs associated with the SAYGO programme. However, the SAYGO programme was adapted from the OEP, and as suggested in the previous section, the OEP has been shown to be a cost-effective fall prevention programme particularly in adults over 80 years of age (Gillespie et al., 2012, Robertson et al., 2001a). A previous evaluation of these peer-led groups suggested that they may have a good 'return on investment' due to the 27% trend towards a decrease in fall rate (Waters et al., 2011), which is similar to a 30% decrease reported with the OEP. The estimated cost of the SAYGO is about NZ\$150 per person per year (Waters et al., 2011) in comparison to > NZ\$400 per person per year for the OEP (Robertson et al., 2001a). These data suggest that the SAYGO programme may be a low cost model for

reducing fall risk and possibly falls in older community-dwelling adults. It has been suggested that recruitment, training, support, and retention of senior volunteers should not be underestimated in planning and costing of peer-led education programmes (Peel and Warburton, 2009), and future research and economic evaluations are required to determine the cost-effectiveness of the peer-led SAYGO exercise classes.

## **2.6 PROGRAMME ADHERENCE – SUSTAINED PARTICIPATION**

---

Regardless of how effective an intervention may be, adherence to a specific fall prevention programme is important to achieve effectiveness (Nyman and Victor, 2012). It has previously been suggested that adherence in fall prevention interventions is low and that there is a need for research on older people's views of fall intervention programmes (Todd and Skelton, 2004). Nyman and Victor (2012) reviewed the previous Cochrane review (Gillespie et al., 2009) and analysed community-dwelling older people's participation and engagement with the interventions in the trials included in this Cochrane review. Adherence rates ranged from 52-82% for individually targeted exercise interventions, depending on the duration of the intervention. At 12 months, the adherence rate for individually targeted exercises was the lowest with 52% (range 43-61.5%). In comparison, the adherence rate at 12 months for class-based exercises was 73.2% (range 42.3-78.7%). For both individually targeted and class-based exercise interventions at the 2-month follow-up, adherence rates were similar at 82% and 82.9% respectively. The highest adherence rates were reported for calcium supplementation (Vitamin D) with 81% at 36-month follow-up and 80% at 60-month follow-up. Home-based exercising three or more times per week reduced from 56% at 2 months to 37.1% at 12 months and 34.9% at 2 years. Nyman and Victor (2012) reported that over 12 months, exercise was performed for an average of 11.3 days per month and the average number of classes attended was 21/78 (0–82/67–90). However, these results should be viewed with caution; reporting of adherence data was not uniform across the studies, which potentially will bias the results. It was suggested that future studies should report the adherence rate of individuals, rather than of total classes held (Nyman and Victor, 2012).

Implications for future fall prevention research have been recommended, which should include methods to increase uptake and adherence of effective programmes by older people (Gillespie et al., 2012). To increase the uptake of fall prevention strategies by older adults, immediate benefits should be promoted such as promoting positive healthy ageing, fitness, and maintaining independence (Peel and Warburton, 2009, Todd and Skelton, 2004), rather than the potential for reducing falls. Recommendations for promoting the engagement of older people in activities to prevent falls were developed in Europe (Yardley et al., 2007) and New South Wales (NSW) (New South Wales Department of Health, 2011). Social encouragement to engage older adults in interventions included support from family, peers, and health professionals. It further included raising awareness that undertaking physical activities is beneficial by increasing independence, gaining confidence in functional capabilities, and the ability to proactively self-manage health (Yardley et al., 2007). In NSW, a recent policy directive identified strategies to support the uptake of fall prevention initiatives by older adults, ranging from awareness, to accessibility, and motivation to participate regularly (New South Wales Department of Health, 2011). Fall prevention interventions, such as exercise interventions should be specific, progressive, and sustained, in order to have continuing benefit (Todd and Skelton, 2004).

Reduced adherence to the Otago Exercises was previously reported in community-dwelling older adults aged 75 years or older (Campbell et al., 2005); however, their population only included people with severe visual impairments, which may differ from other populations. In the SAYGO programme, participants are supported by peers and peer-leaders, which may enhance a sense of belonging to the group and could have a positive effect on adherence. The SAYGO exercise programme only occurs once a week (approximately one hour), and whilst some suggested that once weekly training may suffice (Taaffe et al., 1999), more recent literature regarding exercise for strengthening to prevent falls in older adults recommends a minimum of two hours a week (Sherrington et al., 2011). The latter recommendations derive from a meta-analysis investigating exercise to prevent falls, and therefore, it appears those recommendations are more valid. Additionally, long-term participation is an important factor in the SAYGO classes and previous literature also suggested that long-term continuing exercise is effective in preventing falls in community-dwelling elderly (Fujisawa et al., 2007). This was supported by authors of a recent systematic review

who suggested that regular, sustained participation in physical activities to increase lower limb strength and balance reduces the risk and rate of falls (McMahon and Fleury, 2012). Data regarding attendance in the SAYGO programme however, has not been investigated to date, and it has yet to be established whether the once weekly SAYGO programme improves adherence.

## **2.7 RATIONALE FOR THIS THESIS**

---

Falls are common in older adults and threaten older people's safety and independence. Numerous fall prevention interventions exist, but there is strong evidence that strength and balance exercises are effective in reducing the rate and risk of falling. Although there is strong evidence for individualised home-based exercises for those aged 80 years and older, community-based group exercise classes appear beneficial for older adults 65 years and over. Further, it has been suggested that peer-led interventions may be more effective in encouraging class attendance than professional-led interventions. An evaluation of the SAYGO exercise programme (Waters et al., 2011), delivered in a peer-led, community-based group setting, showed that it is an effective, low cost fall prevention model with numerous benefits such as increasing and maintaining functional levels, and decreasing fall incidence. However, the impact of participation in the SAYGO programme on circumstances and consequences of falling, costs associated with medical treatment following injurious falls, and adherence to the programme are unknown. The current project was conducted to explore in detail the impact SAYGO has on falling in those attending: the occurrence and circumstances of falls, fall-related injuries, types of medical treatment sought after injurious falls, and costs associated with these treatments. In addition, class attendance was investigated. In the following chapter, the methods and procedures of the current project will be described.

## 3. METHODS

The following chapter describes the procedures used in the present study. A description of the experimental design, ethical considerations, recruitment of participants, the outcome measures used, data entry, and data analysis is outlined in the following sections in this chapter.

### 3.1 STUDY DESIGN

---

This study was a prospective cohort study of participants currently enrolled in a community-based peer-led SAYGO strength and balance class in the Otago/Southland region of Dunedin, New Zealand. The current project was an extension of a previous project conducted by Waters et al. (2011): ‘An Evaluation of the Steady as You Go Fall Prevention Programme’.

In the present study data were collected over a 12-month study period (also referred to as the ‘12-month follow-up’). Number of falls, fallers, and number and types of injuries sustained following a fall were gathered in people aged 65 years and over participating in the SAYGO programme. Detailed information regarding fall events and injuries were collected, including fall location and circumstances, types of injuries sustained, whether or not falls resulted in seeking medical attention, and costs associated with medical treatment. In addition, information regarding class attendance was also gathered. In this study, a fall was defined as per the Prevention of Falls Network Europe (ProFaNE) definition, which is “an unexpected event in which the participant comes to rest on the ground, floor, or lower level” (Lamb et al., 2005, p.1619).

## **3.2 ETHICAL CONSIDERATIONS**

---

Ethics approval was sought from the University of Otago Ethics Committee in New Zealand for extension of the original project (8/007) and approved in February 2011 (Appendix A). All participants received an information sheet (Appendix B) and had the opportunity to ask questions prior to deciding to participate in the study. If they wished to participate, a consent form was signed (Appendix C). Participants were advised that their data would be kept confidential by the researchers, but that the results of the project may be published and would be available in the University of Otago library, and that every attempt will be made to preserve participants' anonymity. Furthermore, participants were also advised that they may withdraw from participation in the project at any time and without any disadvantage to themselves of any kind.

## **3.3 STUDY PARTICIPANTS**

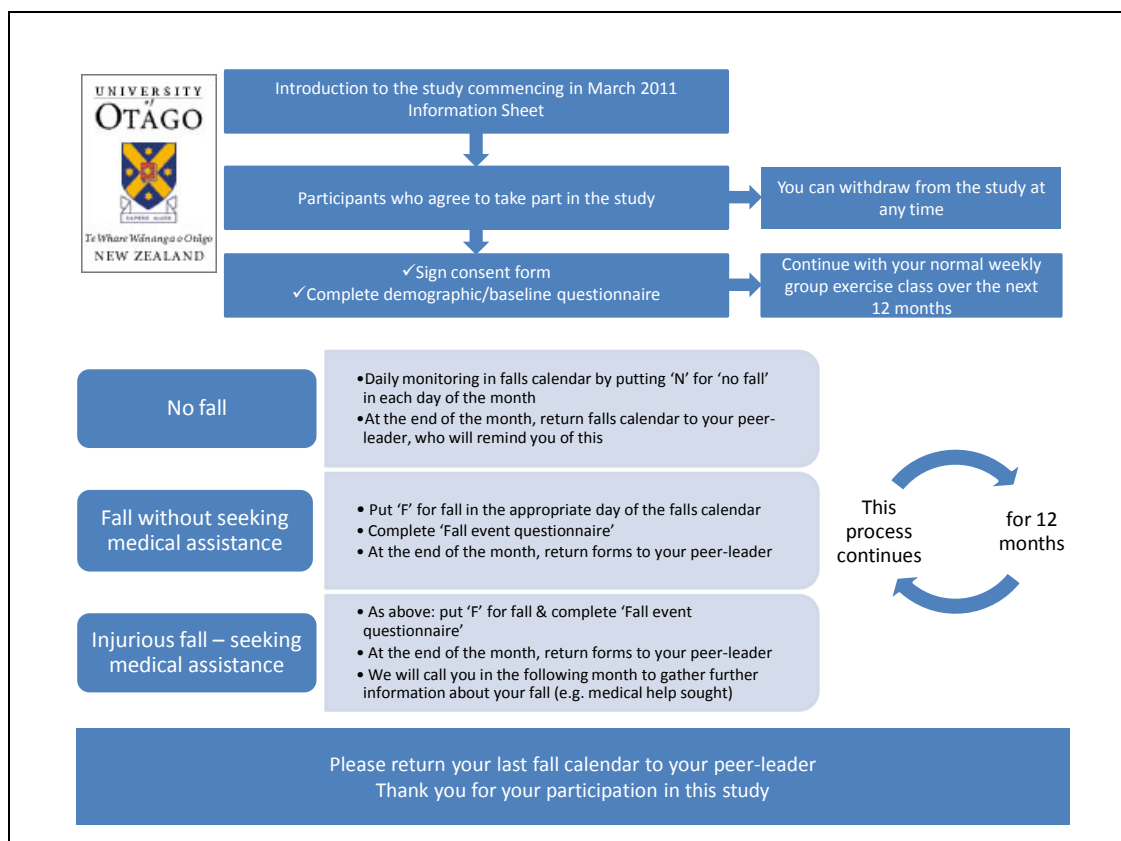
---

Community-dwelling, older adults who were currently participating in one of the peer-led SAYGO exercise classes in Otago/Southland, New Zealand. A detailed description of the strength and balance exercises used in the SAYGO is outlined in Appendix D.

### **3.3.1 Recruitment**

Initial contact was made via Age Concern Otago, a non-profit, volunteer-based, registered charity that serves the needs of older people and initiates and maintains the SAYGO programme. Age Concern provided the researchers with a current list of Otago region-based peer-led SAYGO classes and its members. Furthermore, an invitation letter was published in the Age Concern newsletter (Appendix B), which outlined the aim of the project, type of participants being sought, a brief explanation of what the project would involve, what data would be collected, and how the data would be used. Peer-leaders of the classes were invited to contact either a nominated person from Age Concern Otago or one of the researchers via telephone to gain further information about the study, to discuss the research process, and indicate if they were interested in participating in the project. Subsequently, interested peer-leaders were invited to

discuss the project with the members of their individual classes. If a group showed interest in participating, a meeting day and time was arranged, suitable to all parties, for the researchers to visit each individual class. Out of 35 possible groups at the time, 17 groups agreed to take part in the research project. All information sessions were held at the venue of each exercise class. The project was presented to the group by either one or two of a total of three researchers (candidate = BW, supervisors = LH and DW). Information sessions lasted approximately one hour and were held between 29 March 2011 and 28 April 2011. Information regarding the project was presented with a poster showing a flowchart which outlined the process of the project over the 12-month study period (see Figure 1).



**Figure 1** Flowchart of study process

Additionally, an example of the baseline questionnaire (Appendix E) and a fall calendar (Appendix F) was printed in poster format for the presentation to facilitate explanation of the study to class members. Participants and peer-leaders had opportunities to ask questions at this time and contact details were provided if further clarifications were required or queries about the project arose.



At the end of the presentation, each person who showed interest was supplied with a numbered participation pack which contained:

- One study information sheet (Appendix C)
- One consent form (Appendix C)
- One baseline questionnaire (e.g. demographic information, fall history in previous year) (Appendix E)
- Fall calendars for each month starting from April 2011 (Appendix F)
- Two fall event questionnaires (FEQ) (Appendix G)
- Sufficient blank envelopes for confidential return of monthly fall calendars to the peer-leaders

People who were interested in participating in the study had the choice of either completing the consent form and baseline questionnaire following the presentation, or to take them home to complete and return to their peer-leaders who would forward them to the researchers. Peer-leaders were provided with additional participation packs for those people who were not present on that day. Additionally, only identification numbers were written on all the calendars and questionnaires, assuring confidentiality.

### **3.3.2 Inclusion criteria**

- Older adults ( $\geq 65$  years, Maori/Pacific  $\geq 55$  years) currently participating in a SAYGO community exercise class in Otago/Southland. Māori and Pacific peoples in New Zealand experience poorer health and worse life expectancy than the majority New Zealand European population (Statistics New Zealand, 2013), therefore can participate at a younger age (55+ years).
- Medical clearance from the General Practitioner (GP), which had been given previously to enable participation in such an exercise programme.
- Ability to complete consent form and questionnaires independently.

### **3.3.3 Exclusion criteria**

- Participants who suffered from a chronic medical condition that would limit participation in low to moderate intensity exercise.
- Participants who were unable to comprehend study information and consent process, or were unable to complete consent form and questionnaires independently.

## **3.4 PROCEDURE**

---

Following information sessions and gained consent, demographic characteristics of the cohort (e.g. age, sex, number of medical conditions, medication intake), fall history in the previous year, and number of years participating in the SAYGO were collected using a baseline questionnaire. Participants were asked to continue with their classes as per usual and to complete monthly fall calendars, commencing in May 2011, over a period of 12 months (including April 2012). If a participant sustained a fall, they were asked to complete a FEQ, which was provided in the initial participation pack, to gather additional information regarding the location of fall, the activity prior to the fall event, any injuries sustained, and whether medical treatment was sought.

Prospective, descriptive data on fall rate, number of fallers, number of participants who were frequent fallers, and number of injurious falls were collected monthly over a 12-month follow-up. Additional information relating to the medical treatment and costs associated with injurious falls was also obtained during the follow-up phone call using a structured medical treatment questionnaire (Appendix G). Data regarding class attendance were collected weekly by the peer-leaders over the 12-month study period. Data collected were securely stored in a way that only researchers actively involved in the project were able to gain access to it. Explicit details about each of these steps are described in the following sections (3.4.1-3.4.5, p. 42-44).

### **3.4.1 Rate of falls**

Fall incidence was obtained via monthly fall calendars on which participants recorded any fall by placing a tick or an 'F' on the appropriate date-field. Participants were asked to leave fields blank if they did not sustain a fall. The definition of a fall as per the ProFaNE recommendation (Lamb et al., 2005) was placed on each individual fall calendar to remind participants of what is considered a fall. Completed fall calendars were placed by each participant in a blank envelope, which was collected by the peer-leader of the individual's SAYGO class on a monthly basis. Peer-leaders were provided with additional, large, pre-paid envelopes to enable them to return all fall calendars to the researchers.

### **3.4.2 Classification of falls**

As previously noted, if a fall occurred, participants were requested to provide further details pertaining to the event by completing a fall event questionnaire (FEQ). This questionnaire was modified and adapted from the World Health Organisation (WHO) fall questionnaire (Vellas 1992, as cited in Vellas et al., 1997). The information provided on the FEQ enabled classification of the specific events into three categories:

1. a non-injurious fall,
2. an injurious fall without seeking medical attention, or
3. an injurious fall after which the participant sought medical treatment.

### **3.4.3 Circumstances and consequences of falls**

Questions pertaining to the circumstances of the fall and injuries resulting from the fall were collated via the FEQ. This questionnaire was used to gather information about the location of the fall (whether the fall occurred indoors or outdoors), what the participant was doing at the time of falling (prior activity), and self-reported injuries. The FEQ was attached to the fall calendar and handed in to the peer-leader in the same envelope as

for the monthly fall calendar. Peer-leaders forwarded the sealed envelopes containing the fall calendars and FEQs to the researchers on a monthly basis.

### **3.4.4 Types and estimated costs of medical treatment**

If the fall event was classified as an injurious fall, as identified via the FEQ, the participant was phoned the following month to gain further detailed information regarding the injuries sustained due to this fall. In order to gather detailed information regarding the type of medical treatment sought after an injurious fall, and to estimate the healthcare costs associated with these treatments, information about types of health providers which had been consulted (e.g. General Practitioner, physiotherapist), and which healthcare services were utilised (e.g. ambulance transport, Emergency Department) were collected via follow-up phone calls using a standardised medical treatment questionnaire. This treatment questionnaire was developed for the current study to capture the different types of health care provider funding available in New Zealand (e.g. ACC, District Health Board [DHB], Primary Health Organisation [PHO]). As we did not have consent to have access to gather data regarding injurious falls from ACC, GP records, or hospital databases, these data were gathered via self-report. Estimated unit costs were collected from previously reported data on the mean costs in New Zealand dollars (NZ\$) (Garrett et al., 2008, New Zealand Government, 2012). Further information about increase or change of medication, the number and type of investigations (e.g. X-ray, MRI), or the requirement of additional services (e.g. home help) was also gained using this questionnaire. Additionally, participants were asked if they knew whether a claim was lodged with ACC, and whether they had to pay any additional charges to date when consulting a health professional or when purchasing other items related to the fall, to allow estimation of personal costs incurred as a result of a fall.

### **3.4.5 Class attendance**

As stated earlier, data regarding the number of years of participating in the SAYGO exercise classes were collected retrospectively via the baseline questionnaire.

Participants were asked when they first started attending the peer-led classes (see Appendix E). Additionally, class attendance over the 12-month follow-up was monitored by the peer-leaders on a weekly basis via attendance rolls. Copies of these rolls were provided to the researchers at the end of the 12-month study. Both the number of classes each person participated in, as well as the number of classes held per group were collected to calculate the overall percentage of attendance.

### **3.5 DATA ENTRY**

---

Baseline data entry and follow-up phone calls for incomplete or missing baseline data took place between May and June 2011, for which additional help was provided by a research assistant (DJ). All other data were entered monthly into an excel database and checked for accuracy. Follow-up phone calls took place if data were missing or if any information received was incomplete. At the end of the 12-month study, 10% of all entered data was randomly checked to ensure accuracy and no errors were identified.

### **3.6 DATA ANALYSIS**

---

Data analysis was performed using a Microsoft excel database and the statistical software package 'IBM SPSS Statistics 20' (Statistical Product and Service Solutions, IBM Corp. Released 2011. IBM SPSS Statistics for Windows, version 20.0. Armonk, NY: IBM Corp) (Leech et al., 2012).

Data were analysed using descriptive analysis reporting on mean, standard deviation, range, or percentage for the number of falls and fallers, circumstances of falling, number and types of injuries sustained, as well as class attendance.

The unpaired t-test was used to compare baseline information of the group that completed the 12-month follow-up with the participants that withdrew from the study, as well as to compare fallers that sought medical treatment with those that did not seek medical attention following their fall.

Bivariate correlation analysis was used to assess relationships between baseline data (number of falls 12 months prior to the study, number of medical conditions, number of

medications) and 12-month follow-up data (number of falls and injuries at 12-month follow-up, number of times medical treatment sought) (Polit and Beck, 2006).

Partial correlation analysis was used to find correlations between two variables after removing the effects of another variable (age) (Webb and Bain, 2011).

The crude rate of falls was calculated in person year (PY) by dividing the total number of falls in a specified time period (12-month follow-up) with the total number of participants that completed the study. Further, a crude rate of falls, which excluded five frequent fallers (>5 falls) was also calculated.

Negative binomial regression was used to investigate fall incidence with number of years of attending SAYGO. This is a non-linear regression method that is appropriate for counting data that is over-dispersed, such as fall data (Armitage et al., 2002, Robertson et al., 2005). It was used to assess if years of attendance in SAYGO predicted fall incidence over 24 months (fall data for the year prior to the study combined with fall data over the 12-month follow-up). Age, sex, number of medications, and total months of follow-up (exposure time) were entered into the model. The negative binomial regression model takes into account the total number of falls and the length of time of follow-up, similar to survival analysis (Glynn and Buring, 1996, Robertson and et al, 2001b). The difference is that the negative binomial regression analysis uses a binomial distribution rather than the Poisson distribution and is a better fit for the type of recurrent events that are more likely to occur in some individuals than others (Glynn and Buring, 1996, Robertson and et al, 2001b), because people who fall are more likely to fall again (Tinetti et al., 1988). For this analysis, all participants were included (including those that did not complete the 12-month follow-up).

Data on costs incurred as a result of seeking medical attention after an injurious fall was reported descriptively in New Zealand dollars (NZ\$). An average cost was assigned to each health system resource. GP, practice nurse, and allied health consultation costs covered by ACC were determined according to a schedule detailing treatment costs and data from previous research (Garrett et al., 2008). Ambulance transport costs were obtained from a report prepared for the Ministry of Health (O'Dea, 2005). Personal financial costs incurred due to injurious falls included co-payments for health care, and

other direct costs identified by participants. Total estimated costs, total estimated health care provider costs, and total estimated incurred individual costs are reported.

## **4. RESULTS**

This chapter reports the results of the current study. Baseline data and demographic characteristics are described in Sections 4.1-4.1.4. Data regarding the number, frequency, and circumstances of falls, and types of injuries sustained following falls are reported in Sections 4.2-4.5. Types and costs of medical treatment sought after injurious falls, and data about class attendance are outlined in Sections 4.6-4.7. This was a non-randomised, uncontrolled, unblinded, observational study of participants in an ongoing peer-led fall prevention intervention.

### **4.1 BASELINE DATA**

---

During the information sessions held in March and April 2011, 292 information packs were provided to members of 17 different groups. Two hundred and ten people provided consent, of which three people were excluded for not meeting the inclusion criteria. A total of 33 participants withdrew during the study period. Reasons given for withdrawals were due to health (n=9), having ‘other’ commitments (n=5), moving out of the region (n=3), deceased (n=3), and a further 13 participants participated only six months during the 12-month study period.

#### **4.1.1 Baseline characteristics of participants**

Baseline characteristics of the whole cohort (n=207), of those who completed the 12-month follow-up (n=174), and those who withdrew (n=33) are shown in Table 1.



**Table 1 Characteristics of cohort**

Characteristics	Total (n=207)	Completed (n=174)	Withdrawn (n=33)	p-Value*
<b>Sex</b>				
Female	189	160	29	-
Male	18	14	4	-
<b>Age</b>				
Mean years (SD)	77.65 (6.6)	77.5 (6.5)	78.6 (6.9)	0.38
Range	61-99	61-99	67-96	-
<b>Medical conditions</b>				
Mean n (SD)	1.7 (1.1)	1.7 (1.1)	1.9 (1.1)	0.34
Range	0-3+	0-3+	0-3+	-
<b>Medications</b>				
Mean n (SD)	2.5 (0.9)	2.5 (0.9)	2.6 (0.9)	0.56
Range	0-3+	0-3+	0-3+	-
<b>Vitamin D</b>				
Yes	36	33	3	-
No	171	141	30	-
<b>Years in SAYGO</b>				
Mean n (SD)	4.3 (2.5)	4.3 (2.5)	4.3 (2.7)	0.98
Range	1 - 10	1 - 10	1 - 10	-
Data missing n	6	5	1	-
<b>Walking aide inside</b>				
Yes n (%)	14 (7%)	9 (5%)	5 (15%)	-
No n (%)	193 (93%)	165 (95%)	28 (85%)	-
<b>Walking aide outside</b>				
Yes n (%)	44 (21%)	36 (21%)	8 (24%)	-
No n (%)	163 (79%)	138 (79%)	25 (76%)	-
<b>Fallers (year prior to study)</b>				
Total fallers n (%)	82 (40%)	70 (40%)	12 (36%)	-
Frequent fallers (2+ falls) n (%)	31 (15%)	24 (14%)	6 (18%)	-
<b>Falls (year prior to study)</b>				
Mean n (SD)	0.6 (0.9)	0.6 (0.9)	0.7 (1.1)	0.57
Range	0-4	0-4	0-4	-
<b>Injury (year prior to study)</b>				
Yes n (%)	57 (28%)	47 (27%)	10 (30%)	-
No n (%)	150 (72%)	127 (73%)	23 (70%)	-
<b>Does anyone live with you</b>				
Yes n (%)	79 (38%)	65 (37%)	14 (42%)	-
No n (%)	128 (62%)	109 (63%)	19 (58%)	-

\* Independent t-test comparing participants who completed or withdrew the 12-month follow-up

## 4.1.2 Characteristics of individual groups

As can be seen in Table 2, which shows the baseline characteristics of the individual SAYGO groups that participated in the study, there were no differences between the individual groups that participated.

**Table 2 Baseline characteristics of individual groups**

<b>Group number (n=207)*</b>	<b>Age mean years (SD)</b>	<b>Years in SAYGO mean n (SD)</b>	<b>Medical conditions mean n (SD)</b>	<b>Medications mean n (SD)</b>
1 (n=10)	78.8 (7.9)	4.5 (1.9)	1.6 (1.0)	2.6 (1.0)
2 (n=13)	79.2 (6.1)	4.8 (2.2)	2.1 (1.0)	2.6 (0.7)
3 (n=10)	77.8 (6.4)	3.5 (1.5)	2.1 (0.9)	2.4 (1.1)
4 (n=12)	77.5 (7.4)	3.7 (1.3)	1.6 (1.2)	2.5 (1.0)
5 (n=19)	78.1 (6.0)	5.1 (2.8)	1.6 (1.1)	2.3 (1.2)
6 (n=12)	75.3 (6.1)	2.6 (1.5)	1.7 (1.1)	2.3 (1.0)
7 (n=25)	79.7 (7.1)	4.8 (2.4)	1.8 (1.2)	2.6 (0.9)
8 (n=16)	79.3 (7.0)	4.1 (2.3)	1.6 (1.2)	2.3 (1.0)
9 (n=4)	86.3 (5.0)	2.7 (1.2)	1.5 (0.6)	3.0 (0.0)
10 (n=16)	74.7 (5.3)	4.6 (2.9)	1.9 (1.0)	2.7 (0.9)
11 (n=11)	76.3 (5.3)	2.5 (0.9)	1.2 (0.9)	2.4 (1.0)
12 (n=15)	78.7 (5.6)	5.7 (3.0)	1.6 (1.1)	2.6 (1.1)
13 (n=9)	77.1 (6.6)	5.9 (3.0)	1.6 (1.1)	2.3 (1.1)
14 (n=9)	72.9 (9.2)	3.7 (3.2)	1.7 (1.0)	2.7 (0.7)
15 (n=5)	76.4 (4.5)	8.5 (3.4)	2.2 (1.1)	3.0 (0.0)
16 (n=10)	75.3 (5.4)	2.7 (0.6)	1.8 (0.9)	2.8 (0.6)
17 (n=11)	77.8 (6.6)	2.9 (0.5)	2.0 (1.3)	2.5 (0.8)

\* Sample size too small in some groups to allow statistical analysis

### **4.1.3 Ethnicity**

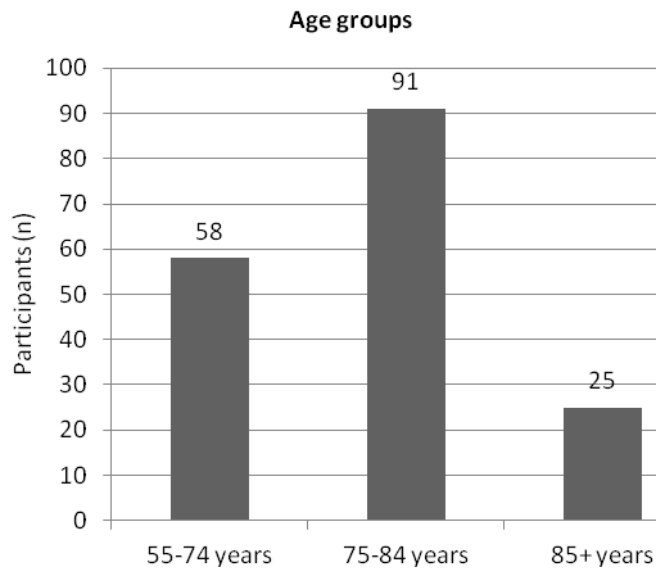
Across all Otago/Dunedin SAYGO classes eight participants self-identified as Maori/Pacific descents. Most other participants identified as New Zealand European descent including England, Netherlands, Germany, and Austria.

### **4.1.4 Characteristics of participants who completed the follow-up**

Participants who withdrew were not statistically significantly different from those who completed the study with regards to age, number of medical conditions/medications, and number of years participating in SAYGO (see Table 1, p. 48), and therefore, the focus of the results of the current study is on participants who completed the 12-month study period.

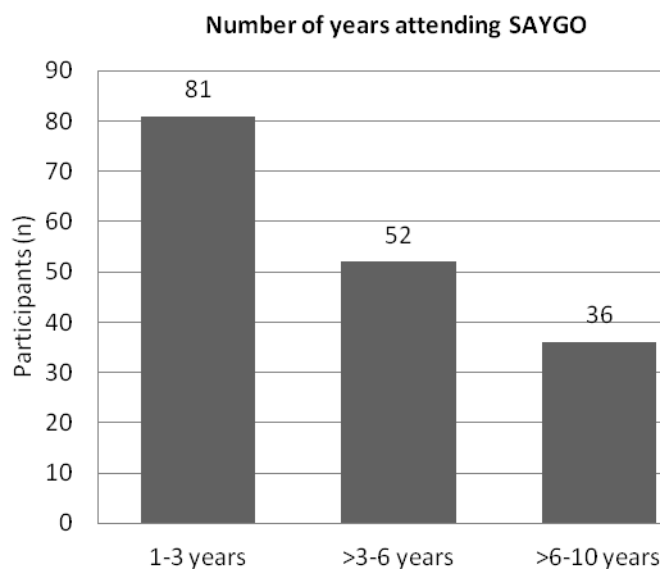
Age distribution, number of years attending SAYGO, number of medical conditions, number of medications, and alcohol consumption grouped into categories are outlined in Figures 2-6.

Initially, participants were divided into four different age groups, with the youngest group defined between 55-64 years of age. However, only five people were in this category, therefore, this age group was combined with the 65-74 age group.



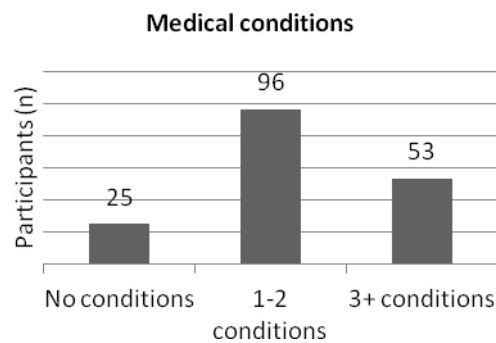
**Figure 2 Participants categorised by age**

The number of years participants attended the SAYGO classes at the time of this study were classified into three groups (1-3 years, >3-6 years, and >6-10 years). As shown in Figure 3, most people had attended the SAYGO peer-led programme between one and three years (missing data n=5).

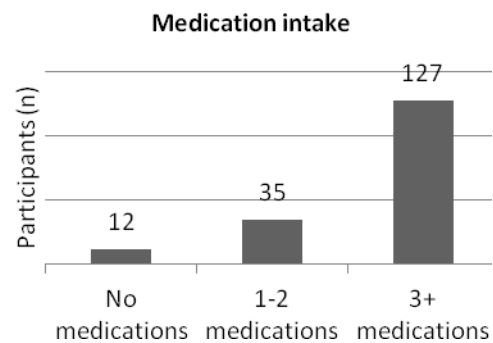


**Figure 3 Participants categorised by years of attending SAYGO**

The number of medical conditions and medications were classed into three categories (see Figures 4 and 5). Most participants indicated that they had one or two medical conditions and were taking three or more medications.



**Figure 4** Participants categorised by number of medical conditions



**Figure 5** Participants categorised by medication intake

Bivariate correlation analysis of the number of falls in the previous year identified a weak, but statistically significant correlation with the number of medications ( $r=.152$ ,  $p=0.045$ ).

Data of participants' alcohol consumption were classified into four categories, based on how often alcohol was consumed per week (Figure 6).



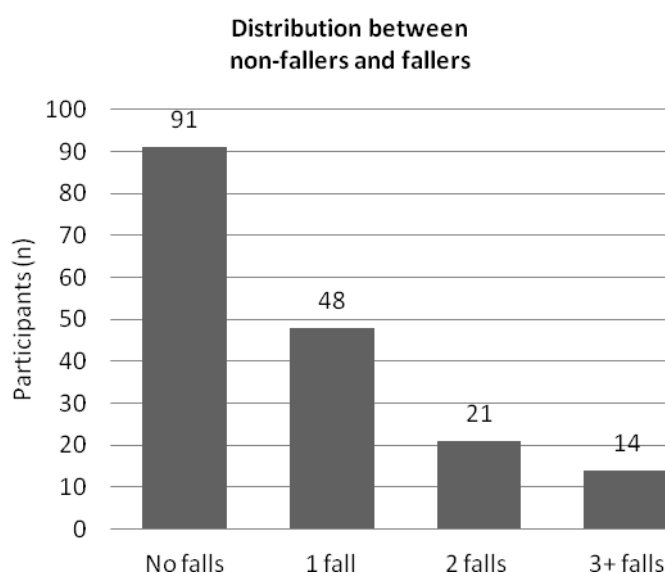
**Figure 6** Participants categorised by weekly alcohol consumption

## 4.2 DESCRIPTIVE ANALYSIS OF FALL DIARIES

In the current study, falls were divided into three categories, as classified by Schwenk et al. (2012):

1. A self-reported fall that did not result in an injury (non-injurious fall),
2. A fall with self-reported injury but no medical attention sought by the participant (fall with minor injury), and
3. Medical attention sought by the participant following a self-reported fall (injurious fall).

Over the 12-month follow-up (May 2011-April 2012), a total of 148 falls were recorded by participants who completed the study (n=174). Furthermore, data suggest that just over half of the participants did not sustain a fall over the 12-month follow-up (n=91, 52.3%), and only a minority (n=14, 8%) sustaining three or more falls, with a maximum of 8 falls recorded by one participant. Figure 7 below demonstrates the distribution between non-fallers, fallers, and frequent fallers.



**Figure 7 Non-fallers, fallers, and frequent fallers**

Bivariate correlation analysis of the number of falls in the previous year identified a statistically significant correlation with the number of total falls sustained over the 12-month study period ( $r=.418$ ,  $p=0.001$ ). The crude rate of falls during the 12-month follow-up was 0.85 per person year (PY). Five participants had >5 falls during the 12-

month follow-up (total falls n=30), and excluding those participants, crude rate of fall calculation decreased the fall rate from 0.85 to 0.69 per PY.

### **4.3 RATE OF FALLS**

---

Partial correlation analysis, adjusting for age, showed that fall incidence in the year prior to the study and fall incidence during the 12-month follow-up were highly correlated ( $r=.897$ ,  $p<0.001$ ), thus they were put into one variable (falls over 24 months) for the negative binomial regression analysis.

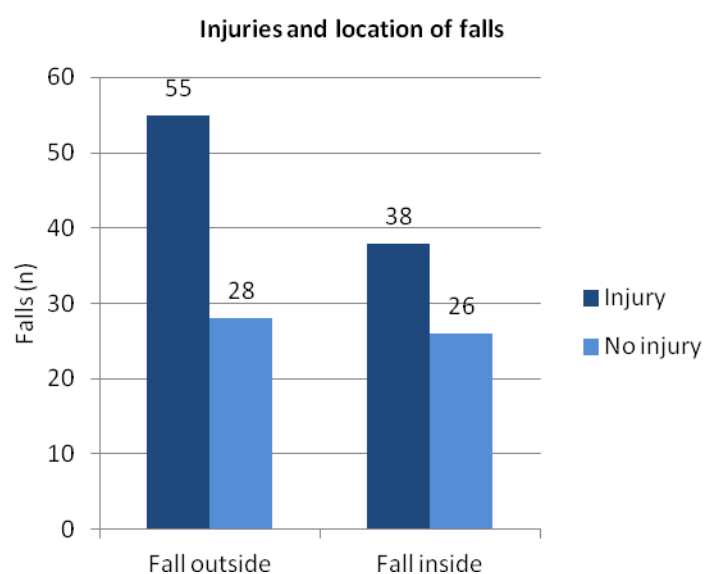
Negative binomial regression analysis was used to examine fall incidence over 24 months with number of years attending SAYGO. For this analysis all 207 participants were included. Age, sex, number of medications, and total months of follow-up were entered into the model. More years of SAYGO participation resulted in lower fall incidence (incidence rate ratio [IRR] 0.91, 95% CI 0.84-0.98,  $p=0.02$ ). These results suggest that those participants who have attended the SAYGO programme longer ( $\geq 3$  years) were about 10% less likely to fall than those participants who participated fewer years (1-2 years) in the SAYGO classes.

Additionally, partial correlation analysis between medication intake and falls, adjusting for age, showed that higher number of medications resulted in more falls (IRR 1.29, 95% CI 1.04-1.61,  $p=0.019$ ). Thus, those participants on more medications were about 30% more likely to fall than those taking fewer medications.

### **4.4 CIRCUMSTANCES OF FALLS (LOCATION, PRIOR ACTIVITY, SEASONALITY)**

---

The location of falls was classified into inside or outside. As shown in Figure 8, more participants reported falling outdoors compared to indoors (missing data, n=1). Additionally, the data collected suggest that the majority of falls that resulted in injuries occurred outdoors (n=55). Further information regarding injuries resulting from falls is described in Section 4.5 (p. 56-58).



**Figure 8 Location of falls and injuries**

Details about the prior activities that led to the fall are listed in Table 3, ranked from the majority of causes at the top.

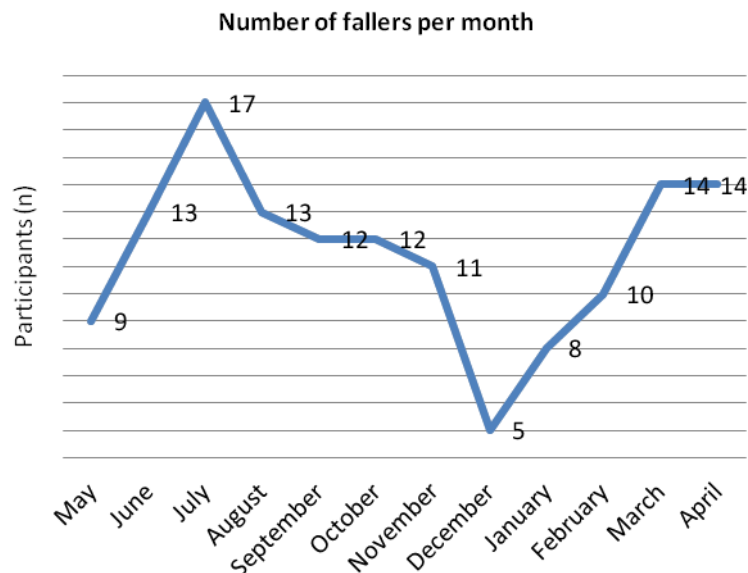
**Table 3 Location and prior activities of falling**

Outdoors		Indoors	
Prior activity	n	Prior activity	n
Walking/tripping	26	Walking/tripping	27
On ladder/step	20	On ladder/steps	15
Gardening	13	Reaching/picking something up/turning around/lifting	7
Walking on wet/icy/uneven surface/slope	13	Getting out of bed/standing up/sitting down	6
Carrying/lifting/pulling	7	Housework/personal hygiene	6
Loosing balance/bending over	5	Playing indoor sports	2

Three people reported that they were unable to get up independently after their fall, and two participants indicated that somebody helped them getting up; however, it is unclear whether they could actually get up independently or not.



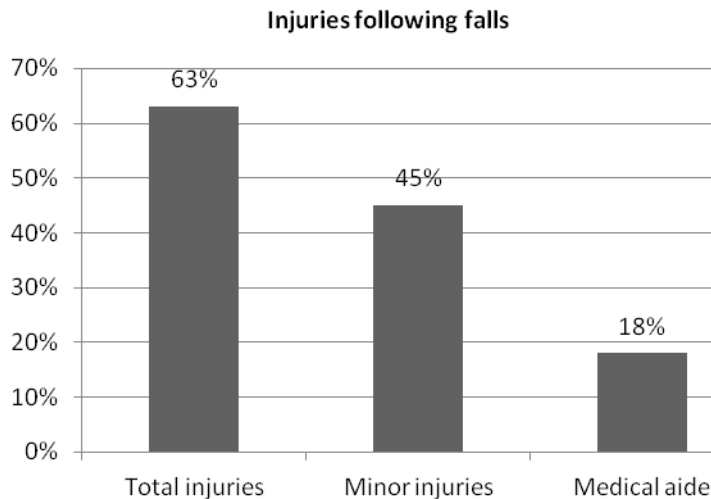
Data regarding the seasonality of falls showed a seasonal variance with a higher number of fallers in July (n=17, winter Southern Hemisphere), compared to five fallers in December (summer) (Figure 9).



**Figure 9 Fallers per month (seasonal variance)**

## **4.5 SELF-REPORTED INJURIES FOLLOWING A FALL**

More than a third of the total falls (55 falls out of the 148 total falls, 37%) did not result in any injuries. The percentages of total injuries, minor injuries, and injurious falls are shown in Figure 10.



**Figure 10 Falls resulting in injuries**

As shown in Figure 10, the majority of falls with an injury (45% out of 63%) resulted primarily in minor injuries such as sprains, bruises, and grazes that did not result in the participant seeking medical attention.

Twenty participants reported one injurious fall and three people sustained two injurious falls. Only females sought medical treatment. Out of the total of twenty-six falls (18%) that resulted in consultation with a health professional, only 4% (n=6) reported a fracture. Five falls resulted in fractures of the upper limb and one participant suffered a lower limb fracture. No hip fractures were reported. One further lower limb fracture was described; however, it was unclear whether this particular fracture was due to the fall, because multiple co-morbidities were identified as being present, and the participant advised that their doctor had referred them for an x-ray investigation prior to the fall. Therefore, this particular injury was not counted as a fracture.

Table 4 shows the differences between the fallers who did not seek medical treatment following their fall (n=60) and the fallers who sought medical treatment as a result of their fall (n=23).

Independent t-tests revealed that there was a statistically significant difference in the number of medical conditions between the groups ( $p=0.03$ ); all other characteristics were not statistically significantly different.

**Table 4 Fallers with and without seeking medical treatment**

Characteristics	Fallers without medical treatment (n=60)	Fallers with medical treatment (n=23)	p-Value
<b>Sex</b>			
Female	52	23	-
Male	8	0	-
<b>Age</b>			
Mean years (SD)	77.62 (6.58)	77.91 (8)	0.87
Range	61-89	64-99	-
<b>Medical conditions</b>			
Mean n (SD)	1.67 (1.08)	2.22 (0.85)	<b>0.03*</b>
Range	1-3+	1-3+	-
<b>Medications</b>			
Mean n (SD)	2.52 (0.91)	2.83 (0.58)	0.13
Range	1-3+	1-3+	-
<b>Years in SAYGO</b>			
Mean n (SD)	4.41 (2.66)	4.2 (2.67)	0.75
Range	1-10	1-9	-
Data missing (n)	2	-	-
<b>Falls (year prior to study)</b>			
Mean n (SD)	0.82 (1)	0.9 (1.13)	0.75
Range	0-4	0-4	-
<b>Class attendance</b>			
Mean n (SD)	30.84 (7.64)	29.33 (5.07)	0.4
Range	13-43	19-38	-
Data missing (n)	3	2	-

\* Statistically significant difference  $p < 0.05$

Bivariate correlation analysis of the number of times medical treatment was sought identified statistically significant correlations with the number of falls in the previous year ( $r=.50$ ,  $p=0.015$ ). Furthermore, there was a weak, but statistically significant correlation between the number of total injuries sustained over the 12-month follow-up and the number of medical conditions ( $r=.18$ ,  $p=0.017$ ).

## 4.6 TYPES AND ESTIMATED COSTS OF MEDICAL TREATMENT

Data about types of medical treatment sought and associated personal costs incurred as a result of a fall were collected via follow-up phone calls using a standardised treatment questionnaire (refer to Section 3.4.4, p. 43).

Time between an injurious fall event and phone call follow-up to gather additional information regarding the event was calculated with a mean of 5.4 weeks (SD 1.7). Twenty-two out of 26 injurious falls resulted in the lodgement of an ACC claim. Two participants were unsure whether a claim was lodged with ACC, and the remaining two fallers reported that no claim was lodged with ACC.

Table 5 summarises the type and frequency of healthcare utilised, the amount of further investigations required, the estimated unit costs, and total estimated costs across all injurious falls.

**Table 5 Types of medical treatment sought and unit costs of healthcare resources**

Type of healthcare treatment (number of participants who sought this resource)	Total visits (n)	Unit costs* (NZ\$)	Total estimated cost (NZ\$)
GP visits (n=18)	36	\$32	\$1,152
Allied providers (n=7)	21	\$36 (physiotherapy follow-up visit)	\$756
X-rays (n=15)	27	\$105	\$2,843
A&E visit (n=4)	4	\$281	\$1,124
Nurse (n=3)	3	\$15	\$45
<b>Total estimated costs across all injurious falls</b>	-	-	<b>\$5,920</b>

\* Unit costs collected from two sources (Garrett et al., 2008, New Zealand Government, 2012)

Four people required ambulance transport to the hospital following their fall, one person reported using taxi services to attend the fracture clinic, and two participants

reported a family member drove them to the hospital (total number that required transport n=7). The mean cost for an ambulance callout with a basic crew type was reported as being NZ\$462 (Garrett et al., 2008, O'Dea, 2005), suggesting an estimated cost of NZ\$3,234 across all seven falls requiring transport to acute medical services in the present study. In New Zealand, the ACC usually pays for the ambulance transport if it is for an accident-related injury (Everybody, 2013).

A total of four people were hospitalised following their fall. One person was not admitted immediately, but some weeks later due to an infection. Two further participants reported presenting at the fracture clinic following their fall. Requirement of additional radiology investigations was also reported (1 ultrasound scan, 1 bone scan, and 1 brain scan). Table 6 summarises the self-reported total personal costs incurred from injurious falls.

**Table 6 Self-reported personal costs incurred from injurious falls**

Healthcare provider type (number of participants)	Total visits (n)	Total personal reported costs (NZ\$)
GP visits (n=18)	36	\$ 905
Allied providers (n=7)	21	\$ 121
Nurse (n=3)	3	\$ 32
<b>Total personal costs across all injurious falls</b>	-	<b>\$ 1,026</b>

The following table (Table 7) summarises the additional help that was reported as being required due to the 26 injurious falls.

**Table 7 Additional medical help required**

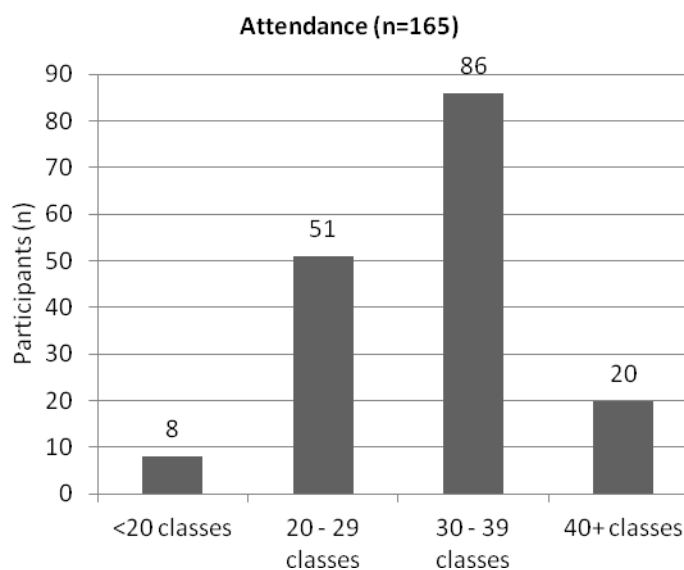
Item	People requiring this item (n)	People requiring this item (%)
Medications, creams, injections	12	46%
Plaster/Bandage/Sling/Moonboot/Collar	4	15%
Home Help	4	15%
Meals on Wheels	3	12%
Wound dressing	2	8%
Aids for achieving independence (toilet/shower seat, frame for support in bed)	3	12%
Walking aids (crutches, walking frame)	2	8%

A further two participants reported that family members or friends were helping with household or caring tasks as a result of their fall, despite their entitlement from other sources (e.g. ACC).

## 4.7 CLASS ATTENDANCE

---

Across all groups, the number of classes held over the 12-month study period ranged from 27 to 47 with a mean of 41.7 (SD 4.6) classes held. The overall percentage of class attendance was 73%, taking into consideration that the amount of classes between groups differed, as stated above. The average number of classes attended per participant was 31.5 (SD 7.0, range 13-44). Figure 11 outlines the number of classes attended, grouped into four different groups (missing data, n=9). The results showed that the majority of people attended between 30 and 39 classes over the 12-month follow-up.



**Figure 11 Class attendance**

It is of note that the number of classes held by the group that met for only 6 months of the year was 25, compared with the 27 classes held by another group that reportedly met for the entire year.

## **4.8 SUMMARY OF KEY RESULTS**

---

The key results that derived from the present 12-month prospective, cohort study include that long-term participation in the SAYGO exercise classes resulted in lower fall incidence. Further, participation in SAYGO appears associated with decreased severity of injuries following falls, with 18% of falls resulting in the participant seeking medical treatment out of which only 4% resulted in fractures. Finally, good adherence was found with 73% of exercise classes attended on average over the 12-month follow-up. The results will be discussed in the following chapter, in the context of previous literature findings and the limitations of the study design.

## 5. DISCUSSION

This study explored the impact of participation in the SAYGO programme; a peer-led, community-based, fall prevention exercise group for older adults on rate of falls, fall-related injuries, circumstances of falls, and types and costs of medical treatment sought after injurious falls. Additionally, class attendance was monitored over the 12-month follow-up. In the following sections, the research questions outlined in Section 1.1 (p. 4) will be discussed in the context of the study results. Strengths and limitations of the study will be outlined, and clinical implications of the study findings, and suggestions for further research will be presented.

### 5.1 RATE OF FALLS

---

Over the 12-month study period, a total of 48% who completed the study reported having sustained a fall (a total of 148 falls recorded). Results showed that 28% of participants sustained one fall, 12% sustained two falls, and 8% sustained three or more falls. Comparing our findings with previously reported falls data in community-dwelling older adults, who do not participate in fall prevention interventions, similarly reported that between 30% and 60% fall each year (Hill et al., 1999, Rubenstein and Josephson, 2002). However, the current results showed that only 42% of those participants who fell sustained multiple falls in comparison to a previous study (Rubenstein and Josephson, 2002), which reported that 50% out of the total fallers sustain multiple falls.

The crude rate of falls in the current study was 0.85 per person year (PY), which seems to be higher than previously reported incidence rates between 0.52 and 0.77 per PY for



community living people (Luukinen et al., 1994, Campbell et al., 1990, Vikman et al., 2011, Rubenstein and Josephson, 2002). However, frequent fallers in a small sample size study such as the present study, can negatively impact on the results. When the five participants who had >5 falls (total falls n=30) were excluded from this calculation, the rate decreased from 0.85 to 0.69 falls per PY. Additionally, and as outlined in detail in the literature review (Section 2.2, p. 11-15), numerous fall risk factors exist, thus careful interpretation of findings is crucial. For example, Hill et al. (1999) reported similar falls data over a 12-month period (49% fallers, 23% multiple fallers) compared with the present results; however, their population was different to the participants in the current study, as they were healthy, older females, living in the community who did not have a history of a fall in the previous year, did not use a gait aid, and did not have a medical illness that may affect balance or mobility. This appears to put the population in the current study at much higher risk of falling, compared to the participants in the study of Hill et al. (1999).

In comparison, a New Zealand study (Garrett et al., 2008) reported a much higher rate of falls in community-dwelling older adults with 2.4 falls per PY reported in a sample with a previous fall history. The participants received no intervention and falls data were only collected for 6 months compared with 12 months data collection in the current study. This shortened follow-up suggests that the number of falls over a 12-month period could have been even higher. Garrett et al's (2008) findings are much higher than the findings of the present study. Possible explanations of the high fall rate in their study could be the participants' increased mean age of 81.2 years, as well as the previous fall history of all 202 participants, which was an inclusion criterion in their study.

The population under investigation in the current study could also be considered to be at high risk of falling, due to their age (mean 77.5 years old) and previous fall history, as both increasing age (Campbell et al., 1989) and previous fall history (Todd and Skelton, 2004, Campbell et al., 1990, Nevitt et al., 1989, Tinetti et al., 1988, O'Loughlin et al., 1993) are risk factors for falling. In the present study, a total of 40% of participants reported having a fall in the previous year, of which 14% reported having two or more falls. The retrospective collection of falls data in the previous year may have resulted in underreporting because of recall bias (Lord et al., 2007), suggesting that more people may have fallen in the previous year, hence more

participants could have been at high risk of falling during the 12-month study period. As expected, bivariate correlation analysis of the number of falls reported in the previous year was significantly correlated with the number of total falls reported over the 12-month follow-up ( $r=.42$ ,  $p=0.001$ ). Further, a high proportion of participants in the current study reported having one or more medical conditions (86%) and taking three or more medications (73%). A higher number of medication intake also predicted more falls in the present study (IRR 1.29, 95% CI 1.04-1.61,  $p=0.019$ ), thus, those participants on more medications were about 30% more likely to fall than those taking fewer medications, confirming previous literature that multi-morbidity and poly-pharmacy increases the risk of falling (Gibson et al., 1987, Lord et al., 2007, Lord et al., 2002, Tinetti, 2003, Campbell et al., 1989). With these data in mind, and the fact that our population was referred to the SAYGO programme due to being at risk of falling or having had a previous fall, the population in the present study would likely have been at higher risk of falling in comparison to other community-dwellers.

Although randomised controlled trials support the efficacy of group exercise interventions (Gillespie et al., 2012), little is known about the effect of interventions when delivered in “real-world” settings (Robitaille et al., 2012). Robitaille et al. (2012) explored the effects of a fall prevention programme delivered in real-world settings by community-based organisations in a quasi-experimental study. This intervention called ‘Stand Up!’ was similar to the SAYGO model as it was a community-based fall prevention programme for older adults primarily aimed at improving balance and strength. However, it only lasted 12 weeks and consisted of twice weekly professional-led group exercise sessions and weekly educational sessions of fall prevention. Similarly to the present findings, the mean age of the participants was 73.8 years (our study 77.5 years), and 41% reported falls in the previous year, compared with 40% in our study. A total of 155 falls over a 12-month follow-up were reported (0.78 falls per PY), which was also similar to the current study’s findings of 0.69-0.85 falls per PY.

As in the present study, the authors defined a fall as per definition of Lamb et al. (2005). However, falls data collection was less frequent (four contacts during the entire study period), and not prospective with monthly falls calendars and follow-up phone calls as recommended (Gillespie et al., 2012, Lamb et al., 2005). This could have likely led to an underestimation of the number of self-reported falls compared to the present study.

Weerdesteyn et al. (2006) investigated whether a five week low intensity exercise programme, the Nijmegen Fall Prevention Program, was effective in reducing falls in community-dwelling elderly people with a history of at least one fall in the year prior. Although this programme was of low intensity, it was suggested that the content was rather unique, as balance and coordination exercises were integrated in an obstacle avoidance course, which was similar to potential hazardous situations of daily life.

Conversely to the current study, participants in Weerdesteyn et al's (2006) study were excluded if they had severe cardiac, pulmonary or musculoskeletal disorders, pathologies associated with increased fall risk (e.g. Stroke, Parkinson's disease), osteoporosis, or used psychotropic drugs, which would likely place the present study's population at a higher risk of falling. Exercise sessions were held twice weekly (1.5 hours) and pre- and post-intervention fall monitoring was performed. A total of 79 participants were included in the exercise group (less than half the number of participants in our study), with a mean age of 73.5 years, similar to the current study. The number of reported medication intake (mean=1.3) was lower than in the present study (mean=2.5), which again supports that participants in the current study may have been at a higher risk of falling compared to the population of Weerdesteyn et al. (2006). Fall incidence was monitored monthly during a 7-month follow-up period from the moment of group assignment via fall registration card. Follow-up cards were sent out as a reminder if no information was received, which differs from recommended monthly fall calendars and follow-up phone calls (Lamb et al., 2005). Although the definition of a fall appeared to be similar to the recommended fall definition by Lamb et al. (2005), it is unclear whether their definition stemmed from this recommendation.

Similarly to the current study, Weerdesteyn et al. (2006) only included the first six falls per person per period if more than six falls occurred, to avoid overweighting of outliers for the analysis of the total number of falls. In the present study, all falls sustained (n=30) from five frequent fallers (>5 falls) were excluded. The results of Weerdesteyn et al. (2006) showed that in the exercise group, the rate of falls decreased from 1.77 at baseline to 0.95 falls per PY at follow-up in contrast to the control group, where the rate of falls per PY at baseline (1.77) remained similar (1.75 at follow-up). Comparing these findings with the current results shows that the rate of falls per PY in the present study is much lower (0.69-0.85 falls per PY), despite the potential higher risk of falling in this population, and the 5-month longer follow-up period.

The SAYGO programme in Alberta (Robson et al., 2003) differed quite drastically from our SAYGO model, despite being a fall prevention programme for older adults in the community, and led by lay senior facilitators, similar to the New Zealand model. However, the Alberta SAYGO only comprised of two 90-minute group sessions held one month apart at which participants were given a handbook and a fitness video. Participants were instructed either to use the video daily for 20 minutes or to get involved in a community exercise programme of about 45 minutes, three times a week; both approaches entailed approximately 140 minutes of exercise per week. The handbook provided guidelines on two different types of exercises: exercises for the entire body fitness (e.g. walking, swimming) and exercises for strength and balance (e.g. Tai Chi).

Identical to the current study, and as recommended, falls were recorded on a monthly basis, using calendars, and follow-up phone calls to gather missing or additional information about the fall. Seniors were randomly assigned to the treatment group and to the control group. The mean age of the participants was similar to the present study's findings and were considered healthy older adults (as per self-report). Robson et al's (2003) findings showed that 31.5% reported a fall history in the previous year in comparison to the present study's findings of 40%, which places the current study's population at a higher risk of falling. Results from Robson et al. (2003) showed that more people reported a fall in the control group (23%) than in the treatment group (17%), a lower percentage of falls than reported in the present study. However, their follow-up time was only four months, in comparison to the current study, that followed people over 12 months as per recommendation (Lamb et al., 2005). Whilst the authors suggested that the participants in the treatment group were 30% less likely to fall compared with individuals in the control group, and that their findings are an encouraging trend, the results were not statistically significant.

A study by Clemson et al. (2004) investigated the 'Stepping On' programme, a community-based fall prevention programme delivered via two hourly sessions for seven weeks, including a follow-up occupational therapy home visit. Their results at a 14-month follow-up showed that a total of 52% of participants in the intervention group reported sustaining falls, of which 26% reported two or more falls, which was similar to the findings of the present study (a total of 48% reporting falls of which 20% reported multiple falls over the 12-month follow-up). The study by Clemson et al. (2004) was a

randomised controlled trial, a stronger design to demonstrate efficacy than the present study, which was an observational cohort study without a control group. Similarly to the present study, the mean age of their population was 78.31 years. However, it appears that more people in the programme group in this study reported having a fall history in the previous year (65%) in comparison to the present study (40%), and a mean intake of 4.37 medications compared to 2.5 respectively. This suggests that the population of Clemson et al. (2004) was at higher risk of sustaining a fall compared to the present study. Additionally, the authors reported that their intervention group experienced a 31% reduction in falls, similar to previous research of the SAYGO, using a quasi-experimental design (Waters et al., 2011) which reported a 27% decrease in falls in the peer-led group.

Whilst a huge amount of research exists on exercise programmes to prevent falls in older people (Gillespie et al., 2012), little research exists regarding sustained participation in fall prevention programmes (McMahon and Fleury, 2012, Fujisawa et al., 2007). The SAYGO model appears to be an exercise model that participants adhere to well with a mean participation rate of the programme of 4.3 years (SD 2.5). Previous literature findings support that long-term continuing exercise is effective in preventing falls in community-dwelling elderly in Japan (Fujisawa et al., 2007). This was also found in the present study with a trend towards lower fall incidence with long-term participation in SAYGO. Participants who attended the SAYGO longer were about 10% less likely to fall than those participants who participated in fewer years of SAYGO, after adjusting for confounding variables (age, sex, and number of medications).

Fujisawa et al. (2007) compared 119 subjects who had a history of participating in exercise classes (between 1993 and 2001) with 878 people who had never participated in exercise classes. Participants who were in the Fujisawa et al. (2007) exercise classes were at similar age (mean age 72.5 years) in comparison to participants in the present study. Their results showed that long-term, ongoing exercise is effective in preventing falls in older adults after the adjustment of confounding variables (e.g. age, depression). It was recommended that community-dwelling older adults at risk of falling should join supervised group exercise sessions to maintain or improve function. Despite some limitations identified in the study (e.g. non-controlled study, irregular participation of

classes in some subjects), the authors suggested that persistent exercise classes proved to be effective (Fujisawa et al., 2007).

A recent Cochrane review (Gillespie et al., 2012) showed that multiple-component group exercise significantly reduced both rate and risk of falling; however, most fall prevention interventions have been tested in randomised controlled trials, which makes comparison to the results of the current study difficult, as it would be considered to have a less rigorous study design. Nevertheless, with the previously reported trend towards a decrease in risk of falling in participants attending the SAYGO programme (Waters et al., 2011), and the current findings of lower fall incidence with long-term compared to short-term participation in the SAYGO, there appears to be a tendency towards decrease in rate of falls in participants who attend the SAYGO classes.

## **5.2 SEVERITY OF INJURIES AFTER A FALL**

---

Out of the total of 63% injured in the present study, more than two thirds (45%) resulted in minor injuries that did not result in the participant seeking medical attention, and only 18% resulted in participants seeking medical treatment. As stated earlier (Section 2.3.2, p. 16-19), research into fall-related injuries is affected by a number of problems and should be interpreted carefully. There does not appear to be a standardised definition of classifications of different injuries, hence comparison between studies remains difficult (Schwenk et al., 2012). Most randomised controlled trials are underpowered to detect a significant reduction in injurious fall rates and large sample sizes are required to achieve adequate statistical power (Schwenk et al., 2012). The classification of injurious falls in the present study (classifying injurious falls by health-care utilisation only) was identified by a recent meta-analysis as being one of three classifications to determine an injurious fall (Schwenk et al., 2012). Data from the current study, suggesting that 18% of falls were classified as injurious falls, are lower in comparison to previous literature that reported between 20-30% of older adults seek medical attention after a fall (Lord, 2006, Robertson et al., 2002, Centres for Disease Control and Prevention, 2012). Findings from a meta-analysis conducted by Robertson et al. (2002), are comparable to the data from the current study, as the population was of similar age and were community-dwelling older adults living in New Zealand. They

included four fall prevention intervention trials of muscle strengthening and balance exercises, which were delivered at home by trained health professionals, and found that approximately 22% of all falls resulted in seeking medical attention; a higher percentage compared with the current results. Further, findings by Hill et al. (1999) showed that among healthy older adults in the community, 16% of falls resulted in seeking medical treatment during a 12-month follow-up. As discussed above, the population in Hill et al.'s (1999) study appeared to have had a much lower risk of falling compared to the population in the present study. Further, this study's results are comparable to falls data from New Zealanders aged 75+ years with a previous fall (Garrett et al., 2008). Garrett et al.'s (2008) results showed that 60% of falls (n=58) resulted in injury, and 19% (n=18) required medical attention. However, participants in the latter study did not attend a fall prevention programme and fall data were only collected for 6 months; a 12-month fall data collection may have resulted in a higher percentage of injurious falls.

Of the 10-60% of older adults suffering injuries from falls (Bergland and Wyller, 2004, Hill et al., 1999, Lord et al., 2007, Vikman et al., 2011), 5-15% suffer serious injuries such as a fracture, head injury, or serious laceration (American Geriatrics Society et al., 2001, Vikman et al., 2011), and 2-16% suffer fractures from accidental falls (Gibson et al., 1987, Lord et al., 2007, Tinetti et al., 1988, Tinetti, 1987, Hill et al., 1999, Bergland and Wyller, 2004). In comparison, Koski et al. (1998) found in a prospective population based study, that major injuries were sustained in 32% of fallers (n=120) among home dwelling older adults, of which 48% (n=58) sustained a fracture. A major injury was classed as being a fracture, joint dislocation, laceration requiring sutures, and intracranial injuries. These authors also reported that two thirds of the fallers who sustained a major injury were classified 'disabled' at baseline, according to functional ability scores. This may explain the high percentage of injurious falls in their study compared to the current study's results and others.

Additional results of the present study showed a low percentage of falls resulted in fractures (4%), which is similar to previous authors who suggested that the proportion of falls resulting in fractures is low (Todd and Skelton, 2004, Gillespie et al., 2012, Rubenstein and Josephson, 2002, Luukinen et al., 1995, O'Loughlin et al., 1993), accounting for less than 10% (Campbell et al., 1990, Tinetti et al., 1988, Centres for Disease Control and Prevention, 2012). Furthermore, in the current study only women

sustained fractures, which is similar to previous literature findings which support that women are more likely to incur fractures when they fall (Campbell et al., 1990a, Robbins et al., 1989). In contrast to these findings, Bergland and Wyller (2004) found that as much as 13% of falls resulted in any types of fractures in an RCT over a one year period in community-dwelling older women in Norway.

Another finding of the current study was that no hip fractures were reported during the 12-month follow-up. Despite the developments in suggesting a decline in fall-related hip fractures in older adults in recent literature (Hartholt et al., 2010, Stevens and Rudd, 2010a, Langley et al., 2011, Leslie et al., 2009), the outcomes following a fall-related hip fracture can be detrimental and can result in mortality within the following months (Freeman et al., 2002). However, a recent systematic review suggested that RCTs with sample sizes between approximately 33,000 and 56,000 participants would be required to establish the effectiveness of an intervention with respect to falls resulting in hip fractures (Schwenk et al., 2012). The authors of this systematic review (Schwenk et al., 2012) suggested that none of the included 41 RCTs in their study met this sample size and therefore not allowing them any statement on effectiveness of interventions with respect to fall-related hip fractures. The current study reported no hip fractures; however, it was a prospective cohort study and thus could not determine intervention efficacy in reducing hip fractures due to its study design and small sample size.

As previously suggested, not only do risk factors such as co-morbidities and previous fall history increase risk of falling, the current findings also suggest that there is a relationship between these known risk factors and the total number of injuries sustained in the following year. The number of falls in the previous year was significantly correlated with the number of times medical treatment was sought in the following year. This may suggest a previous fall history places someone not only at higher risk of sustaining a fall in the following year, but may also be associated with sustaining fall-related injuries in the following year. These data warrant further investigation employing specifically designed, and adequately powered trials.

Previous findings from a Cochrane review suggested that exercise interventions for fall prevention appear to reduce fall-related fractures (Gillespie et al., 2012). The low percentage of falls in the current study resulting in fractures (4%), and the fact that



none were hip fractures, may suggest that people participating in SAYGO exercise classes incur less severe injuries than reported in the literature.

### **5.3 CIRCUMSTANCES OF FALLS (LOCATION, PRIOR ACTIVITY, SEASONALITY)**

---

Age, sex, and frailty are risk factors for falls location (Lord et al., 2007). In the present study, a higher number of falls (56%) occurred outdoors in comparison to indoors, and 66% of people who reported that their fall occurred outdoors also incurred an injury as a result of the fall. This conflicts with previous prospective community-dwelling cohort studies with some reporting more than 50% of falls occur inside their homes (Campbell et al., 1990, Lord et al., 1992). More recent findings from a prospective cohort study in Sweden suggested that as much as 97% of falls occurred indoors in community-dwellers aged 65+ years, who received home-help services (Vikman et al., 2011). Contrarily, findings of Hill et al. (1999) are similar to the present study's findings, which suggested more than half of the falls occurred outside the home. Individuals participating in greater levels of outdoor activities (more robust people) may have higher exposure to environmental fall risk factors, and hence fall more frequently outdoors (Hill et al., 1999, Campbell et al., 1990, Luukinen et al., 1996, Lord et al., 2007). This is in comparison to frailer people with limited mobility who suffer more falls within their homes, and could be one of the reasons why most falls and injuries in the present study occurred outdoors. The sample, although older and at risk for falling, may be considered more robust by the fact they are living in the community, and participating in a weekly exercise programme.

In an RCT of water-based exercise and fall risk, the authors suggested that water-based exercise may not have reduced fall risk compared with the control group who attended a computer class (Hale et al., 2012). Getting out of the house on a regular basis may have resulted in increased physical activity, which in turn results in increased functional changes. This was also previously proposed by Morie et al. (2010) who found that getting out of the house one day a week may improve function in older adults who were previously sedentary. In the present study, this may have also been the case, suggesting that these older people were more robust due to the combination of participation in the SAYGO exercise classes, and the regular activity of simply getting to those classes.

Whilst living alone may imply greater functional ability in the older adults, it has also been shown to be a risk factor for falls, and outcomes can be worse, especially if the person cannot rise from the floor (Wickham et al., 1989). In the present study, more than two thirds (63%) of participants indicated that they were living alone, but only a small proportion of people (n=5, 6%) reported that they were unable to rise from the floor after their fall and required assistance. This differs from previous literature, which suggested that approximately 50% of people who fall require help to get up, even without sustaining an injury (Todd and Skelton, 2004). This may be further evidence that participants in the SAYGO peer-led groups are more vigorous and robust older people. However, it remains to be determined whether participation in SAYGO exercise classes contributed to greater robustness or whether other factors not captured were contributing, but evidence from a previous evaluation of the SAYGO classes suggested that physical function improves, and is maintained at higher levels with SAYGO participation (Waters et al., 2011).

The activity just prior to a fall showed that the majority of falls occurred while walking/tripping (36%), both indoors and outdoors, with an additional of 9% reporting walking on wet/slippery surfaces. Being on a ladder or on steps was also often reported (indoors n=15, outdoors n=20, total 24%). These findings are similar to previous findings of Hill et al. (1999) who suggested that circumstances of falling were most commonly tripping over an obstacle (35%) and involving steps or kerbs (25%). Many falls in the current study occurred during walking commonly associated with environmental constraints, such as slippery, wet or uneven surfaces, similarly to Hill et al's (1999) study findings. Two participants in the current study, whose falls were classed as indoor falls occurred whilst playing indoor sports (Badminton and Bowls), therefore, interpretation of purely indoors and outdoors may result in false assumptions of the participant being 'less active' when falling indoors. In this example, those particular participants would certainly be classed as being active.

Finally, seasonality was another factor associated with falls in the current study. Results showed that there were more fallers over the winter months in comparison to the summer months. The association between seasonal variations and falls has been studied to some extent but the precise effect of seasonal change on the epidemiology of falls is somewhat unclear and remains controversial (Douglas et al., 2000, Vikman et al., 2011). Monthly fall incidence was significantly associated to daylight periods, but not

to temperature in persons aged 65+ living in a Swedish community (Vikman et al., 2011). Whether the daylight period, the temperature, the winter conditions (e.g. icy surface), or a combination of factors played a role in the seasonal variance in the present study remains unclear and needs further investigation.

## **5.4 TYPES AND ASSOCIATED COSTS OF MEDICAL TREATMENT**

---

Over the duration of the present study the cost across all injurious falls (n=26) was NZ\$5,920 with additional personal costs of NZ\$1,026, totalling NZ\$6,946. Comparing the current study's findings with the findings of Garrett et al. (Garrett et al., 2008), who recorded 97 falls over a one year period, out of which only 18 falls (19%) resulted in participants seeking medical attention and thus incurring health service costs. The reported total cost in their study was NZ\$7,597, suggesting that the costs incurred due to injurious falls in the present study were lower. However, the costs presented in the current study are most likely underreported, as transport costs to the hospital or other treatment providers, costs for other investigations (except x-ray reports), and costs for additional medical help (e.g. home-help, wound dressing, bandage, walking aid) were not included in this figure.

Nearly half of the participants that sought medical help (46%) also reported the need for further medications/creams/injections. Two additional participants reported that a family member or friend was helping with household or caring tasks as a result of their fall, despite their entitlement from other sources (e.g. ACC). The private costs incurred after a fall may be underreported in the literature, as older adults may seek private help, rather than going through public health services. So, even if data collection about costs would be done via public records (e.g. hospital, GP, or ACC records), the true amount of costs incurred to the individual may exceed the amounts reported. This has previously been reported by Davis et al. (2010) who conducted a systematic review to compare costs of falls in older adults living in the community and reported that the costs of falls are likely greater than assumed.

Transport costs to the hospital or fracture clinic was estimated with a total cost of NZ\$3,234 across all seven falls that required transport to acute medical services

(ambulance n=4, taxi service n=1, family member n=2). This is similar to Garrett et al. (2008), who reported that four people required transportation via ambulance. According to Halter et al. (2000) approximately 10% of ambulance call-outs in the United Kingdom are for people over 65 years who sustained a fall and about 60% of these are taken to hospital. The current study showed that only seven people who suffered a fall required transport to acute medical treatment facilities immediately after their fall and a minority of fallers (n=4, 3% of falls) required admission to the hospital following their fall. Although this information needs to be interpreted cautiously, it may suggest that the few hospital admissions could create potential cost-savings for participants attending the SAYGO exercise classes, a finding previously suggested for the OEP which showed cost savings for people aged  $\geq 80$  years due to fewer admissions to hospitals (Robertson et al., 2001a).

However, data of medical treatment sought as a result of falling should be viewed with care. Fall calendars were returned monthly and the time between each fall event and phone-call follow up to gather additional information regarding the fall and injuries was a mean of 5.4 weeks (SD 1.7). Those who were contacted within the first few weeks after their fall could have sought medical attention at a later date, leading to potential underreporting of injurious falls for which medical treatment was sought. However, as previously discussed, only 4% of falls resulted in a fracture, and there were no hip fractures reported in the current study. If this result is corroborated in larger trials, this may suggest potential cost savings to the public health sector, as fractures have been suggested to be the main consequence of falls with respect to costs (Heinrich et al., 2010), particularly hip fractures (Borgstrom and Kanis, 2008).

Fall prevention strategies need to be targeted at particular subgroups of older people to obtain maximum value for money (Gillespie et al., 2012). This may also be the case in the present study, as there was a range in age of participants (61-99 years), and the SAYGO programme may need to be targeted at different subgroups. Data on costs were collected via self-report and health provider unit costs were gathered from previous literature on costs of falls, but no costs were collected from hospital or ACC databases as this was beyond the scope of the current project. Comparisons with other studies are difficult as health care funding differs between countries and previous literature also suggested that there is a need for a consensus on methodology for cost of falls studies to enable accurate comparisons between different countries (Davis et al., 2010).

## 5.5 CLASS ATTENDANCE

---

The overall mean attendance rate of participants who completed the 12-month follow-up was 73%, which can be considered reasonably high. For example, adherence of strength and balance exercises from a community-based programme ('Stepping On') was reported to be much lower, between 41-59% at 14 month follow-up (Clemson et al., 2004). The programme was only delivered for seven weeks (2hours/week), which was different from the current study. The SAYGO exercise programme only occurs once a week for one hour, which is lower than the reported recommendations regarding exercise for strengthening to prevent falls in older adults, suggesting a minimum of two hours a week (Sherrington et al., 2011).

In the current study, approximately half of the participants attended between 30-39 classes, followed by 51 participants who attended between 20-29 classes. However, class attendance between groups varied considerably, ranging between 27-47 classes; it was unclear why there were considerable differences between groups. Motivation of participants and particular peer-leaders of each group might play a role. A recent study also investigated adherence to fall prevention interventions in community-dwelling older adults (Nyman and Victor, 2012). Similar to the present study's findings, adherence rates at 12 months for class-based exercises were reported with 73.2%, which was higher than adherence rates for individually targeted exercises with 52%.

In comparison, a Thai Chi programme in Taiwan recorded 63% attendance over one year (Lin et al., 2006). The lower attendance rate could be due to the fact that the Thai Chi exercises were performed for one hour per day, six days per week. Interestingly, Nyman et al's (2012) results showed that over 12 months, the average number of exercise classes attended was 21/78, which was much lower than the findings in the current study, which had a mean class attendance rate of 31.5 classes, suggesting that adherence to the SAYGO programme is good. It has previously been suggested that adherence in fall prevention interventions is generally low (Todd and Skelton, 2004) and recommendations for future fall prevention research have been made to include methods to increase uptake and adherence of effective programmes by older people (Gillespie et al., 2012, New South Wales Department of Health, 2011, Yardley et al., 2007). A recent systematic review suggested that regular, sustained participation in physical activities which increase lower limb strength and balance reduces both the risk

of falls and their occurrence (McMahon and Fleury, 2012). The present study's results suggest that the SAYGO model appears to be an effective peer-led model with generally high attendance, and most importantly, a long-term dedication with a participating rate of the programme of over 4 years overall. Finally, and as described above, it is the long-term participation in the SAYGO exercise classes which predicted lower fall incidence.

## **5.6 STRENGTHS AND LIMITATIONS**

---

The following strengths and limitations were identified in this study and are outlined in the following two sections.

### **5.6.1 Strengths**

- The definition of a fall, as recommended by the Prevention of Falls Network Europe (ProFaNE) (Lamb et al., 2005, p. 1619) was used in the present study and placed on each fall calendar to remind participants of the exact definition. Its use is recommended to facilitate comparisons of research findings.
- All efforts were made to collect data on falls and injuries as per recent published recommendations (Gillespie et al., 2012, Lamb et al., 2005), which suggested prospective daily recording and a minimum of monthly reporting to avoid recall bias over a minimum of 12 months (Lord et al., 2007, Campbell et al., 1989), and therefore, minimise underreporting of falls. Monthly follow-up phone calls were performed to gather missing and incomplete data and over the entire study period, many follow-up phone calls were necessary as it often occurred that the information received was incomplete, that participants did not send their fall calendars back at all, or that they sent a wrong fall calendar back (e.g. for the following month instead). Telephone or face to face interviews have been suggested to be used to gather missing data and to gather further details of the individual fall and the injuries sustained (Lamb et al., 2005).

- Data of the present study were reported and analysed as per recommendations from collaborators of a recent Cochrane review (Gillespie et al., 2012). This review suggested that certain aspects of methodology need to be adopted for future research. The authors suggested that fall events should be reported as total number of falls, fallers, the number of people sustaining a fall-related fracture and the rate of falls (falls per person year). With regards to analysis, it was recommended that results should be analysed using appropriate methodology (e.g. negative binomial regression, survival analysis) (Robertson et al., 2005).
- In this study, an ‘injurious’ fall was classified if the participant sought medical treatment as a result of their fall. All other injuries were classed as ‘minor injuries’. Whilst it has been acknowledged that there is no consensus on the definition of injuries and the severity of injuries to allow comparisons between studies (Schwenk et al., 2012), the authors of a recent systematic review suggested that classification of injuries according to health care utility was one of the possibilities to differentiate between injurious and non-injurious falls (Schwenk et al., 2012). This definition was used in the present study.

### **5.6.2 Limitations**

- Despite all efforts of adhering to recommended fall and injury data collection, self-reported fall data collection is prone to potential errors and recall bias, particularly when gathered retrospectively, which was the case for fall data in the year prior to the study.
- The current study has limited generalisability as it was not a randomised controlled trial and therefore no control group served as a comparison.
- The generalisability to men and other ethnic groups is limited, as the sample in the present study was biased to females (~90%) and White Europeans.
- The sample size may have been underpowered as data on falls and injuries require large sample sizes, to be adequately powered (Schwenk et al., 2012).

- The timeframe between an injurious fall event and the phone-call follow up to gather additional information regarding the fall and injuries sustained was calculated with a mean of 5.4 weeks (SD 1.7). Therefore, some people may have consulted a medical practitioner after the phone call follow-up, and this fall was classed as ‘minor injury’, despite possible medical attention being sought at a later date. Ideally, phone-call follow-up should have occurred at a certain point in time or on numerous occasions (e.g. 2, 4, and 6 months post fall), to get a clear indication whether a faller consulted a medical professional or not at that time.
- Data about medical conditions and medications were only gathered via self-report, and analysis included categorical data (no medical condition or no medication, 1-2 medical conditions or medications, and 3+ medical conditions or medications). This method of data-collection may result in inaccuracies and possible underreporting, as it was noted that some people did not consider their ‘usual’ chronic conditions (e.g. diabetes, high blood pressure) as chronic conditions. Future research should gather information about medical conditions and medications via GP records for accurate data (e.g. type and dosage) to capture certain illnesses, diseases, and medications that may put someone at a high risk of falling, to enable differentiation between high risk participants.
- It is possible that the number of people who actually required medical attention compared to those who sought medical attention differed. One participant reported that “it has to be pretty serious to go to a doctor, cannot afford it because it costs NZ\$27 and I am only on the pension”. Others suggested that their family members insisted they see a health professional, despite them not wanting to do so.
- Data gathering regarding costs of falls was not consistent with recent recommendations (Gillespie et al., 2012), as this was beyond the scope of this project. To establish the cost-effectiveness of fall prevention interventions, economic evaluations should be conducted, including measuring health-related quality of life as an outcome, defining the perspective and timeframe for costs, collecting data on healthcare use, and calculating cost-effectiveness ratios,



according to recently published guidelines (Davis et al., 2011). Future studies should aim to gather costs according to these recommendations.

- Although these classes were long-standing and turnover of peer-leaders was low, recruitment, training, support and retention of senior volunteers should not be underestimated in planning and costing of such peer-led programmes (Peel and Warburton, 2009). This was not evaluated in the current study and should be considered for future studies.

## **5.7 FURTHER RESEARCH**

---

Future research is needed to compare participation in the SAYGO model versus other fall prevention interventions or to a population not participating in any form of exercise. Prospective, controlled studies on community translation of fall prevention exercise programmes into peer-led models, using monthly fall calendars, data on injuries and costs, and clear definitions of severity of injuries are needed to confirm and extend these findings. As previously suggested, strategies need to be targeted at particular subgroups of older people to obtain maximum value for money which may also be considered for the SAYGO programme in the future. In addition to SAYGO, it may be beneficial to include medication reviews with General Practitioners in future projects.

Whilst the SAYGO programme has been operating successfully in Otago since 2003, future research may need to investigate the implementation of these classes to different settings within or outside of New Zealand, with different peer-leaders and support structures such as Age Concern Otago. Furthermore, future studies require adequate sample size, and standardised methodologies regarding definitions of fall injuries to make comparisons between studies possible. Possible contributing factors for the good adherence in the SAYGO in Dunedin may be explained by the opportunity for social interaction, that the majority of participants were females and that the study took place in a small city. These factors could be explored further in future research studies. And finally, economic evaluations are required to determine the cost-effectiveness of the SAYGO peer-led, community-based exercise classes.

## 5.8 CLINICAL IMPLICATIONS

---

The SAYGO peer-led model is a unique exercise-based fall prevention programme in Otago, New Zealand. It is led by trained peer-leaders in a community setting and has shown to have functional benefits, is affordable due to the minimal cost of setting up (Waters et al., 2011), and ongoing costs are minimal for participants, as it is self-funded by participants. The current results suggest that sustained participation in SAYGO peer-led exercise classes decreases the rate of falls. Additionally, only a minority of fallers sought medical treatment as a result of a fall, the fracture rate was low at 4%, and there were no hip fractures reported, suggesting that participation in this exercise model may decrease the severity of injuries. The overall attendance rate was high at 73% with a mean participation rate in the SAYGO classes of 4.3 years. Therefore, this type of model appears to motivate older adults to ongoing participation in exercise classes, with the benefits of decreased fall rate over longer periods, reduced serious injurious falls, and is a low cost means for older adults to adhere to a fall prevention programme.

## 6. CONCLUSION

Falls are common in older adults and preventing falls is important for older people and society. Worldwide, the proportion of older people is growing exponentially (Tinetti et al., 1994, Yamashita et al., 2012) and the risk of falling increases with age (Campbell et al., 1989, Tinetti et al., 1988). Numerous fall risk factors exist, and consequences of falling can be detrimental, ranging from minor injuries to major traumas (e.g. fractures) often resulting in hospitalisation and subsequent nursing home admissions. Falls can also lead to psychological consequences, loss of independence and quality of life, as well as enormous economic costs to health care systems.

Many fall prevention interventions exist and exercises aimed at improving muscle strength and balance are beneficial for the prevention of falls in community-dwelling older adults (Gillespie et al., 2012). Previous research suggested that the Steady As You Go (SAYGO) exercise programme, a community-based, peer-led fall prevention programme in New Zealand, has shown to be effective for increasing and maintaining functional levels, and has shown a 27% decrease in falls compared to a control group (Waters et al., 2011). However, little research has been undertaken on the SAYGO programme to date. The aim of the current study was to evaluate the impact of the SAYGO model on falls, severity of injuries, types and costs of medical treatment sought following falls, and attendance rate over a 12-month study period.

The main findings of this one year prospective, observational study was that long-term participation in the SAYGO exercise classes resulted in 10% lower fall incidence compared to people who attended for less time. The number of falls in the previous year was significantly correlated with the number of total falls and injuries sustained, and the number of times medical treatment was sought over the 12-month follow-up.

These findings are similar to previous research suggesting a previous fall history puts someone at higher risk of falling in the following year (Todd and Skelton, 2004) and appears to also place someone at higher risk of sustaining a fall-related injury.

The crude fall rate in the present study ranged from 0.69 to 0.85 falls per PY, which is similar to the reported fall rate in previous literature from New Zealand (Robertson et al., 2002), which investigated four exercise intervention studies. In contrast, the rate of falls from a non-interventional New Zealand study (Garrett et al., 2008) was much higher in comparison to the findings of the current study, with reportedly 2.4 falls per PY in a population with a fall history in the previous year.

Participants in the SAYGO exercise programme could be considered a population at high risk of falling, due to their age, previous fall history (63%), reported underlying medical conditions, and high medication intake. Fall prevention programmes delivered in real-world settings by community-based organisations have previously been investigated (Robitaille et al., 2012) with regards to falls, and showed results similar to the current findings (0.78 falls per PY), although underreporting of falls was more likely due to the type of fall data collection, which was less frequent than in the present study. The findings of the current study also suggest that participants in the SAYGO exercise classes may sustain less severe injuries than commonly reported in community-dwelling older adults. However, comparison between studies remains difficult due to the lack of standardised definitions or classifications of injuries (Schwenk et al., 2012). Out of the total of 63% injured, only 18% resulted in injurious falls for which participants sought medical attention, which is lower than previous findings of 23% (Robertson et al., 2001a). Exercise interventions for fall prevention have shown to reduce fall-related fractures (Gillespie et al., 2012), supporting the suggestion that participation in the SAYGO exercise classes may reduce fracture rates, with only 4% fractures reported in the current study.

There is evidence that participants in the SAYGO peer-led groups may be generally robust older people, with high physical functional levels that are maintained (Waters et al., 2011). Most falls and injuries in the present study occurred outdoors, supporting the notion that the sample group were robust older adults, who are generally known to have more falls outside in comparison to frailer people (Lord et al., 2007). However, it remains unclear whether participation in the SAYGO exercise classes contributed to

this robustness or whether other contributing factors that were not captured are associated with this.

Costs related to fractures are a significant consequence of falls (Heinrich et al., 2010), specifically hip fractures (Borgstrom and Kanis, 2008). The results of this study reported no hip fractures suggesting potential cost savings to the public health sector. Costs for falls that do not require hospitalisation are often underreported (Garrett et al., 2008) and the total estimated cost of medical treatment sought across all injurious falls in the current study was NZ\$6,946. However, there is a lack of consistent methodologies to enable comparisons of costs between studies (Davis et al., 2010). Fall prevention strategies need to be targeted at particular subgroups of older people to obtain maximum value for money (Gillespie et al., 2012), and the SAYGO programme may also need to be targeted to different subgroups. The results of this study further showed that participants' class attendance rate was 73% over one year, with an average of 31.5 out of 41.7 classes attended. This is much higher than previously reported by Nyman and Victor (2012) who suggested 21 out of 78 classes were attended. Finally, an average of 4.3 years of participating in the SAYGO classes across participants shows the long-term dedication of older adults to this exercise model in Otago.

The multifactorial nature of falls and the heterogeneity of fall prevention programmes (e.g. delivery, inclusion/exclusion criteria of participants) makes comparisons between studies difficult; however, interventions should be feasible, sustainable, and cost effective to be practical for widespread use (Rubenstein and Josephson, 2006). The peer-led SAYGO groups may be the future way of providing an effective, low cost fall prevention programme in community-dwelling older adults, with a decrease in fall incidence with long-term participation, less severe injuries following falls, and a good attendance rate with a long-term dedication to participate. Prospective, controlled studies on community translation of fall prevention exercise programmes into peer-led models are needed to confirm and extend the findings of the current study.

# REFERENCES

- ACCIDENT COMPENSATION CORPORATION. 2011. *Falls in the home cost New Zealand \$272 million* [Online]. Available: <http://www.acc.co.nz/news/WPC095508> [Accessed 2 May 2013].
- AGE CONCERN 1997. Looking for a fall. A report on falls incidence in the UK. *London*.
- AGE CONCERN. 2012. *Vision Mission Values* [Online]. Available: <http://www.ageconcern.org.nz/acnz/vision> [Accessed 16 April 2013].
- ALEXANDER, B., RIVARA, F. & WOLF, M. 1992. Hospitalization for fall-related injuries in older adults. *Am J Public Health*, 82, 1020-1023.
- ALEXANDER, N. B., ULBRICH, J., RAHEJA, A. & CHANNER, D. 1997. Rising from the floor in older adults. *Journal of the American Geriatrics Society*, 45c, 564-569.
- ALLEN, T. 2004. Preventing falls in older people: evaluating a peer education approach. *British Journal of Community Nursing*, 9, 195-200.
- AMERICAN GERIATRICS SOCIETY 2011. Summary of the Updated American Geriatrics Society/British Geriatrics Society Clinical Practice Guideline for Prevention of Falls in Older Persons. *Journal of the American Geriatrics Society*, 59, 148-157.
- AMERICAN GERIATRICS SOCIETY, BRITISH GERIATRICS SOCIETY & AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS PANEL ON FALLS PREVENTION 2001. Guidelines for the prevention of falls in older persons. *Journal of the American Geriatrics Society*, 49, 664-672.
- ARMITAGE, P., BERRY, G. & MATTHEWS, J. 2002. *Statistical methods in medical research*, Cornwell.
- BERGLAND, A. & WYLLER, T. B. 2004. Risk factors for serious fall related injury in elderly women living at home. *Injury Prevention*, c, 308-13.

- BORGSTROM, F. & KANIS, J. A. 2008. Health economics of osteoporosis. *Best Pract Res Clin Endocrinol Metab*, 22, 885-900.
- BULAJIC-KOPJAR, M. 2000. Seasonal variations in incidence of fractures among elderly people. *Injury Prevention*, 6, 16-9.
- CAMERON, M. H., POEL, A. J., HASELKORN, J. K., LINKE, A. & BOURDETTE, D. 2011. Falls requiring medical attention among veterans with multiple sclerosis: A cohort study. *Journal of Rehabilitation Research and Development*, 48, 13-20.
- CAMPBELL, A. J., BORRIE, M., SPEARS, G., JACKSON, S., BROWN, J. & FITZGERALD, J. 1990. Circumstances and consequences of falls experienced by a community population 70 years and over during a prospective study. *Age and Ageing*, 19, 136-141.
- CAMPBELL, A. J., BORRIE, M. J. & SPEARS, G. F. 1989. Risk factors for falls in a community-based prospective study of people 70 years and older. *The Journals of Gerontology*, 44, M112-M117.
- CAMPBELL, A. J. & ROBERTSON, M. C. 2010. Comprehensive approach to fall prevention on a national level: New Zealand. *Clinics in Geriatric Medicine*, 26, 719-731.
- CAMPBELL, A. J., ROBERTSON, M. C. & GARDNER, M. 1997. Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. *BMJ*, 315, 1065-9.
- CAMPBELL, A. J., ROBERTSON, M. C. & GARDNER, M. 1999. Psychotropic medication withdrawal and a home-based exercise program to prevent falls: a randomized, controlled trial. *Journal of the American Geriatrics Society*, 47, 850-853.
- CAMPBELL, A. J., ROBERTSON, M. C., LA GROW, S. J., KERSE, N. M., SANDERSON, G. F., JACOBS, R. J., SHARP, D. M. & HALE, L. A. 2005. Randomised controlled trial of prevention of falls in people aged > or =75 with severe visual impairment: the VIP trial. *British Medical Journal*, 331, 817.
- CAMPBELL, A. J., SPEARS, G. F. & BORRIE, M. J. 1990a. Examination by logistic regression modelling of the variables which increase the relative risk of elderly women falling compared to elderly men. *Journal of clinical epidemiology*, 43, 1415-1420.
- CAMPBELL, A. J., SPEARS, G. F., BORRIE, M. J. & FITZGERALD, J. 1988. Falls, elderly women and the cold. *Gerontology*, 34, 205-8.
- CENTRES FOR DISEASE CONTROL AND PREVENTION. 2012. *Falls - Older Adults* [Online]. Available: <http://www.cdc.gov/HomeandRecreationalSafety/Falls/index.html> [Accessed 1 May 2013].

- CLEMONSON, L., CUMMING, R. G., KENDIG, H., SWANN, M., HEARD, R. & TAYLOR, K. 2004. The effectiveness of a community-based program for reducing the incidence of falls in the elderly: A randomized trial. *Journal of the American Geriatrics Society*, 52, 1487-1494.
- CLOSE, J. 1999. Prevention of falls in the elderly trial (PROFET): a randomized controlled trial. *Lancet*, 353, 93-97.
- CUMMING, R. G., THOMAS, M., SZONYI, G., SALKELD, G., O'NEILL, E. & WESTBURY, C. 1999. Home visits by an occupational therapist for assessment and modification of environmental hazards: a randomized trial of falls prevention. *Journal of the American Geriatrics Society*, 47, 1397-1402.
- CUMMINGS, R., SALKELD, G., THOMAS, M. & SZONYI, G. 2000. Prospective study of the impact of fear of falling on activities of daily living, SF-36 scores, and nursing home admission. *J Gerontol A Biol Sci Med Sci*, 55, M299-M305.
- DAVIS, J. C., ROBERTSON, M. C., ASHE, M. C., LIU-AMBROSE, T., KHAN, K. M. & MARRA, C. A. 2010. International comparison of cost of falls in older adults living in the community: a systematic review. *Osteoporosis International*, 21, 1295-1306.
- DAVIS, J. C., ROBERTSON, M. C., ASHE, M. C., LIU-AMBROSE, T., KHAN, K. M. & MARRA, C. A. 2010a. Does a home-based strength and balance programme in people aged > or =80 years provide the best value for money to prevent falls? A systematic review of economic evaluations of falls prevention interventions. *British Journal Sports Med*, 44, 80-9.
- DAVIS, J. C., ROBERTSON, M. C., COMANS, T. & SCUFFHAM, P. A. 2011. Guidelines for conducting and reporting economic evaluation of fall prevention strategies. *Osteoporosis International*, 22, 2449-59.
- DEANDREA, S., LUCENTEFORTE, E., BRAVI, F., FOSCHI, R., LA VECCHIA, C. & NEGRI, E. 2010. Risk factors for falls in community-dwelling older people: A systematic review and meta-analysis. *Epidemiology*, 21, 658-68.
- DOUGLAS, S., BUNYAN, A., CHIU, K. H., TWADDLE, B. & MAFFULLI, N. 2000. Seasonal variation of hip fracture at three latitudes. *Injury-International Journal of the Care of the Injured*, 31, 11-19.
- EMAUS, N., OLSEN, L. R., AHMED, L. A., BALTESKARD, L., JACOBSEN, B. K., MAGNUS, T. & YTTERSTAD, B. 2011. Hip fractures in a city in Northern Norway over 15 years: time trends, seasonal variation and mortality The Harstad Injury Prevention Study. *Osteoporosis International*, 22, 2603-2610.
- EVERYBODY. 2013. *New Zealand Health System - what you might pay for healthcare* [Online]. Available: <http://www.everybody.co.nz/page-0a4164ca-3942-4d25-a6af-fa77aac8de68.aspx> [Accessed 6 May 2013].
- FEDER, G. 2000. Guidelines for the prevention of falls in older people. *British Medical Journal*, 321, 1007-1011.



- FLEMING, J. & BRAYNE, C. 2008. Inability to get up after falling, subsequent time on floor, and summoning help: prospective cohort study in people over 90. *British Medical Journal*, 337, 2227.
- FREEMAN, C., TODD, C., CAMILLERI-FERRANTE, C., LAXTON, C., MURRELL, P., PALMER, C. R., PARKER, M., PAYNE, B. & RUSHTON, N. 2002. Quality improvement for people with hip fracture: experience from a multi-site audit. *Quality and safety in health care*, 11, 239-245.
- FRICK, K. D., KUNG, J. Y., PARRISH, J. M. & NARRETT, M. J. 2010. Evaluating the cost-effectiveness of fall prevention programs that reduce fall-related hip fractures in older adults. *Journal American Geriatrics Society*, 58, 136-141.
- FRIEDMAN, S. M., MUNOZ, B., WEST, S. K., RUBIN, G. S. & FRIED, L. P. 2002. Falls and fear of falling: which comes first? A longitudinal prediction model suggests strategies for primary and secondary prevention. *Journal of the American Geriatrics Society*, 50, 1329-35.
- FUJISAWA, M., ISHINE, M., OKUMIYA, X., NISHINAGA, M., DOI, Y., OZAWA, T. & MATSUBAYASHI, K. 2007. Effects of long-term exercise class on prevention of falls in community-dwelling elderly: Kahoku longitudinal aging study. *Geriatrics & Gerontology International*, 7, 357-362.
- GALBRAITH, J. G., BUTLER, J. S., MEMON, A. R., DOLAN, M. A. & HARTY, J. A. 2011. Cost analysis of a falls-prevention program in an orthopaedic setting. *Clinical Orthopaedics & Related Research*, 469, 3462-8.
- GANZ, D. A., BAO, Y., SHEKELLE, P. G. & RUBENSTEIN, L. Z. 2007. Will my patient fall? *JAMA*, 297, 77-86.
- GARRETT, S., ELLEY, C. R. & O'DEA, D. 2008. The cost of falls in older adults in the community. *NZFP*, 35, 22-27.
- GIBSON, M. J., ANDRES, R. O., ISAACS, B., RAEBAUGH, T. & WORM-PETERSEN, J. 1987. The prevention of falls in later life - a report of the Kellogg International Work Group on the prevention of falls by the elderly *Danish medical bulletin*, 34, 1-24.
- GILLESPIE, L. D., ROBERTSON, M. C., GILLESPIE, W. J., LAMB, S. E., GATES, S., CUMMING, R. G. & ROWE, B. H. 2009. Interventions for preventing falls in older people living in the community. *Cochrane Database of Systematic Reviews*.
- GILLESPIE, L. D., ROBERTSON, M. C., GILLESPIE, W. J., SHERRINGTON, C., GATES, S., CLEMONSON, L. M. & LAMB, S. E. 2012. Interventions for preventing falls in older people living in the community. *Cochrane Database of Systematic Reviews*.
- GLYNN, R. J. & BURING, J. E. 1996. Ways of measuring rates of recurrent events. *British Medical Journal*, 312, 364-367.

- GRAHAM, H. J. & FIRTH, J. 1992. Home accidents in older people: role of primary health care team. *British Medical Journal*, 305, 30-32.
- GRONSKAG, A. B., FORSMO, S., ROMUNDSTAD, P., LANGHAMMER, A. & SCHEI, B. 2010. Incidence and seasonal variation in hip fracture incidence among elderly women in Norway. The HUNT Study. *Bone*, 46, 1294-1298.
- HALE, L. A., WATERS, D. & HERBISON, P. 2012. A randomized controlled trial to investigate the effects of water-based exercise to improve falls risk and physical function in older adults with lower-extremity osteoarthritis. *Archives of Physical Medicine and Rehabilitation*, 93, 27-34.
- HALL, S. E. & HENDRIE, D. V. 2003. A prospective study of the costs of falls in older adults living in the community. *Australian and New Zealand Journal of Public Health*, 27, 343-351.
- HALTER, M. 2000. Falls in the older population: a pilot study to assess those individuals who are attended to by the London Ambulance Service as a result of a fall but are not conveyed to an accident and emergency department.
- HARTHOLT, K., VAN BEECK, E., POLINDER, S., VAN DER VELDE, N., VAN LIESHOUT, E., PANNEMAN, M., VAN DER CAMMEN, T. & PATKA, P. 2011. Societal consequences of falls in the older population: injuries, healthcare costs, and long-term reduced quality of life. *Journal of Trauma-Injury Infection & Critical Care*, 71, 748-53.
- HARTHOLT, K., VAN DER VELDE, N., LOOMAN, C., VAN LIESHOUT, E., PANNEMAN, M., VAN BEECK, E., PATKA, P. & VAN DER CAMMEN, T. 2010. Trends in fall-related hospital admissions in older persons in the Netherlands. *Arch Intern Med*, 170, 905-911.
- HEALY, T. C., PENG, C., HAYNES, M. S., MCMAHON, E. M., BOTLER, J. L. & GROSS, L. 2008. The feasibility and effectiveness of translating a matter of balance into a volunteer lay leader model. *Journal of Applied Gerontology*, 27, 34-51.
- HEINRICH, S., RAPP, K., RISSMANN, U., BECKER, C. & KOENIG, H. H. 2010. Cost of falls in old age: a systematic review. *Osteoporosis International*, 21, 891-902.
- HEINRICH, S., RAPP, K., STUHLREHER, N., RISSMANN, U., BECKER, C. & KOENIG, H. H. 2013. Cost-effectiveness of a multifactorial fall prevention program in nursing homes. *Osteoporosis International*, 24, 1215-1223.
- HILL, K., SCHWARZ, J., FLICKER, L. & CARROLL, S. 1999. Falls among healthy community-dwelling, older women: a prospective study of frequency, circumstances, consequences and prediction accuracy. *Australian and New Zealand Journal of Public Health*, 23, 41-48.
- JOHNS, J. 2007. *Peer Education: Current Literature, Practice and Emerging Trends*, Adelaide, South Australian Community Health Research Unit, Flinders University 2007.

- KOSKI, K., LUUKINEN, H., LAIPPALA, P. & KIVELA, S. L. 1998. Risk factors for major injurious falls among the home dwelling elderly by functional abilities. *Gerontology*, 44, 232-238.
- LAMB, S. E., JORSTAD-STEIN, E. C., HAUER, K. & BECKER, C. 2005. Development of a common outcome data set for fall injury prevention trials: the prevention of falls network europe consensus. *Journal of the American Geriatrics Society*, 53, 1618-1622.
- LANGLEY, J., SAMARANAYAKA, A., DAVIE, G. & CAMPBELL, A. J. 2011. Age, cohort and period effects on hip fracture incidence: analysis and predictions from New Zealand data 1974-2007. *Osteoporosis International*, 22, 105-111.
- LAWLOR, D. A., PATEL, R. & EBRAHIM, S. 2003. Association between falls in elderly women and chronic diseases and drug use: cross-sectional study. *British Medical Journal*, 327, 712-717.
- LEECH, N. L., BARRETT, K. C. & MORGAN, G. A. 2012. IBM SPSS for Intermediate Statistics : Use and Interpretation, Fourth Edition. 4 ed. Hoboken: Taylor and Francis.
- LEIPZIG, R. M., CUMMING, R. G. & TINETTI, M. E. 1999. Drugs and falls in older people: a systematic review and meta-analysis: II. Cardiac and analgesic drugs. *Journal of the American Geriatrics Society*, 47, 40-50.
- LESLIE, W. D., O'DONNELL, S., JEAN, S., LAGACE, C., WALSH, P., BANCEJ, C., MORIN, S., HANLEY, D. A. & PAPAIOANNOU, A. 2009. Trends in hip fracture rates in Canada. *JAMA* 302, 883-889.
- LETTS, L., MORELAND, J., RICHARDSON, J., COMAN, L., EDWARDS, M., GINIS, K. M., WILKINS, S. & WISHART, L. 2010. The physical environment as a fall risk factor in older adults: systematic review and meta-analysis of cross-sectional and cohort studies. *Aust Occup Ther J*, 57, 51-64.
- LIN, H. C. & XIRAXAGAR, S. 2006. Seasonality of hip fractures and estimates of season-attributable effects: a multivariate ARIMA analysis of population-based data. *Osteoporosis International*, 17, 795-806.
- LIN, M., HWANG, H., WANG, Y., CHANG, S. & WOLF, S. 2006. Community-based tai chi and its effect on injurious falls, balance, gait, and fear of falling in older people. *Physical Therapy*, 86, 1189-201.
- LORD, S. R. 2006. *Falls in older people: risk factors and strategies for prevention*, Cambridge, Cambridge University Press.
- LORD, S. R. & BASHFORD, G. M. 1996. Shoe characteristics and balance in older women. *Journal of the American Geriatrics Society*, 44, 429-433.
- LORD, S. R., DAYHEW, J. & HOWLAND, J. 2002. Multifocal glasses impair edge-contrast sensitivity and depth perception and increase the risk of falls in older people. *Journal of the American Geriatrics Society*, 50, 1760-1766.

- LORD, S. R., MCLEAN, D. & STRATHERS, G. 1992. Physiological factors associated with injurious falls in older people living in the community. *Gerontology*, 38, 338-346.
- LORD, S. R., SHERRINGTON, C. & MENZ, H. 2007. *Falls in older people: risk factors and strategies for prevention*, Cambridge, Cambridge University Press.
- LORD, S. R., SHERRINGTON, C. & MENZ, H. B. 2000. *Falls in older people: risk factors and strategies for prevention*, Cambridge, Cambridge University Press.
- LUUKINEN, H., KOSKI, K., HILTUNEN, L. & KIVELA, S. L. 1994. Incidence rate of falls in an aged population in northern Finland. *J Clin Epidemiol*, 47, 843-50.
- LUUKINEN, H., KOSKI, K., HONKANEN, R. & KIVELA, S. L. 1995. Incidence of injury causing falls among older adults by place of residence - a population-based study. *Journal of the American Geriatrics Society*, 43, 871-6.
- LUUKINEN, H., KOSKI, K. & KIVELA, S. L. 1996. The relationship between outdoor temperature and the frequency of falls among the elderly in Finland. *J Epidemiol Community Health & Social Care in the Community*, 50, 107-111.
- MCCLURE, R. J., TURNER, C., PEEL, N., SPINKS, A., EAKIN, E. & HUGHES, K. 2008. Population-based interventions for the prevention of fall-related injuries in older people. *Cochrane Database of Systematic Reviews*.
- MCMAHON, S. & FLEURY, J. 2012. External validity of physical activity interventions for community-dwelling older adults with fall risk: a quantitative systematic literature review. *Journal of advanced nursing*, 68, 2140-2154.
- MODARRES, R., OUARDA, T. B. M. J., VANASSE, A., ORZANCO, M. G. & GOSSELIN, P. 2012. Modeling seasonal variation of hip fracture in Montreal, Canada. *Bone*, 50, 909-916.
- MOLLER, J. 2005. Current costing models: are they suitable for allocating health resources? The example of fall injury prevention in Australia. *Accident Analysis & Prevention*, 37, 25-33.
- MORENCY, P., VOYER, C., BURROWS, S. & GOUDREAU, S. 2012. Outdoor falls in an urban context: winter weather impacts and geographical variations. *Canadian Journal of Public Health, Revue Canadienne de Sante Publique*. 103, 218-22.
- MORIE, M., REID, K. F. & MICIEK, R. 2010. Habitual physical activity levels are associated with performance in measures of physical function and mobility in older men. *Journal of the American Geriatrics Society*, 58, 1727-33.
- MURRAY, I. R., HOWIE, C. R. & BIAANT, L. C. 2011. Severe weather warnings predict fracture epidemics. *Injury-International Journal of the Care of the Injured*, 42, 687-690.
- NEVITT, M. C., CUMMINGS, S. R., KIDD, S. & BLACK, D. 1989. Risk factors for recurrent nonsyncopal falls: a prospective study. *JAMA*, 261, 2663-8.

- NEW SOUTH WALES DEPARTMENT OF HEALTH. 2011. *Falls - prevention of falls and harm from falls among older people: 2011-2015* [Online]. Available: <http://www.health.nsw.gov.au/policies/pages/default.aspx> [Accessed 16 April 2013].
- NEW ZEALAND GOVERNMENT. 2012. *RE: Injury Prevention, Rehabilitation, and Compensation (Liability to Pay or Contribute to Cost of Treatment) Regulations 2003*.
- NILSAGÅRD, Y., LUNDHOLM, C., DENISON, E. & GUNNARSSON, L. 2009. Predicting accidental falls in people with multiple sclerosis—A longitudinal study. *Clinic Rehabil*, 23, 259-269.
- NYMAN, S. R. & VICTOR, C. R. 2012. Older people's participation in and engagement with falls prevention interventions in community settings: an augment to the cochrane systematic review. *Age and Ageing*, 41, 16-23.
- NYMARK, T., LAURITSEN, J. M., OVESEN, O., ROCK, N. D. & JEUNE, B. 2006. Decreasing incidence of hip fracture in the Funen County, Denmark. *Acta Orthopaedica*, 77, 109-113.
- O'DEA, D. 2005. The cost of suicide to society. Wellington: Ministry of Health of New Zealand.
- O'LOUGHLIN, J. L., ROBITAILLE, Y., BOIVIN, J. F. & SUISSA, S. 1993. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. *Am J Epidemiol*, 137, 342-54.
- PEEL, N. M. & WARBURTON, J. 2009. Using senior volunteers as peer educators: What is the evidence of effectiveness in falls prevention? *Australasian Journal on Ageing*, 28, 7-11.
- POLIT, D. F. & BECK, C. T. 2006. *Essentials of nursing research: methods, appraisal, and utilization*, Philadelphia, Lippincott Williams & Wilkins.
- PUBLIC HEALTH AGENCY OF CANADA. 2006. *Frequently used terms in HIV/AIDS monitoring and epidemiological research in Canada* [Online]. Available: [http://www.phac-aspc.gc.ca/publicat/haest-tesvs/i-eng.php#INCIDENCE\\_DENSITY](http://www.phac-aspc.gc.ca/publicat/haest-tesvs/i-eng.php#INCIDENCE_DENSITY) [Accessed 18 May 2013].
- ROBBINS, A. S., RUBENSTEIN, L. Z., JOSEPHSON, K. R., SCHULMAN, B. L., OSTERWEIL, D. & FINE, G. 1989. Predictors of falls among elderly people. Results of two population-based studies. *Archives of internal medicine*, 149, 1628-1633.
- ROBERTSON, M. C., CAMPBELL, A. J., GARDNER, M. M. & DEVLIN, N. 2002. Preventing injuries in older people by preventing falls: A meta-analysis of individual-level data. *Journal of the American Geriatrics Society*, 50, 905-911.
- ROBERTSON, M. C., CAMPBELL, A. J. & HERBISON, P. 2005. Statistical analysis of efficacy in falls prevention trials. *Journals of Gerontology Series A-Biological Sciences & Medical Sciences*, 60, 530-534.

- ROBERTSON, M. C., DEVLIN, N., GARDNER, M. M. & CAMPBELL, A. J. 2001a. Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. 1: Randomized controlled trial. *British Medical Journal*, 322, 697-701.
- ROBERTSON, M. C., DEVLIN, N., SCUFFHAM, P., GARDNER, M. M., BUCHNER, D. M. & CAMPBELL, A. J. 2001c. Economic evaluation of a community based exercise programme to prevent falls. *J Epidemiol Community Health*, 55, 600-606.
- ROBERTSON, M. C. & ET AL 2001b. Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. 2: Controlled trial in multiple centres. *British Medical Journal*, 322, 701-704.
- ROBITAILLE, Y., FOURNIER, M., LAFOREST, S., GAUVIN, L., FILIATRAULT, J. & CORRIVEAU, H. 2012. Effect of a Fall Prevention Program on Balance Maintenance Using a Quasi-experimental Design in Real-World Settings. *Journal of Aging and Health*, 24, 827-845.
- ROBSON, E., EDWARDS, J., GALLAGHER, E. & BAKER, D. 2003. Steady as you go (saygo): A falls-prevention program for seniors living in the community. *Canadian Journal on Aging / La Revue canadienne du vieillissement*, 22, 207-216.
- RUBENSTEIN, L. Z. & JOSEPHSON, K. R. 2002. The epidemiology of falls and syncope. *Clin Geriatr Med*, 18, 141-185.
- RUBENSTEIN, L. Z. & JOSEPHSON, K. R. 2006. Falls and their prevention in elderly people: what does the evidence show? *Med Clin N Am*, 90, 807-824.
- SALKELD, G., CAMERON, I. D., CUMMING, R. G., EASTER, S., SEYMOUR, J., KURRIE, S. E. & QUINE, S. 2000. Quality of life related to fear of falling and hip fracture in older women: A time trade off study. *British Medical Journal*, 320, 341-5.
- SARTINI, M., CRISTINA, M. L., SPAGNOLO, A. M., CREMONESI, P., COSTAGUTA, C., MONACELLI, F., GARAU, J. & ODETTI, P. 2009. The epidemiology of domestic injurious falls in a community dwelling elderly population: an outgrowing economic burden. *European Journal of Public Health*, 20, 604-6.
- SCHWENK, M., LAUENROTH, A., STOCK, C., MORENO, R. R., OSTER, P., MCHUGH, G., TODD, C. & HAUER, K. 2012. Definitions and methods of measuring and reporting on injurious falls in randomised controlled fall prevention trials: a systematic review. *BMC Med Res Methodol*, 12, 50-64.
- SCUFFHAM, P., CHAPLIN, S. & LEGOOD, R. 2003. Incidence and costs of unintentional falls in older people in the United Kingdom. *Journal of epidemiology and community health*, 57, 740-744.
- SHERRINGTON, C., TIEDEMANN, A., FAIRHALL, N., CLOSE, J. & LORD, S. 2011. Exercise to prevent falls in older adults: an updated meta-analysis and

- best practice recommendations. *New South Wales public health bulletin*, 22, 78-83.
- SKELTON, D. A. 2001a. Effects of physical activity on postural stability. *Age and Ageing*, 30, 33-39.
- SKELTON, D. A., BECKER, C., LAMB, S. E., CLOSE, J. C. T., ZIJLSTRA, W., YARDLEY, L. & TODD, C. J. 2004. Prevention of falls network europe: a thematic network aimed at introducing good practise in effective falls prevention across Europe. *European Journal of Ageing*, 1, 89-94.
- SOSNOFF, J. J., SOCIE, M. J., BOES, M. K., SANDROFF, B. M., PULA, J. H., SUH, Y., WEIKERT, M., BALANTRAPU, S., MORRISON, S. & MOTL, R. W. 2011. Mobility, Balance and Falls in Persons with Multiple Sclerosis. *PLoS One*, 6, e28021.
- SPEECHLEY, M. & TINETTI, M. 1991. Falls and injuries in frail and vigorous community elderly persons. *Journal of the American Geriatrics Society*, 39, 46-52.
- SPINKS, A. & WASIAK, J. 2009. Maintaining independence after a fall. *Reviews in Clinical Gerontology*, 19, 61-69.
- STATISTICS NEW ZEALAND. 2007. *New Zealand's 65+ Population, A statistical volume: 2007* [Online]. Available: [http://www.stats.govt.nz/browse\\_for\\_stats/people\\_and\\_communities/older\\_people/new-zealands-65-plus-population.aspx](http://www.stats.govt.nz/browse_for_stats/people_and_communities/older_people/new-zealands-65-plus-population.aspx) [Accessed 6 May 2013].
- STATISTICS NEW ZEALAND. 2013. *People and communities* [Online]. Available: [http://www.stats.govt.nz/browse\\_for\\_stats/people\\_and\\_communities.aspx](http://www.stats.govt.nz/browse_for_stats/people_and_communities.aspx) [Accessed 29 May 2013].
- STEVENS, J. 2005a. Falls among older adults--risk factors and prevention strategies. *Journal of Safety Research*, 36, 409-11.
- STEVENS, J., BALDWIN, G., BALLESTEROS, M., NOONAN, R. & SLEET, D. 2010. An older adult falls research agenda from a Public Health perspective. *Clin Geriatr Med*, 26, 767-779.
- STEVENS, J., CORSO, P., FINKELSTEIN, E. & MILLER, T. 2006. The cost of fatal and non-fatal falls among older adults. *Injury Prevention*, 12, 290-295.
- STEVENS, J. & RUDD, R. 2010a. Declining hip fracture rates in the United States. *Age and Ageing*, 39, 500-503.
- STEVENS, J. & SOGOLOW, E. 2005. Gender differences for non-fatal unintentional fall related injuries among older adults. *Injury Prevention*, 11, 115-119.
- TAAFFE, D. R., DURET, C., WHEELER, S. & MARCUS, R. 1999. Once-weekly resistance exercise improves muscle strength and neuromuscular performance in older adults. *Journal of the American Geriatrics Society*, 47, 1208-14.

- TINETTI, M. E. 1987. Factors associated with serious injury during falls by ambulatory nursing home residents. *Journal of the American Geriatrics Society*, 35, 644-648.
- TINETTI, M. E. 2003. Clinical practice. Preventing falls in elderly persons. *New England journal of medicine*, 348, 42-49.
- TINETTI, M. E., DE LEON, C., DOUCETTE, J. & BAKER, D. I. 1994. Fear of falling and fall-related efficacy in relationship to functioning among community-living elders. *Journal of Gerontology*, 49, M140-M147.
- TINETTI, M. E. & POWELL, L. 1993a. Fear of falling and low self-efficacy: a cause of dependence in elderly persons. *Journal of Gerontology*, 48, 35-38.
- TINETTI, M. E. & SPEECHLEY, M. 1989. Prevention of falls among the elderly. *New England journal of medicine*, 320, 1055-1059.
- TINETTI, M. E., SPEECHLEY, M. & GINTER, S. 1988. Risk factors for falls among elderly persons living in the community. *New England journal of Medicine*, 319, 1701-1707.
- TINETTI, M. E. & WILLIAMS, C. S. 1997. Falls, injuries due to falls, and the risk of admission to a nursing home. *New England journal of Medicine*, 337, 1279-1284.
- TINETTI, M. E. & WILLIAMS, C. S. 1998. The effect of falls and fall injuries on functioning in community-dwelling older persons. *The journals of gerontology. Series A, Biological sciences and medical sciences*, 53, M112-M119.
- TODD, C. & SKELTON, D. 2004. What are the main risk factors for falls among older people and what are the most effective interventions to prevent these falls? *Copenhagen, WHO Regional Office for Europe (Health Evidence Network report; <http://www.euro.who.int/document/E82552.pdf>, accessed 5 April 2004).*
- VANWEEL, C., VERMEULEN, H. & VANDENBOSCH, W. 1995. Falls, a community care perspective. *Lancet*, 345, 1549-51.
- VELLAS, B. J., WAYNE, S. J., ROMERO, L. J., BAUMGARTNER, R. N. & GARRY, P. J. 1997. Fear of falling and restriction of mobility in elderly fallers. *Age and Ageing*, 26, 189-93.
- VIKMAN, I., NORDLUND, A., NASLUND, A. & NYBERG, L. 2011. Incidence and seasonality of falls amongst old people receiving home help services in a municipality in northern Sweden. *International Journal of Circumpolar Health*, 70, 195-204.
- WATERS, D. L., HALE, L. A., ROBERTSON, L., HALE, B. A. & HERBISON, P. 2011. Evaluation of a peer-led falls prevention program for older adults. *Arch Phys Med Rehabil*, 92, 1581-1586.



- WATSON, W. L., CLAPPERTON, A. & MITCHELL, R. J. 2011a. The burden of fall-related injury among older persons in New South Wales. *Australian and New Zealand Journal of Public Health*, 35, 170-175.
- WATSON, W. L., LI, Y. & MITCHELL, R. J. 2011b. Projections of hospitalised fall-related injury in NSW, Australia: impacts on the hospital and aged care sectors. *Journal of Safety Research*, 42, 487-92.
- WEBB, P. & BAIN, C. 2011. Essential epidemiology an introduction for students and health professionals. 2nd ed. ed. Cambridge, UK: Cambridge University Press.
- WEERDESTeyN, V., RIJKEH, H., GEURTS, A. C. H., SMITS-ENGELSMAN, B. C. M. & MULDER, T. 2006. A five-week exercise program can reduce falls and improve obstacle avoidance in the elderly. *Gerontology (Basel)*, 52, 131-141.
- WICKHAM, C., COOPER, C., MARGETTS, B. M. & BARKER, D. J. P. 1989. Muscle strength, activity, housing and the risk of falls in elderly people. *Age and Ageing*, 18, 47-51.
- WORK AND INCOME. 2013. *65 years or older* [Online]. Available: <http://www.workandincome.govt.nz/individuals/65-years-or-older/> [Accessed 24 May 2013].
- YAMASHITA, T., NOE, D. A. & BAILER, A. J. 2012. Risk factors of falls in community-dwelling older adults: logistic regression tree analysis. *The Gerontologist*, 0, 1-11.
- YARDLEY, L., BEYER, N., HAUER, K., MCKEE, K., BALLINGER, C. & TODD, C. 2007. Recommendations for promoting the engagement of older people in activities to prevent falls. *Quality and Safety in Health Care*, 16, 230-234.

# APPENDICES

## APPENDIX A

---

**Ethics application (p. 98-99), and**

**Ethics approval (p. 100)**

Gary Witte  
Manager  
Academic Committees  
University of Otago

30 January 2011

Re: Extension/Amendment to existing ethics application (8/007)

Dear Gary,

Leigh Hale and I are co-supervising a Masters student (Birgit Wurzer) at the School of Physiotherapy. The proposed project will be an extension of 8007 "An Evaluation of the Steady as You Go Fall Prevention Programme".

This proposed extension will be conducted similarly to the original investigation; however, the functional outcome measurements will not be included in the study. New data to be collected include more detail on any injuries sustained with a fall and an estimation of costs related to the fall (e.g. hospitalization, GP/specialist consults, physiotherapy visits), gathered via a telephone interview.

Age Concern Otago supports this extension evaluation and they have already provided a list of SAYGO strength and balance classes currently held in Dunedin. Age Concern has also offered to make the first point of contact with the groups via their newsletter. Please find the invitation letter attached.

Recruitment: Participants that are currently enrolled in a peer-led SAYGO programme in Dunedin will be invited to participate in the extension project. Initial contact will be made with the peer-leaders to explain the purpose of the study who then will discuss the project with the members of their individual classes. Participants who show interest will be provided with information sheets about the study.

After obtaining signed informed consent, demographic information (e.g. age, gender, length of participation in the SAYGO programme) will be collected via a questionnaire and participants will be asked to complete the Rapid Assessment of Physical Activity (RAPA) questionnaire to assess their level of physical activity. Those who report a fall will complete a further RAPA questionnaire following the fall event. Participants will also be asked to complete the RAPA questionnaire at the end of the study (12 months after baseline testing). Please find the questionnaires outlined above attached to this letter.

Falls will be monitored by monthly fall calendars on which participants record any fall. If a fall occurs in the previous month, further details pertaining to the event will be collected via a fall event questionnaire (definition of 'fall' will be outlined in that questionnaire). Both the fall calendars and questionnaires (if applicable) will be returned on a monthly basis to the peer-group leader who will forward the collected documents to the researchers.

Should a participant have had an injurious fall requiring attention from a health professional, as identified via the fall event questionnaire, the researcher will phone this participant to collect further information about the treatment received, in order to estimate the costs related to the fall. Please find both fall event questionnaire and treatment questionnaire also attached.

If participants have any questions or require further clarification they can telephone Leigh Hale or myself.

Summary of relevant changes to the previous application:

- Recruitment of participants from all peer-led groups held in Dunedin (approx 10 participants per class, a total of approx 35 classes)
- Data collection at baseline (demographic data, RAPA questionnaire for physical activity) and monitoring of falls via monthly fall calendar over a 12 month period, commencing in March 2011
- Functional outcome measures which have previously been included will not be measured in the proposed study (Chair Stand Test, Step Touch Test, Timed Up and Go Test, Single Leg Stand Test and Functional Reach Test)
- The Activity-specific Balance Confidence (ABC) Scale and SF-36v2 will not be included in the proposed study
- If a fall occurs, further details pertaining to the event will be collected via a fall event questionnaire rather than by telephone
- Additionally, following each fall, a further RAPA questionnaire will be completed
- If participants seek medical input due to a fall (e.g. visit to GP, hospital, other treatment providers, or radiology investigation), additional information relating to the amount of medical visits will be gained via a follow up phone call (treatment questionnaire). This will enable us to gather information regarding costs of falls.

Thank you for considering this extension of our study for further ethical approval and if you need further clarification, please do not hesitate to contact me.

Kind Regards

Debra Waters, PhD  
Dunedin School of Medicine  
Department of Preventive and Social Medicine  
479 7222

*Enclosed:*

*Letter for Age Concern newsletter*

*Information Sheet*

*Consent Form*

*Questionnaires: demographic questionnaire, RAPA questionnaire, fall event questionnaire, and treatment questionnaire*



Dr Debra Waters  
Department of Preventive and Social Medicine  
Dunedin School of Medicine  
University of Otago

10 February 2011

08/007

Dear Dr Waters

Re: An Evaluation of the 'Steady as You Go' Fall Prevention Programme

Thank you for your email requesting an extension to the original application. We are grateful for the thorough detail you have provided regarding the relevant changes.

Your proposal has been extended for a further three years, and continues to be fully approved by the Human Ethics Committee. If the nature, consent, location, procedures or personnel of your approved application change, please advise me in writing. I hope all goes well for you with your upcoming research.

Yours sincerely

Gary Witte  
Manager, Academic Committees  
University of Otago

Cc Professor J Connor, Head, Department of Preventive and Social Medicine

Academic Committees  
PO Box 56, Dunedin 9054, New Zealand  
Tel +64 3 479 8256 • Fax +64 3 479 8221 • Email [gary.witte@otago.ac.nz](mailto:gary.witte@otago.ac.nz)  
[www.otago.ac.nz](http://www.otago.ac.nz)

## **APPENDIX B**

---

**Letter for Age Concern Otago (p. 102-103), and**

**Letter for Age Concern Otago's newsletter (p. 104)**

The University of Otago is extending their evaluation of the Steady as You Go Falls Prevention Programme starting in March 2011. As a participant of the Steady as You Go Fall Prevention Programme this year, you will be invited take part in this project. The duration of the study is 12 months and the study is organised by Dr. Debra Waters (Department of Preventive and Social Medicine) and Associate Professor Leigh Hale (School of Physiotherapy).

### **Aim of the Project**

To determine if participation in a peer-led community-based exercise programme reduces falls and to estimate the costs associated with any injuries sustained in a fall.

### **Type of Participants that are being sought**

People who live in the community and who:

- Are aged 65 years or older (or over 55 years for Māori and Pacific)
- Are participating in a SAYGO community exercise programme starting in February 2011
- Have medical clearance to participate in an exercise class

### **What the project will involve**

You will continue with your exercise classes once weekly in the usual environment.

If you agree to participate, you will be asked to complete a couple of questionnaires relating to your current health and how active you are. Additionally, you will be asked to keep a monthly diary to document any falls you may have had. You will be provided with a monthly fall calendar that you will need to return to your peer-leader on a monthly basis. Your peer-leader will post the envelope back to the researchers in a pre-paid envelope.

In the event of a fall, you will also be asked to complete two further additional short questionnaires within 4 weeks relating to your fall and how active you are following your fall. If your fall leads you to seeking medical assistance (e.g. hospitalisation, GP visit, physiotherapy treatment, etc), the researchers will contact you via telephone to clarify details pertaining to your fall.

Participation in the study will not cost you anything, except for some of your time completing some questionnaires. The initial questionnaires regarding your health, physical activity and the consent form should not take any longer than approximately 15 minutes. Additionally, completing the fall calendar on a monthly basis may take up to 5 minutes. However, if a fall occurs, you are asked to complete two additional questionnaires

within 4 weeks of your fall, which may take up to 10 minutes. The follow-up phone call is required if you have sought medical intervention following a fall, which should take no longer than approximately 10 minutes.

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

If you have any questions at any time, further clarification can be sought by calling the researchers whose phone numbers will be provided in the detailed information sheet.





Dear participants in peer-led Steady As You Go classes,

The University of Otago is planning to extend their evaluation of the peer-led Steady As You Go Falls Prevention Programme. We are planning to collect fall data (by monthly fall diaries), and information regarding any injuries and subsequent medical treatment due to falls. We will also collect information on the impact any fall has had on your physical activity and quality of life. We are inviting all people who have been attending peer-led classes for a minimum of 6 months to participate.

Our first step will be to invite the peer-leaders to a discussion evening in order to discuss and ask questions about the project. Following this meeting, the peer-leaders will be invited to discuss the aims of the project with their individual classes. People who agree to participate will be provided with further detailed information regarding the study in form of an information sheet and consent form. We are hoping to start this in March 2011, and would be delighted if you agree to participate.

Kind Regards

Dr. Debra Waters & Associate Professor Leigh Hale

## **APPENDIX C**

---

**Information sheet (p. 106-109), and**

**Consent form (p. 110)**

## **An Evaluation of the Steady As You Go Fall Prevention Programme**

### **INFORMATION SHEET FOR PARTICIPANTS**

The University of Otago is extending their evaluation of the peer-led Steady as You Go Fall Prevention Programme to include more groups.

As a participant of the peer-led Steady as You Go Fall Prevention Programme, we invite you to take part in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you of any kind and we thank you for considering our request.

#### **What is the Aim of the Project?**

To determine the number of falls in participants attending peer-led fall prevention exercise programme and to estimate the costs associated with any injuries sustained in a fall. We are also interested in finding out if a fall impacts on your physical activity and quality of life.

#### **What Type of Participants are being sought?**

Participants who live in the community and who:

- Have are currently participating in a peer-led SAYGO community exercise programme.
- Have medical clearance to participate in an exercise class.

People who are in one or more of the categories listed below will not be able to participate in the project because, in the opinion of the researchers and the University of Otago Human Ethics Committee, it may involve an unacceptable risk to them:

- Inability to comprehend study information and consent process
- Inability to fill in questionnaires independently

## **What will Participants be Asked to Do?**

Should you agree to take part in this project, you will be invited to participate as a research participant for 12 months during which time you attend your peer-led Steady as You Go classes as usual.

Your classes will be conducted as they normally are (once weekly) and held at the same venue.

If you agree to participate, you will be asked to fill out a couple of questionnaires relating to your current health and how active you are. Additionally, you will be asked to keep a monthly diary to document any falls you may have. You will be provided with a monthly fall calendar that you will need to return to your peer-leader at the end of each month. Your peer-leader will post the calendars back to us in a pre-paid envelope.

In the event of a fall, you will also be asked to fill in an additional short questionnaire asking for more details about the fall and whether you were injured. There will also be two short questionnaires to see if this impacted on your normal physical activities and quality of life. If your fall leads you to seeking medical assistance (e.g. hospitalisation, GP visit, physiotherapy treatment, etc), one of the researchers or research assistants will contact you via telephone to clarify details pertaining to your fall. The phone call should not take any longer than 10 minutes.

There are no risks associated with you being part of this study.

Participation in the study will not cost you anything, except for some of your time filling in the questionnaires. Filling in the initial questionnaires regarding your health, physical activity, quality of life, and the consent form should not take any longer than approximately 15 minutes. Completing the fall calendar on a monthly basis may take up to 5 minutes each month. However, if a fall occurs, you will be asked to fill in 2 additional questionnaires within/after 4 weeks of your fall, which may take up to 10 minutes. The follow-up phone call is required if you have sought medical intervention following a fall, which should take no longer than approximately 10 minutes. One of the researchers will call you approximately 6 weeks after your fall.

If you have any questions at any time, please call Dr. Debra Waters or Dr. Leigh Hale whose phone numbers are at the bottom of this information sheet.

## **Can Participants Change their Mind and Withdraw from the Project?**

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

## **What Data or Information will be Collected and What Use will be Made of it?**

You will be asked for demographic data about yourself (e.g. age, gender, and ethnicity) and how long you have been participating in the peer-led community exercise classes. In addition, the results from the questionnaires and if applicable, information collected via phone-calls will also be collected.

The data is being collected to determine the number of falls in people participating in peer-led fall prevention exercise classes, if there are injuries related to the falls and to estimate the associated costs of falls. Finally, we will collect information on whether a fall impacted on your physical activity or quality of life.

Your data will be kept confidential by the researchers but the results of the project may be published and will be available in the library but every attempt will be made to preserve your anonymity.

You are most welcome to request a copy of your results from this project should you wish. We will have a “research appreciation day” at the end of the project to share the study findings with you.

The data collected will be securely stored in such a way that only researchers actively involved in the project will be able to gain access to it. At the end of the project any personal information will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

Reasonable precautions will be taken to protect and destroy data gathered by email. However, the security of electronically transmitted information cannot be guaranteed. Caution is advised in the electronic transmission of sensitive material.

## **What if Participants have any Questions?**

If you have any questions about our project, either now or in the future, please feel free to contact -

Dr. Debra Waters  
Department of Preventive and Social Medicine  
University Telephone Number: 479 7222

Dr Leigh Hale  
School of Physiotherapy  
University Telephone Number: 479 5425

This project has been reviewed and approved by the University of Otago  
Human Ethics Committee



**An Evaluation of the  
Steady As You Go Fall Prevention Programme**  
CONSENT FORM FOR PARTICIPANTS

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:-

1. My participation in the project is entirely voluntary;
2. I am free to withdraw from the project at any time without any disadvantage;
3. All data on which the results of the project will be retained in secure storage for five years, after which they will be destroyed;
4. The results of the project may be published and will be available in the library but every attempt will be made to preserve my anonymity.
7. I understand that reasonable precautions have been taken to protect data transmitted by email but that the security of the information cannot be guaranteed.

I agree to take part in this project.

.....  
(Signature of participant) (Date)

.....  
(Signature of research assistant/researcher) (Date)

Participant Contact Details, telephone number:  
(please notify the researchers should your contact details change)

.....  
Contact details of another person should we not be able to get hold of you:

.....  
This project has been reviewed and approved by the University of Otago  
Human Ethics Committee

## **APPENDIX D**

---

**Description of exercises used in the SAYGO programme (p. 112-114)**



## **Level A exercises**

### **Warm-up/cool down exercises**

#### **FLEXIBILITY EXERCISES**

1. Head turns
2. Neck stretches
3. Chin tucks
4. Pelvic tilts
5. Shoulder/chest stretch
6. Ankle movement

#### **EYE EXERCISES**

1. Smooth eye movements
2. Eye stability
3. Head/eyes moving the same direction

### **Conditioning exercises**

#### **STRENGTHENING EXERCISES**

1. Heel raises
2. Front knee strengthening
3. Sitting to standing

#### **STANDING BALANCE EXERCISES**

1. Standing with arm movement
2. Weight shifting – forward and backward
3. Weight shifting – side to side
4. Single side steps
5. Kicking a ball

## **Level B exercises**

### **Warm-up/cool down exercises**

#### **FLEXIBILITY EXERCISES**

1. Shoulder/chest stretch
2. Low back extension
3. Trunk twists
4. Hamstring (back thigh) stretch

#### **EYE EXERCISES**

1. Eye stability – standing with feet apart
2. Head/eyes moving the same direction
3. Ball tossing

## **Conditioning exercises**

### **STRENGTHENING EXERCISES**

1. Hip extension strengthening
2. Back knee strengthening
3. Side hip strengthening
4. Knee bends
5. Sitting to standing

### **STANDING BALANCE EXERCISES**

1. Standing with arm movement
2. Standing with arm movement – feet together
3. Standing with head movement – feet apart
4. Single side steps
5. Ball tossing against a wall

### **WALKING EXERCISES**

1. Backwards walking
2. Heel-toe walking
3. Sideways walking

## **Level C exercises**

### **Warm-up/cool down exercises**

#### **EYE EXERCISES**

1. Eye stability – standing with feet together

## **Conditioning exercises**

### **STRENGTHENING EXERCISES**

1. Sitting to standing

### **STANDING BALANCE EXERCISES**

1. Standing with arm movement – feet together
2. Standing with arm movement – feet heel to toe
3. Standing with head movement – feet together
4. Small turns
5. Kicking a ball
6. Reaching/placing objects

### **WALKING EXERCISES**

1. Walking with head turns
2. Walking around obstacles
3. Heel walking
4. Toe walking

## **Level D exercises**

### **Warm-up/cool down exercises**

#### **EYE EXERCISES**

1. Eye stability – standing with feet in stride
2. Eye stability – standing with feet heel to toe
3. Ball tossing

### **Conditioning exercises**

#### **STANDING BALANCE EXERCISES**

1. Standing with arm movement – feet heel to toe
2. Standing with head movement – feet heel to toe
3. Small turns
4. Reaching/placing objects

#### **WALING EXERCISES**

1. Heel walking
2. Toe walking
3. Backwards walking
4. Heel toe walking
5. Sideways walking
6. Walking in 'Figure 8'

## **APPENDIX E**

---

### **Baseline questionnaire (p. 116-117)**

**Demographic Information****ID number** \_\_\_\_\_

Name: \_\_\_\_\_

Are you:                      Female [ ]                      Male [ ]

Date of Birth: \_\_\_\_\_

Address: \_\_\_\_\_

When did you first start attending the peer-led SAYGO classes?

Month: \_\_\_\_\_ Year: \_\_\_\_\_

At what location do you attend the exercise class?

\_\_\_\_\_

**Please check your responses**

Do you use a walking aid inside your home?

Yes\_\_\_\_\_ No\_\_\_\_\_

Do you use a walking aid outside your home?      Yes\_\_\_\_\_ No\_\_\_\_\_

Does anyone live with you in your home?      Yes\_\_\_\_\_ No\_\_\_\_\_

How often do you drink alcohol in a week?

Daily \_\_\_\_\_ 3-6 days\_\_\_\_\_ 1-2days\_\_\_\_\_ Never\_\_\_\_\_

Do you have any medical conditions for which you are receiving treatment from your doctor?

Yes\_\_\_\_\_ No\_\_\_\_\_

If yes, please list any conditions:

\_\_\_\_\_

\_\_\_\_\_

---

---

Please list the name and amount of any medications you are currently taking that are prescribed by your doctor:

---

---

---

**Fall history**

How many times have you fallen in the last 12 months? \_\_\_\_\_

Did you injure yourself in this/these fall(s)? YES ☐ NO ☐

If yes, what was your injury? (*e.g. bruise on left knee, lump on back of head*)?

---

---

---

---

## **APPENDIX F**

---

**Fall calendar (example May 2011, p. 119)**





## **APPENDIX G**

---

**Fall event questionnaire (FEQ) (p. 121), and**

**Medical treatment questionnaire (p. 122-123)**

**Please fill in this questionnaire, if you have had a fall in the last month**  
**(One questionnaire per fall)**

**Participant ID number:** \_\_\_\_\_ **Date:** \_\_\_\_\_

Was your “fall” a fall, slip or trip in which you lost your balance and landed on the ground or floor or lower level (for example on a piece of furniture, another person or against a wall)?

Confirm fall? **YES** ☐ **NO** ☐ **Date of fall:** \_\_\_\_\_

Did you fall inside or outside? **INSIDE** ☐ **OUTSIDE** ☐

What were you doing when you fell?

Did you injure yourself? **YES** ☐ **NO** ☐

What was/were your injury(ies)? (*e.g. bruise on left knee, lump on back of head*)?

\_\_\_\_\_

Did you seek medical help for your injury? **YES** ☐ **NO** ☐

(If YES, one of the researchers will call you at the beginning of next month to gather further information regarding your fall)

Do you think you have fully recovered and are back to your activity/health level prior to your fall?

**YES** ☐ **NO** ☐

Why/Why not?

\_\_\_\_\_

**Fall follow-up phone calls check list**                      **Researcher** \_\_\_\_\_

Participant ID number: \_\_\_\_\_ Date: \_\_\_\_\_

“I am sorry to hear you have had a fall in the last month. As you know, we would like to ask you some further questions regarding your fall/injury, for the project you volunteered to participate in. Is now a good time for you to do this?”

When did your fall happen? \_\_\_\_\_

Did you injure yourself? YES ☐ NO ☐

What was your injury? (e.g. bruise on left knee, lump on back of head)?

Did you seek medical help for your injury? YES ☐ NO ☐

Who did you see? (e.g. GP, physiotherapist, hospital/ambulance, nurse)

How many times to date/How long did you stay in hospital?

D)

Did you have to pay any co-payments? YES ☐ NO ☐

How much approximately did you have to pay to date?

Was a claim lodged with ACC? YES ☐ NO ☐ UNSURE ☐

Did you break any bone(s) during your fall?      YES      ☐      NO      ☐

If yes, which bone(s) did you break? \_\_\_\_\_

---

If yes, was the break (fracture) confirmed with an x-ray?

YES ☐ NO ☐

Did you require any other health investigations such as an MRI or CT scan?

YES ☐ NO ☐ UNSURE ☐

What were they?

---

---

Did you require any other medical help such as crutches, home-help, new medication?

What did you require?

A) \_\_\_\_\_

B) \_\_\_\_\_

C) \_\_\_\_\_

For how long?

A) \_\_\_\_\_

B) \_\_\_\_\_

C) \_\_\_\_\_

Do you still require this?

A) \_\_\_\_\_

B) \_\_\_\_\_

C) \_\_\_\_\_

Do you think you are back to your same level of health/activity as that prior to your fall?

YES ☐ NO ☐

Why/Why not?

---