FALLS AND FALL RISK FACTORS IN THE ELDERLY FOLLOWING A COMMUNITY EXERCISE PROGRAM

RESEARCH PAPER
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# TABLE OF CONTENTS

Table of Contents…………………………………………………………………………i

ABSTRACT……………………………………………………………………………….iii

CHAPTER I: INTRODUCTION

Introduction...........................................................................................................1

Background and Significance ...........................................................................4

Problem .............................................................................................................6

Purpose ............................................................................................................6

Research Question ...........................................................................................6

Theoretical Framework .....................................................................................7

Definition of Terms ..........................................................................................7

Limitations .......................................................................................................8

Assumptions ....................................................................................................8

Summary ..........................................................................................................9

CHAPTER II: REVIEW OF LITERATURE

Introduction.......................................................................................................10

Organization of Literature ............................................................................10

Organizing Framework ..................................................................................10

Incidence and Prevalence of Falls .................................................................13

Fall Risk Factors ............................................................................................18

Fall Prevention Programs ...............................................................................35

Instrumentation ..............................................................................................37

SUMMARY .......................................................................................................41
Incidence and Prevalence of Falls.................................................................41
Fall Risk Factors ..........................................................................................42
Fall Prevention Programs.............................................................................44
Instrumentation.............................................................................................44

CHAPTER III: METHODOLOGY

Introduction.................................................................................................46
Research Question .......................................................................................46
Population, Sample, and Setting.................................................................46
Protection of Human Rights.........................................................................47
Procedures.....................................................................................................47
Data Collection..............................................................................................48
Intervention...................................................................................................48
Instrumentation, Reliability, and Validity....................................................49
Design............................................................................................................49
Data Analysis................................................................................................49
Summary........................................................................................................50
References.....................................................................................................51
ABSTRACT

RESEARCH TOPIC: Falls and Fall Risk Factors in the Elderly Following a Community Exercise Program

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Falls are a leading cause of non-fatal injuries and hospital admissions for trauma in the elderly. Fall prevention programs for community-dwelling older adults may prevent falls. The purpose of this study is to evaluate the effectiveness of a community-based fall prevention program that includes exercise, education and individual risk assessment strategies for older adults. This is a replication of Shumway-Cook, Silver, LeMier and York’s (2007) study. The framework is the Guidelines for the Prevention of Falls in Older Persons (AGS, BGS, AAOP, 2001). The sample will be 400 adults over 65 from senior community groups throughout Howard County, Indiana. The instruments include the Timed Up and Go Test, the Pfeiffer Short Portable Mental Status Questionnaire, the Health History Questionnaire, the Leg Strength Balance Berg Test, and fall frequency tabulation, all completed before and after the year-long program on exercise training. The findings will provide information about the effectiveness of a community-based multi-factorial intervention program in the elderly population in Howard County.
Chapter I

Introduction

Patient falls are a major healthcare problem being addressed by Evidence Based Practices. By the year 2030 there will be approximately 70.3 million older adults, and with the increasing older population there will be an increased number of falls. According to Mahoney and Goc (2009) there are close to 22 million households with persons age 65 years and older. Nearly 16,000 people that fall will die as a result of the fall. Twenty to 30 % will suffer moderate to severe injuries.

Older adults are hospitalized for fall-related injuries five times more than injuries from other causes (Centers for Disease Control and Prevention, 2010). In 2005, the last year that statistics have been made available, 430,000 people over the age of 65 were admitted to the hospital after falling, and 15,800 died as a direct result of the fall. In addition, falls are costly and add to the financial burden of the system, and to nursing home costs (Innovative Healthcare Systems, 2009).

The costs to the Medicare Program, Medicaid Programs, and Private Insurance Companies from falls by elderly persons will continue to climb faster than inflation and population growth. Direct costs for falls are funded by Medicare/Medicaid and Private Insurance Companies for treating fall-related injuries. Over 70% of the charges for falls have been paid for by Medicare. Direct costs include: insurance processing fees for
hospital and nursing home care, doctors and other professional services, and rehabilitation services (Centers for Disease Control and Prevention, 2010). By 2020, the annual direct and indirect costs of fall injuries is expected to reach 54.9 billion dollars. Direct and indirect costs do not account for the long-term effects of injuries which include: disability, dependence on others, lost time from work, household duties, and a reduced quality of life (Innovative Healthcare Systems, 2009).

For the elderly, falling could have lasting consequences for injuries such as a fracture, disability, and long term pain. Traumatic brain injuries and injuries to the hips, legs, and feet, have been the most common type of fatal fall injuries, and have accounted for up to 78% of fatalities. Fractures are the most common type of nonfatal injury from a fall. Five percent of falls lead to bone fracture, resulting in approximately 300,000 hip fractures annually. Current studies show that up to 33% of older adults with a hip fracture die within a year of the fracture. With the aging of the baby boomers, the number of fractures could double by 2040 (Innovative Healthcare Systems, 2009).

Falls are very common in community-dwelling older adults, and a major threat to independence and quality of life. Forty-six percent of older adults are living alone. Falls in older people usually result from the interaction of a number of variables rather than any single factor. Intrinsic factors associated with falls and fall injuries in community-dwelling older adults include: increasing age, female gender, a history of falls, chronic medical conditions, decreased bone mineral density, multiple medications, sensory problems, impaired cognition, and low levels of physical activity. There are also a number of extrinsic factors that include hazards in and around the home and in public
places. The intrinsic and extrinsic risk factors combined increase the risk of falls and injuries (Stevens, Mack, Paulozzi, & Ballesteros, 2008).

There are many programs to prevent falls and provide education in the community setting. The Centers for Disease Control and Prevention encourage three physical and mental activities for community dwelling older adults that assist the elderly in identifying risk factors and providing strength and gait training. The three activities include: “Stepping On,” “Tai Chi: Moving for Better Balance,” and a “Falls Pocket Guide” for physicians (2010).

The National Council on Aging (NCOA) has joined with the Falls Free Coalition that includes more than 55 organizations, and employs a collective approach to promoting a national fall prevention action plan. This program, called the Matter of Balance, was designed to reduce the fear of falling, increase self-efficacy and a sense of control in relation to fall risk, and increase physical and social activity (Centers for Disease Control and Prevention, 2010).

Another program in the United States called “Stepping On,” determines the capabilities of state health departments and type of technical support required to implement community-based fall prevention programs. The multifactorial interventions should include: gait training and advice on the use of assistive devices, review and modification of medications, exercise programs with balance training, treatment of postural hypotension, modification of environmental hazards, and treatment of cardiovascular disorders (Stevens et al., 2008).

In summary, falls are a public health problem that can be preventable. Falling in the elderly has lasting consequences, and is a major threat to independence and quality of
life. There are programs that assist in preventing falls, and in providing education to elders living in the community and nursing homes. A number of interventions to improve balance and decrease fall risk have been found to be effective in decreasing falls and reducing injuries (Boulgarides, McGinty, Willett, & Barnes, 2003). Further study is needed to evaluate fall programs.

**Background and Significance**

The impact of falls on the elderly population is significant, and often results in debilitating injuries, loss of independence, transfer to an institution, or death. Estimates suggest that one in three elderly people living in the community fall at least 1 time per year. From 1992-1997 there were 147 million injuries related visits to the emergency departments in the United States in the elderly population (Weir & Culmer, 2004).

According to Weir and Culmer (2004), physicians play a major role in identifying elders that are at risk of falling. Patients who have a history of falls can benefit from an assessment and modification of environmental hazards. Falls are related to age, and associated diseases. Other risk factors include: being house-bound, living alone, use of an assistive device, previous falls, acute illness, chronic disease, foot problems, vision or hearing impairments, cognitive impairment, impairment in activities of daily living, lower extremity weakness or disability, impaired balance or gait, dizziness, reduced body mass index, number of medications used, and use of psychotropic medications (p. 724).

In 2001, the American Geriatrics Society, with participation from other organizations, published the “Guidelines for the Prevention of Falls in Older Persons.” The Guidelines were updated again in 2006. The Guidelines were established to assist health care professionals in the assessment of fall risk and management of older patients.
who are at risk of falling, or who have had a fall. The Guidelines were based on a number of studies, and stated that care should be designed based on a history of falls. The fall evaluation includes: history, medications, vision, gait and balance, lower extremity joints, neurological examination, and a cardiovascular examination. The interventions can include: exercise programs, medication modification, postural hypotension treatment, environmental hazard modification, and/or cardiovascular disorder treatment. The Guidelines also had several suggestions for future research that will be ongoing to assist in reduction and management of falls in the elderly (AGS, 2001; BGS, 2001; AAOP, 2001).

Belsia, Shumway-Cook, Phelan, and Williams (2006) examined the effectiveness of participation in a program called Enhance Fitness, a community-based exercise program for older adults. The program did improve elders’ performance tests and self-ratings on health. The study did verify that older adults can maintain, and/or improve physical function through exercise. Campbell and Robertson (2007) tried to determine if evidence supports that interventions with multiple components improve falls over single strategies in community-dwelling elders. The results showed that single interventions were just as effective in reducing falls as using multiple interventions. Elders benefit from individual assessment and treatment. Lin, Hwang, Chang, and Wolf (2006) studied the effect of a community-based tai-chi program on injurious falls, balance, gait, and fear of falling in a 1 year intervention. Falls did decline significantly in the study, and the authors found that exercise can prevent a decline in balance and gait.

Shumway-Cook et al. (2007) found that a community-based multifaceted intervention was effective in improving balance, mobility, and strength. The authors
evaluated the effectiveness of a 12 month community-based intervention on falls and fall risk factors in community-dwelling elders. There was a 12 month follow-up completed on 95% of participants; falls were 25% lower among the intervention group when compared to the control group. The program did not reduce the incidence of falls in sedentary, healthy, community-living older adults in the 12 month period. Further research is needed to understand low participation in exercise classes, the effects of involving older adults in identifying risk factors, identifying an exercise threshold to reduce falls with varying levels of risks, and the role of the health care provider in falls prevention and exercise adherence.

Statement of Problem

Evidence supports that multifactorial interventions with exercise can be effective in reducing the rate of falling, and the risks of falling among older adults who are community-dwelling. There are still questions that remain concerning the effectiveness of community level interventions on falls among typical, community-dwelling older adults (Shumway-Cook et al., 2007).

Purpose of the Study

The purpose of this study is to evaluate the effectiveness of a community-based exercise intervention program on falls and fall risk factors in community-dwelling older adults. The risk factors include: balance, lower extremity strength, and mobility. This is a modified replication of Shumway-Cook et al.’s (2007) study.

Research Question

1. Are there differences in incidence of falls and risk factors in four groups of community-dwelling Elders based on treatment over time?
Theoretical Framework

The theoretical framework for this study is the Guideline for Prevention of Falls in Older Persons (American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopaedic Surgeons Panel, 2001). The guideline focuses on screening and assessment, focused history, physical examination, functional assessment, and environmental assessments. The key elements to address are risk factors, and the key intervention is to develop individualized interventions that will include exercise programs, education, review of medications, and home modification.

Definition of Terms

Risk Factors for Falls: Conceptual.

Shumway-Cook et al. (2007) defined impaired balance, lower extremity weakness, and impaired mobility being risk factors for falls.

Risk Factors for Falls: Operational.

The Repeated Chair Stand Test was used to conduct tests of leg strength in participants. The Berg Balance Test was used to test balance of participants. The Timed Up and Go Test was used to test mobility in the participants (Shumway-Cook et al., 2007).

Community Based Exercise Intervention Programs: Conceptual

Community based exercise intervention programs evaluated the effectiveness of a 12 month community-based intervention on falls and fall risk factors in community-dwelling elders (Shumway-Cook et al., 2007).
Community Based Exercise Intervention Programs: Operational.

The community based exercise program consists of a group exercise classes for 1 hour, three times per week, for up to 12 months, and participation in 6 hours of fall prevention group exercise classes (Shumway-Cook et al., 2007).

Fall Incidence: Conceptual.

Fall incidence will be the number of times that a participant will be identified as coming to rest unintentionally on the ground or the lower level (Shumway-Cook et al., 2007).

Fall Incidence: Operational.

The Health History is a 20 question questionnaire that includes: history of falls in the last 3 months, history of fall related injuries in the last 3 months, fear of falling or activity self-restriction due to fear of falls, comorbid conditions, polypharmacy, use of an assistive device for walking, alcohol use, sensory impairment, impairment in balance or gait, lower extremity weakness, and decrease in participation (Shumway-Cook et al., 2007).

Limitations

The study is limited in sample size and geographic area.

Assumptions

1. A community-based falls prevention program can improve fall risk factors.
2. The effectiveness of exercise programs for older adults will improve balance, mobility, and strength if participants can remain engaged in exercise.
3. It is feasible to implement fall prevention programs in the community using existing resources.
Summary

Falls are the leading cause of death from injury for older adults each year. Falls are also a leading cause of hospital admissions. Community-based exercise programs can be beneficial in providing education and improving physical strength and balance. The purpose of this study is to evaluate the effectiveness and feasibility of community-based fall prevention education, exercise, and individual risk assessment strategies for community-dwelling older adults that can be implemented through state and public health partnerships. This study will be a replication of Shumway-Cook et al.’s (2007) study. The Guideline for the prevention of falls in older persons will provide a framework which will provide education and direction to health care providers.
Chapter II

Literature Review

Introduction

Falls are one of the most common problems facing the elderly. Falls usually result from the interactions of multiple risk factors. Falling in the elderly population is associated with significant mortality, reduced functioning, morbidity, and premature nursing home admissions. The purpose of this study is to evaluate the effectiveness of a community-based exercise program on falls and fall risk factors in community-dwelling older adults. This is a replication of Shumway-Cook et al.’s (2007) prior research.

Organization of the Literature

The literature is organized into five sections: (a) organizing framework; (b) incidence and prevalence of falls; (c) fall risk factors; (d) fall prevention programs; and (e) instrumentation.

Organizing Framework

The Guidelines for the prevention of falls in older persons (American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopaedic Surgeons Panel, 2001) is the framework for this study. The guidelines were developed to assist health care professionals assess fall risks of older patients who are at risk of falling or
who have fallen. The guidelines were based on various controlled studies to detect a history of falls to perform a fall-related assessment. The guidelines were aimed at reducing risks for future falls. The guidelines include an algorithm to summarize the assessment and management of falls. The recommendations came from epidemiological studies that demonstrated an association between risk factors and falls, and from experimental studies where assessment and intervention was beneficial. The risk factors address falls in a primary care setting. A fall evaluation includes an assessment leading to multifactorial interventions to reduce falls as appropriate, and include exercise programs, medication modification, postural hypotension treatment, environmental hazard modification, and cardiovascular disorder treatment.

Fall assessment varies by target population. According to the Fall Prevention Guidelines, low risk populations need a brief assessment, and high-risk groups need a comprehensive and detailed assessment. The fall assessment includes items such as: circumstances of the falls, identification of risk factors, medical co-morbidity, functional status, and environmental risks. The risk factors in the assessment are modifiable or non-modifiable, both being very important for treatment planning. Older persons, as a part of routine care, should be asked at least once a year about falls. Older persons who report a single fall should be observed getting up from a chair without using arms (TUG test). The approach to older persons who present with one or more falls, recurrent falls, or abnormalities in gait and/or balance, will have a different evaluation. The assessment includes a fall evaluation of the history of falls, medications, medical problems, mobility levels, vision exam, gait and balance exam, lower extremity joint function, basic
neurological function, cerebellar function, and cardiovascular status (AGS, 2001; BGS, 2001; AAOP, 2001).

The specific recommendations and interventions for community-dwelling older persons include: gait training, advice on the use of an assistive device, modification of medication, exercise programs, treatment of postural hypotension, modification of environmental hazards, and treatment of cardiovascular disorders. In the long-term care or assisted living settings, the interventions include staff education programs, gait training and the use of assistive devices, and review and modification of medications (AGS, 2001; BGS, 2001; AAOP, 2001).

The Guideline for the Prevention of Falls was developed and written under the direction of the American Geriatrics Society Panel on Falls in Older Persons (2001). The panel of experts made observations about exercise, and recommended that exercise be sustained for benefit. The type, duration, and intensity for falls prevention remained unclear. Older people with recurrent falls should have balance training and long-term exercise. The Panel of experts (2001) agreed that older persons at increased risk should have a facilitated environmental home assessment considered. Older persons who have fallen should also have medications reviewed. Medications should potentially be stopped or altered due to the risk of future falls. There is a consistent association between psychotropic medication use and falls. Poor vision is associated with falls. Vision should be formally assessed and abnormalities treated.

In 2006 there was a revision of the guideline for the prevention of falls (Williams, 2006). The multi-factorial intervention of the updated guidelines identified a need to evaluate differences among subgroups, such as community-dwelling individuals
compared with individuals in long term care settings, and the cognitively intact vs. cognitively impaired individuals. The recommendation (2006) was that the clinician performing the assessment should implement and monitor the interventions performed by others. The Panel recommended stopping or reducing sedatives, anxiolytics, antidepressants, and antipsychotics because of the increase in risk of falls due to side effects. Tinetti also stated that addressing podiatric concerns, evaluating and treating orthostatic hypotension, and staff training with feedback in the long-term care setting should be components in multifactorial interventions. The 2006 guideline stated that exercise can be performed individually or as a part of group exercise.

Incidence and Prevalence of Falls

The incidence of falls will continue to rise due to the increase in the baby boomer population. The purpose of the study by Painter, Elliott, and Hudson (2009) was to examine the prevalence and contributing factors associated with falls in community dwelling adults 50 years and older living in North Carolina.

The study took place in a rural eastern county in North Carolina. There were 663 community-dwelling adults 50 years and older that attended group meetings in churches and senior centers, who volunteered for the study. The study took place over 4 years. The age of the participants ranged from 50 years to older than 90 years (Painter et al., 2009).

Fall risk factors were examined that included: gender and age, whether living alone or with others, location of falls and time of day, injuries and activities associated with falls, use of safety equipment and ambulation devices, and fear of falling. The Fall Interview Schedule questionnaire was used to collect information on fall history. The
tool had been used in pilot studies and modifications were made. The questionnaire had two parts. Part one included demographic information on gender, living status, age, working status, and whether or not the person had a fall or near fall. Participants who experienced a fall completed part two of the survey, which focused on how many prior falls the person experienced, information about the last fall, and use of safety devices or ambulatory equipment. The survey was administered by occupational therapists (Painter et al., 2009).

Falls occurred in 62.1% of the respondents, and 56.5% experienced more than one fall. Sixty-eight percent had almost fallen one or more times. There were more women in the age group of 71-80 years that experienced a fall. The group of 50-60 year olds reported the most falls (71.9%). Falls were significantly more frequent for participants who lived alone than for individuals who lived with others (66.6%), and significantly higher in women. Falls most commonly occurred in the early afternoon or in the morning. Falls occurred most often in the bedroom or kitchen. The activity that the participants were involved in when a fall occurred was usually walking (80.3%). Participants sustained an injury from the fall. There was a significant correlation between the use of assistive devices and age, using devices was more common in people 81 years and older. The fear of falling was prevalent in 48.8% of the participants who had a fall. The findings suggested that many people report falls to relatives, coworkers, or friends. The authors concluded that the general public does need education on fall prevention and fall risk factors (Painter et al., 2009).

Examining falls in the Medicare population can improve health and functioning as individuals age. Schumway-Cook, Ciol, Hoffman, and Dudgeon (2009) studied the
incidence of falls, health care costs, associated factors, and provider responses to falls among Medicare beneficiaries. The purposes of this study were: (a) to use the falls supplement to the Medicare Current Beneficiary Survey (MCBS) to provide a national estimate of the incidence of falls in the Medicare population, (b) to examine health care provider responses to reported falls, (c) to identify factors associated with having recurrent falls or medically injurious falls, and (d) to compare health care costs as a function of fall status.

The Medicare Current Beneficiary Survey (MCBS) is a longitudinal survey of the Medicare population sponsored by the Centers for Medicare and Medicaid Services, and uses a multistage, stratified sampling design. The authors used the 2002 MCBS that implemented the falls supplement in the health and functioning interview. A total of 12,669 beneficiaries over 65 were included in the 2002 MCBS. Beneficiaries living in institutions were not included in the survey (Shumway-Cook et al., 2009).

Interviews were conducted in person or by proxy; data were collected on items such as the use of health care services, medical care expenditures, health status and functioning, and sources of payment. Income, education level, and living arrangements information was also collected (Shumway-Cook et al., 2009).

The MCBS 2002 falls supplement determined the self-reported incidence of falls and health care provider response to falls with two questions: “In the past 12 months have you fallen down?” and “How many times in the last year have you fallen down?” The incidence of falls was recorded as none, one, or recurrent falls. The interview question “Did you hurt yourself badly enough to get medical help?” was used to establish the incidence of injurious falls (Shumway-Cook et al., 2009, p. 327).
The MCBS estimated that 22.1% of beneficiaries 65 years of age and older fell in the previous year with 10% of the population having recurrent falls. The mean age for fallers was slightly higher, and there was a higher percentage of women, white non-Hispanic, participants who were not married, had lower education, lower SES, were living alone, were underweight or overweight, reported fair or poor health, had four or more comorbidities, and had at least one ADL difficulty (Shumway-Cook et al., 2009).

Health care provider responses were addressed by three questions about falls, and whether or not the provider asked if the individual understood why the fall occurred, how to prevent falls, or talked to anyone about the fall. Cost data were used to determine annual total costs. Data summarized from the Medicare health care claims for 2002 were used to estimate the average costs in home health, outpatient, inpatient, medical provider, and prescription medicine events (Shumway-Cook et al., 2009).

The findings were that less than half of participants spoke with a health care professional about the fall. If the participant did speak to a health care provider, 75% stated the provider tried to understand the circumstances or reasons for the fall, and 61% received fall prevention information from the provider after the fall. Health care costs for three categories of falls (no falls, 1 fall, 2 or more falls) were higher in older adults reporting one fall and higher among individuals reporting recurrent falls. Total costs by health care category were similar, with 3% to 5% of dollars spent on home health, 30% to 35% spent on inpatient care, 30% to 36% spent on provider costs, 11% to 13% spent on outpatient costs, and 17% to 19% spent on medications. Health care costs were 44% higher for beneficiaries that had an injury with a fall (Shumway-Cook et al., 2009).
Socio-demographic variables were divided into binary categories that included: race, marital status, socioeconomic status, education status, living status, self-report of general health, and smoking status. The co-morbidity number was determined by a count of 18 clinical conditions: cancer, hypertension, diabetes, acute myocardial infarction, coronary artery disease, and stroke. Body mass index was calculated using the height and weight, and grouped into categories ranging from overweight to underweight. The findings were that older adults who required medical attention after a fall were: slightly older, not married, women, living alone, reporting fair or poor health, were not smoking, had more comorbidities, and had at least one ADL difficulty (Shumway-Cook et al., 2009).

Activities of daily living included in the survey were: dressing, bathing, getting in and out of a chair, eating, using the toilet, and walking. Instrumental activities of daily living were also included: use of a telephone, housework, meal preparation, money management, and shopping. Possible responses were, “yes,” “no,” or “doesn’t do.” Weights provided by the multistage sampling used in the MCBS estimated the incidence of falls during the year prior to the interviews. Age, race, education, living status, BMI, ADL categories, and co-morbidities were not statistically significant in the model (Shumway-Cook et al., 2009).

Recurrent falls were associated with being female, white, increased age, poor or fair health, and increased limitations in activities of daily life. Falls with injuries were consistent with other reports, but did not find that injuries were increased with age, BMI, ADL disability, or co-morbidity. Only 50% of older adults who fell discussed this with a health care provider. This study did provide a national annual incidence estimate of falls
among adults age 65 years and older in the Medicare population, as well as identifying factors associated with having recurrent falls or having a fall with an injury. This population needs consistent management and assessment of fall risk so that risk factors can be more properly managed to reduce health care costs and injuries related to falls (Shumway-Cook et al., 2009).

*Fall Risk Factors*

The incidence of side falls increase with risk of a hip fracture. The purpose of the study was to investigate functional measures of balance and mobility, balance self-efficacy, and falls incidence in a population of community-dwelling adults. Gunter, DeCosta, White, Hooker, Hayes and Snow (2010, p. 29) asked the questions:

1. Does balance self-efficacy change over a 1 year period?
2. Is there a difference in the balance self-efficacy scores of individuals who fell during the 1 year observation and individuals who did not fall?
3. What is the relationship between balance self-efficacy and risk factors for side falls and frequent falls?

Participants resided in the mid-Willamette Valley in western Oregon, and were recruited from an ongoing falls-surveillance study in the Bone Research Laboratory at Oregon State University. The individuals had to be at least 70 years old and live independently either at home or in a retirement facility. The means age was 79.8 years with 80.3% being women. One hundred ninety-eight individuals were tested at baseline. Tests included: mobility, strength, and balance; a brief medical and medication history; a balance self-efficacy questionnaire; and a simple physical activity questionnaire.
Baseline testing was completed as well as follow up testing 1 year later (Gunter et al., 2003).

Balance and functional mobility were assessed by timing participants on gait and power tests that included: characteristic gait, tandem gait, maximum-wide gait, circular gait, and get-up-and-go. The stair climb, isometric dynamometry, and Accusway system were used to assess balance and functional mobility; reliability was assessed in previous studies. The Balance Self-Efficacy Scale (BSE) was used to assess balance self-efficacy. The BSE was based on the Activities-Specific Balance Confidence Scale and consisted of 18 questions which asked the respondents to rate the length of time confident engaging in a particular task (from confident 0% of the time, to confident 100% of the time).

Consistency of the BSE was assessed by Cronbach’s alpha reliability, and by split-half reliability. Validity was tested by correlating the BSE with the ABC and the Falls Efficacy Scale. Reliability was .88 in a previous study (Gunter et al., 2003).

The follow-up testing was completed by 85.4% of the original participants who filled out postcards, self-report falls diaries, and follow-up phone contacts to report the frequency and characteristics of falls. Postcards were mailed every 3 months, and if a fall had occurred then a phone call was made and the participants filled out a questionnaire. The study spanned the time interval between the baseline and follow-up tests determined falls status. Participants who had one or more falls during the observation period were categorized as fallers (Gunter et al., 2003).

BSE scores between baseline and follow-up showed no differences among fallers and non-fallers over 1 year. Fallers did have significantly lower BSE scores than non-fallers. The BSE scores were predictive of sway during tandem stance, get-up-and-
go, independent age, tandem walk, height, and strength. Only the BSE scores were predictive of fall status. The side-fall risk factors and balance self-efficacy scores were significantly associated (Gunter et al., 2003).

Reporting a low balance self-efficacy may tend to self-induce restrictions in physical activity, which results in compromised function, and may lead to falls. There is a need for follow up physical performance data to make a determination on whether function is as stable as self-efficacy. There are psychological contributions to hip-fracture risk, and BSE is predictive of functional tasks that are known risk factors for falls with injuries. Improving function may improve balance self-efficacy and psychological health (Gunter et al., 2003).

Many elderly persons report a fear of falling that is not always associated with a history of falls. The purpose Hatch, Gill-Body, and Portney’s (2003) study was: (a) to examine the relationship between balance confidence, balance performance, and functional mobility, and (b) to examine the extent that balance confidence can be explained by clinical measures of balance and functional mobility, as well as health-related, fall-related characteristics, and socio-demographic variables.

The participants lived in the Boston area. The sample included 50 community-dwelling elderly people that were between 65 and 95 years of age. The subjects participated on a volunteer basis by responding to information from lectures in senior centers and senior housing sites. The criteria for inclusion were that the participants had to be English speaking, able to follow 3 step commands, walk 20 feet without assistance, see well enough to read, have no history of clinical depression or progressive neurological disorder, and have had no lower extremity fracture, surgery, or joint
replacement within the past year. The subjects were overall in good health, which may not reflect the general elderly population. Interviews and testing took place in common areas in the senior housing sites and the senior center (Hatch et al., 2003).

Socio-demographic information, health related information, and fall related information were gathered using a standard interview protocol. The Activities-specific Balance Scale (ABC) questionnaire was administered by a research assistant. The ABC is a 16-item list that asks respondents to score level of confidence in performing specific activities such as reaching at eye level, picking up something from the floor, reaching on tiptoes, walking in a crowded mall without becoming unsteady or losing balance. Each item is scored from 0% to 100%, with 0% = no confidence, to 100% = full confidence in the ability to perform the activity without losing balance. The reliability was reported as .92, and validity with the physical activity of the ABC scale was .63 (Hatch et al., 2003).

The Balance Berg Scale (BBS) and the Timed Up and Go Test (TUG) were administered after the interview. The BBS is a 14-item balance assessment tool that is scored on a 5-point scale (0-4) that measures ability to perform each task (4=safe and independent, 0=unable). The tasks include: standing with eyes closed, standing on one foot, picking up objects from the floor, and reaching. The reliability of the BBS was reported as .99. The Timed Up and Go (TUG) tool measures basic functional mobility by the time it takes for a subject to stand, walk 10 feet, walk back to a chair, and sit. The reliability of the TUG was reported as .99 in patients with neurological disorders, and was predictive for fall risk in community-dwelling elderly people using a cutoff score of 14 seconds (Hatch et al., 2003).
The findings showed that there was a strong correlation between ABC and BBS scores, between ABC scores and TUG scores, and between TUG and BBS scores. Findings from BBS were that 57% of the variance of the ABC Scale scores was the largest determinant of balance confidence among all variables measured in the study. The TUG scores validated that there was a relationship between balance confidence and functional mobility (r=.62, p<.05). The authors concluded that balance impairments are present in people who have diminished confidence and this has important implications for developing rehabilitation programs to diminish the impact for the elderly population (Hatch et al., 2003).

Falls in the age group of 65 years and older continue to rise, and falls can affect quality of life. There are several interventions and fall risk screening tools to assist in identifying people at risk for falls. The testing that has been done in the past has focused more on residents in nursing homes. The purpose of this study was to examine the data from five different balance tests, combined with data regarding fall history, number of medications, dizziness, visual problems, use of an assistive device, sex, physical activity, and age. The study by Boulgarides et al. (2003) examined predictors of falls in community dwelling older adults who were independent.

Ninety-nine subjects completed the study, with 60 being women and 39 being men. The participants were recruited from senior centers, retirement centers, the 50-PlusWellness Program, and the general community in Sacramento, California. The criteria to be included in the study were that the subject had be able to stand for at least 5 minutes without an assistive device, and to walk a minimum of 12m at a time without an assistive device. People with cognitive deficits, medical, or neurological problems were
excluded if the condition prevented them from meeting the inclusion criteria. The participants were able to participate in the interview process, follow directions, and give appropriate responses to survey questions without assistance. Subjects with heart or pulmonary problems that caused medical risk during mild activity were excluded from the study. The mean age was 74 years and the number of medications the subjects took ranged from 0-10. Fifty-six subjects reported problems with dizziness (Boulgarides et al., 2003).

The participants were tested one time for the study and then followed for 12 months to track falls. Reliability was performed on all tests by having the testers view videotapes and judge movement quality using the BBS and DGI. An interview was completed that included medical history, history of falls, and physical activity. The medical history included vision, dizziness in the last year, number of medications, cardiac and pulmonary problems, use of an assistive device, and cancer. Fall information was determined based on fall incidents from the previous year, and injuries. Follow up contact was made by email or telephone every 2 to 4 weeks for the 12 months following the balance assessment to track fall history (Boulgarides et al., 2003).

The Berg Balance Scale (BBS) had validity and reliability established in previous studies. The BBS challenges the subjects to keep balance with an increasingly narrow base of support with initial level at sitting and final level one-leg standing. The highest score is 56 and the cutoff score of the participants who do not fall is usually 45 points. The Timed Up and Go Test (TUGT) measured activities with a stopwatch, when the participant was instructed to move from a seated position in a chair to a standing position,
walk 3m at a normal pace, turn around, walk back to the chair, and sit down. There are
two timed trials that are averaged for the final score (Boulgarides et al., 2003)

The Dynamic Gait Index (DGI) used eight test items to measure a person’s ability
to accommodate changes in environment, head position during gait, and speed. Tasks
were rated on a 3-point scale from 0 (unable) to 3 (normal execution). There was no
reliability established for this test. The Modified Clinical Test for Sensory Interaction on
Balance (CTSIB) examined postural sway during the four conditions assessed for the
CTSIB: standing on a firm surface with eyes open, standing on a firm surface with eyes
closed, standing on a foam surface with eyes open, and standing on a foam surface with
eyes closed. Composite sway was the mean sway speed over the four conditions with
each condition being tested three times (Boulgarides et al., 2003).

The 100% Limits of Stability Test (LOS) was established by the Balance Master
software based on the participants height. LOS addresses the maximum angle a person
should be able to sway the body over the feet without losing balance and having to take a
step. The test provides information on reaction time, movement speed, end-point
excursion, maximum excursion, and directional control. Reliability of this test was
moderately high for movement speed, maximum excursion, and end-point excursion
(Boulgarides et al., 2003).

By the completion of the study there were 42 participants who had experienced a
fall, with the mean number of falls per person being 2.14. There were two models:
standing on a firm surface with eyes closed from the Modified CTSIB, or standing on a
firm surface with eyes closed combined with age and sex that were predictive of falls.
The use of an assistive device was not predictive of falls and dizziness problems were
found to be predictive of falls with injuries. The other tests used in the study were not good predictors of falls (Boulgarides et al., 2003).

Boulgarides et al. (2003) found that due to poor information obtained from the tools, new screening tools are needed for community-dwelling older adults. The participants who had multiple falls or not many falls both scored very well on the balance tests. Many of the subjects scored very high on the BBS, DGI, and TUGT, indicating that the tests are not suitable for adults who are high functioning even if at risk for falls. The authors concluded that fall risk strongly depends on the interaction of many factors and is difficult to predict and that may interact differently at different ages and activity levels.

Pain, reductions in cerebral blood flow, somatosensory deficits, and foot disorders are risk factors for falls that need further investigation. The MOBILIZE Boston Study (MBS) included the following variables: maintenance of balance, independent living, intellect, and zest in the elderly of Boston. This was a cohort study conducted by Leveille et al. (2008) that was part of the Hebrew Rehabilitation Center/Harvard Nursing Home Program Project. The purpose of the study was to identify hazards for falling by assessing problems of pain, cerebral hypoperfusion, and foot disorders in the older population for future research studies.

Leveille et al.’s study was conducted in the Institute for Aging Research (IFAR) at Hebrew Senior Life, which is a large geriatric housing, health care, and research organization. The MBS involved investigators from IFAR, Beth Israel Deaconess Medical Center, the University of Massachusetts at Boston, Boston University, and
Harvard Medical School. There were 765 participants that completed a two-part assessment.

The participants were 70 years and older, and lived within a 5 mile radius of IFAR. The average age was 77.9 years, and two-thirds were women. The participants were from ethnically and socio-economically diverse communities. Eligibility criteria included age 70 years or older, ability to walk across a room, ability to speak and understand English, vision adequate to read the material, and lived in the area for 2 years. Participants were excluded if the Mini-Mental State Exam (MMSE) was less than 18.

Results from the 600 participants did show that the sample was largely representative of seniors in the Boston area in terms of age, sex, race, and ethnicity (Leveille et al., 2008).

The baseline home interview was conducted first, and included information about health and functioning: chronic diseases, health behaviors, self-efficacy for pain and disease management, support and social network, pain assessment, fall and fracture history, adherence to medication regimen, and socio-demographic characteristics. Verbal memory was assessed with the Hopkins Verbal Learning Test, which was a 12-item word list that was a test for memory. Verbal fluency was assessed with semantic fluency tasks and phonemic. Reliability and validity was demonstrated in previous tests (Leveille et al., 2008).

The Trail Making Test measured executive function. The Clock-in-a-Box Test (CIB) was used as a cognitive screening measure. The researchers completed a medication review of all medications used in the last 2 weeks. At the end of the home interview the participants were given a questionnaire to bring to the clinic visit. The
McGill Pain Map, was validated in previous studies, which identifies sites of current pain that lasted more than 1 to 2 weeks (Leveille et al., 2008).

The multidimensional Brief Pain Inventory (BPI) has subscales that measure pain descriptors, quality of life, and pain relief, with 0 = no pain and 10 = severe or excruciating pain. This tool also measures pain interference with activity, mood, walking, housework, relations with others, sleep, and enjoyment of life (Leveille et al., 2008).

The Women’s Health and Aging Study (WHAS) addressed the presence and severity of back and joint pain using a 0 to 10 numeric scale. The Tinetti Falls Efficacy Scale was used to evaluate fall history, a 10-item instrument to measure degree of confidence in performing daily activities. Depression symptoms were measured using a modification of the Centers for Epidemiologic Studies Depression (CESD) scale, which was established as valid and reliable. Footwear information was collected for type of shoe the participant was currently wearing and historically worn (Leveille et al., 2008).

The musculoskeletal exam was assessed by the American College of Rheumatology’s clinical criteria and included observations of movement of hands, hips, wrists, knees, and feet for joint tenderness, pain, or swelling. Reliability for this test was established. The validated Foot Assessment Clinical Tool captured the main features of 25 common clinical foot disorders with excellent reliability. The Semmes-Weinstein monofilament test (SWMT) evaluated the threshold for light touch pressure, and results were categorized into sensory loss groupings of mild, moderate, and severe deficits (Leveille et al., 2008).
The Cerebral Blood Flow velocity was measured in the cerebral artery using the transcranial Doppler ultrasonography (TCD) while sitting in a chair. The Berg Balance Scale (BBS) tested standing balance for 14 balance tasks with a score ranging from 0-56 and was well validated. Postural sway was tested on a Kistler force platform and the subject was asked to subtract 3 from 500 until the end of the trial. Vision was assessed by the Good-Lite Chart Model 600A light box and was designed at a 10 foot text distance with total score a sum of successfully identified numbers. The Short Physical Performance Battery (SPBB) was utilized to measure lower extremity mobility performance and measured 4-meter walking speed and ability and time to rise from a chair five times with validity and reliability demonstrated (Leveille et al., 2008).

The average length of the home interview was 2 hours and 45 minutes, and the average exam length was 2 hours and 45 minutes. The cohort had a high prevalence of obesity with low levels of physical activity, and 40% reported walking less than 1 mile per week. Depressive symptoms were infrequent, and participants reported good to excellent health 85% of the time. Thirty-nine percent of participants fell at least once in the last 12 months (Leveille et al., 2008).

Doppler testing was completed with 63% of the sample. None of the participants reported a serious adverse event as a result of participation. Eleven of the participants had minor muscle soreness, 11 had back or joint pain and 3 had headaches that were resolved quickly. The results demonstrated that a population-based study that examines a novel set of risk factors is very feasible with excellent information obtained. The MBS provides important new data resources to examine risk factors for falls and mobility problems in this population (Leveille et al., 2008).
Leveille et al. (2008) concluded that the project will provide excellent information about falls that will advance the understanding of the causes of falls. There are many risk factors in relation to falls, such as gait and balance limitations, dizziness, vision problems, confusion, and weakness. The MBS provides extensive data for examination of the non-traditional risk factors for falls and mobility problems. The findings will help researchers and caregivers understand fall prevention strategies.

Sleep disorders are a highly prevalent problem in the elderly population and benzodiazepines are a commonly prescribed drug for treatment. Many of the benzodiazepines that the elderly use are for long-term treatment, even though activity is short-lived and should not support long-term use. Benzodiazepines are associated with an increased risk of falling. Pariente, Dartigues, Benichou, Letenneur, Moore, and Fourrier-Reglat (2008) studied the association between benzodiazepine use and the occurrence of falls with injuries in the elderly to estimate the impact on injurious falls.

The study took place in areas of the Aquintaine region of south-western France. There were a total of 3,777 participants aged 65 years or older. Subjects that were confined to bed were not eligible for this study. Among the 3,777 subjects there were 840 that were not eligible for the first index period. There were 124 participants for the second index period, 122 subjects for the third index period, and 53 subjects for the last period (Pariente et al., 2008).

Data were collected for 10 years of follow up of the Personnes Agees QUID (PAQUID) study. The cohort group was designed to study cerebral and functional aging. The participants were interviewed at home by neuropsychologists at the beginning of the study and then again at 3, 5, 8, and 10 years. The interview questions included
sociodemographic items, medical history, and a set of neuropsychological tests. Data were collected on baseline and during follow up on falls causing hospitalization, fracture, or head trauma. Death certificates were also examined to see if death events were associated with falling. The participants with no report of injurious falls from baseline to the end of the trial period were considered as controls (Pariente et al., 2008).

All benzodiazepines that were available during the time frame were counted, and drug use was assessed by face to face interviews using the hoc questionnaire. The questionnaire asked about prescribed and non-prescribed drugs regularly used in the past 2 weeks. Validation of drug use was done by visual inspection of the patient’s medicine by the interviewer. Risk factor information was considered in the analysis within the cohort framework. The person-year method estimated the incidence of injurious falls in the PAQUID cohort (Pariente et al., 2008).

In the 10 years of follow up of the PAQUID there were 382 cases of injurious falls that resulted in 275 hospitalizations, 270 fractures, 69 head injuries, and 18 fatalities. The participants who had an injurious fall tended to be single women, have incapacities, visual deficiency, depressive symptoms, slightly older, and partial urinary incontinence. Benzodiazepine use was found to be significantly associated with the occurrence of injurious falls but also with an increase in age. The attributable risk for injurious falls that were exposed to medications was 28.1% if 80 years of age or older. Nine percent of the falls were fatal. The results with recent population estimates in this study showed that the use of benzodiazepines could be responsible for close to 20,000 falls with injuries for participants living in France, and for almost 1,800 deaths (Pariente et al., 2008).
The authors concluded that there is a significant association between the use of benzodiazepine and the number of injurious falls in the participants 80 years of age and older. New methods need to be found to limit the use of drugs, or prevent misuse due to the morbidity and mortality that is associated, as well as the increased risk of falls with significant injuries (Pariente et al., 2008).

Risk factors of falling in a very old population living at home remains poorly described. Inattiniemi, Jokelainen, and Luukinen (2009) studied the risk factors of falls among home-dwelling seniors aged 85 years or older. Risk factors of falling included: high age, being female, reduced lower extremity strength, history of falling, cognitive impairment, impaired vision, depressive symptoms, dizziness, peripheral sensory deficit, fear of falling, incontinence, high and low physical activity, use of an assistive device, malnutrition, high number of drugs, and chronic diseases.

The population included persons aged 85 years or more that were living at home or in sheltered housing in Oulu, Northern Finland. Persons living in institutional care were excluded from the study. There were 555 subjects who participated from the period of October 16, 2000 to March 26, 2001 (Iinattiniemi et al., 2009).

Baseline measurements were conducted through a postal questionnaire and clinical examinations made during home visits by geriatric nurses. The questionnaire gathered the following data: number of falls in the previous 12 months, self-rated health, disease history, change in mental agility during the past year, trouble with vision when moving, difficulty in urination, feelings of nervousness, anxiety, or fear, sleeping problems, and breathlessness during the previous 2 weeks (Iinattiniemi et al., 2009).
A standardized question that was taken from the classification of physical activity assessed the habitual physical activity and included seven alternative responses: mainly resting or minimal physical activity, most activities performed sitting down, light physical activity, moderate physical activity about 3 hours per week, moderate physical activity about 4 hours per week, or heavy physical activity greater than 4 hours per week, physical activity several times per week or heavy leisure-time working at least 3 hours per week, and competitive sports several times per week (Iinattiniemi et al., 2009).

The short version of the Geriatric Depression Scale assessed depression. Medications were recorded from data that was present at the home and characterized according to ATC Index. The Mini Mental State Examination test (MMSE) measured cognition, with poor cognition being defined as a score of 20 or less. Body mass index was calculated from weight versus height with values being categorized according to the WHO criteria. Standing balance, walking speed, and ability to rise from a chair were the three performance measures with a sum of all three scores being calculated according to Guralnik et al. Fall occurrences were monitored by telephone calls bimonthly. Incidence of falls was calculated from a negative binomial model (Iinattiniemi et al., 2009).

The results of the study were that 273 (49%) subjects did experience at least one fall and more received home care and had experienced recurrent falls in the past year. There were 512 total falls. The fallers scored less in the lower extremity performance test, used a higher number of drugs, were more depressed, had worsening mental agility, feelings of anxiety, nervousness, or fear, difficulty in urination during the last 2 weeks, had trouble with vision when moving, and used a psychotropic drug. The participants who had recurrent falls had a lower body mass index, poor self-rated health, worsening
mental agility, and sedentary physical activity. There were feelings of anxiety, nervousness, fear, difficulty with urination in last 2 weeks, depression, trouble with vision, use of an antipsychotic, hypnotic, or antidepressant drug, and higher number of used drugs associated with falls. A higher score of lower extremity function was negatively associated with falls (Inattiniemi et al., 2009).

The authors concluded that the results did not differ from findings presented in younger old populations. It may be important to study the relationship between future falls and previous falls by prospective studies on risk factors separately among subjects, with a history of falls and without. The quantity of drug prescriptions among elderly subjects also needs improvement. The conclusion was that older adults have a history of recurrent falling, trouble with vision when moving, use an antipsychotic drug, and have feelings of anxiety, nervousness, or fear, identified as independent risk factors for subsequent falls (Inattiniemi et al., 2009).

Health care providers and researchers who develop interventions for older adults that live in the community will benefit from knowing that there are differences in psychosocial functions depending on the place of residence. The purpose of Wert, Talkowski, Brach, and VanSwearingen’s (2010) study was to compare characteristics of older adults that live in senior living residences and independent community residences on walking, physical activity, fear of falling, and fall history.

The two settings were a senior living facility for independent older adults, and the Senior Mobility, and Aging Research Training Center at the University of Pittsburgh. There were 18 older adults that live in the senior living facility. The Senior Living Residence (SLR) group had a mean age of 83.9 years, with 83% being women. There
were 41 adults from the Smart Center that served as the Independent Community Residence (ICR) group who had a mean age of 77.5 years, with 61% being women. The criteria for inclusion were: 65 years of age or older, must be ambulatory with an assistive device that is not a straight cane, and walk without the assistance of another person. Individuals had difficulty with walking or balance as indicated by slowing of walking speed and variable gait. Criteria for exclusion were: individuals using oxygen, or who had dyspnea at rest; uncontrolled cardiovascular disease or an acute illness; a diagnosis of dementia or Mini Mental Status Questionnaire of less than 24; recent hospitalization for cardiac reasons or for greater than 3 days; hemiparesis with lower extremity strength less than 4 to 5; fixed or fused lower extremity joint or amputation; or a progressive motor disorder. The researchers collected demographic information that included: age, level of education, race, gender, number of comorbidities, and living arrangement (Wert et al., 2010).

The GaitMatII was used to measure gait speed and identified gait characteristics. An accelerometer was used to record physical activity. The accelerometer data has been validated in the laboratory to measure physical activity. The Survey of Activity and Fear of Falling in the Elderly was an instrument used to measure fear of falling and activity restriction in activities of daily living. The information was gathered by interview (Wert et al., 2010).

An activity subscale with a score range between 0-11 represents the number of activities individuals currently participate in. The SAFFE Fear Subscale and the question “are you afraid of falling” measured the fear of falling. The SAFFE Fear Subscale has a mean score of fear for the 11 activities ranging from 0 = not worried to 3 = very worried.
Higher fear scores were related to greater activity restriction, which was validated by Lachman et al. The Gait Efficacy Scale measured confidence in walking. Items were scored from 1 (no confidence) to 10 (complete confidence) (Wert et al., 2010).

The demographic findings were that adults in the Senior Living Residences were more likely to live alone, were older, and had more comorbidities. The similarities between the SLR and ICR groups were that participants were primarily white women, and had 4 or more years of college education. Physical measures showed that gait speed was similar between the SCR and ICR, and that all older adults walked slowly. SAFFE activity and physical activity were also similar in both groups. Twenty-two percent of adults in the SLR, and 54% of adults in the ICR had a fear of falling. There were less adults in the SLR group that reported falling in the last year. There were no confidence differences regarding walking. The authors concluded that older individuals generally have a fear of falling. The SLR environment is more supportive and with greater activity participation (Wert et al., 2010).

*Fall Prevention Programs*

The location of one third to one half of all falls or events in older persons occur in the home environment. Nikolaus and Bach (2003) focused on examining programs for home assessment and interventions for the effectiveness of reducing falls in community-living older persons who have a decline in functional mobility.

The study took place in Southern Germany in a University-affiliated geriatric hospital and in older patients’ homes. There were 360 subjects with a mean age of 81.5 years, and included 261 women. Inclusion criteria were met if the subjects lived at home before admission, had multiple chronic conditions or functional deterioration, and could
be discharged to home. Subjects were excluded if had a terminal illness, had a severe cognitive decline, or lived too far away from the home intervention team to make regular visits (Nikolaus & Bach, 2003).

Patients were assigned randomly to comprehensive geriatric assessment and post discharge follow-up home visits from an interdisciplinary home intervention team (HIT) or comprehensive geriatric assessment (CGA). Individuals were followed at home. During the hospital stay a CGA was implemented and activities of daily living were assessed using the Barthel Index that measures the ability to perform daily tasks. Instrumental activities of daily living were measured using the Lawton-Brody Questionnaire. Cognition and mood were measured using the Mini-Mental State Examination (MMSE) and the Geriatric Depression Scale (Nikolaus & Bach, 2003).

The subjects’ mobility was tested using the Oriented Mobility Assessment and the Timed Up and Go test. The Timed Test of Money Counting assessed vision, manual skills, and cognitive capacity. Subjects were also asked about falls during the previous year and about chronic diseases. After hospital discharge the participants had monthly contact by the team to obtain information on falls and the circumstance surrounding the fall and had a diary for recording falls and injuries. Home visits were made by the HIT to identify home hazards and to give advice and provide education (Nikolaus & Bach, 2003).

The CGA showed a functional limitation for all participants in mobility, but had good cognitive capabilities. There were 163 falls in the intervention group after 1 year, and 204 falls in the control group. There was a lower rate of falls (31%) during the trial for the intervention group. In studying the participants who had a history of frequent
falls, there was a 37% lower fall rate for the intervention group than for the control group. The proportion of frequent fallers, and the rate of falls, were significantly reduced for the intervention group. There were over 200 recommendations made for home modification. The most common recommendations were use of an elevated toilet seat, use of a rollator, and fixing grab bars in the bathroom with compliance rate ranging from 33.3% to 82.6% (Nikolaus & Bach, 2003).

Nikolaus and Bach (2003) concluded that the intervention did reduce reported falls in a group of frail older people in this study. Assessing the home for environmental hazards, providing information and education for changes, assisting with modifications in the home, and training in the use of technical and mobility aids was effected in a group of older adults that had a history of recurrent falls.

Instrumentation

Because balance is necessary in performing everyday activities in all people, balance impairment is a high risk factor for falling in the elderly. The Berg Balance Scale (BBS) was developed to measure functional balance in older people. Because balance is necessary in performing everyday activities in all people, balance impairment is a high risk factor for falling in the elderly. The purpose of the study by Muir, Berg, Chesworth, and Speechley (2008) was to examine the predictive validity of the BBS for three types of falls (any fall, multiple falls, or injurious falls) in community dwelling older people.

The study was carried out at the University of Western Ontario. Data on falls were collected during a fall prevention trial called “The Project to Prevent Falls in Veterans (PPF).” During phase one there were 1,192 questionnaires mailed out, with 210 respondents who received the comprehensive geriatric assessment at baseline. The mean
age was 79.4 years, and 65% were men. At the end of the 1 year follow up there were 187 participants who had completed information. Eighty sustained a fall, 33 sustained multiple falls, and 55 sustained an injurious fall (Muir et al., 2008).

The modified risk factors questionnaire addressed lower-extremity muscle weakness, use of four or more prescription medications, and balance, foot, and vision problems. The second phase of the study was a risk factor modification trial. Participants were divided into groups based on the number of risk factors reported. The use of mailed questionnaires has been reliable and valid for screening community dwelling older adults. The modifiable risk factors on the questionnaire were: lower-extremity muscle weakness, greater than four prescription medications, and balance, foot and vision problems. The interRAI CHA is a subset of the Minimum Data Set for Home Care, and validity and reliability has been reported. The comprehensive assessment is a modular assessment of relatively well people living in the community (Muir et al., 2008).

The Balance Berg Scale measures assessment and consisted of 14 tasks. The questionnaire is scored on a scale of 0-4 with a total possible score of 56, indicating no balance difficulties. The score of 0 is assigned if the participant cannot perform the task, and 4 when the task is performed independently. Daily fall information was collected for 1 year by the use of “fall calendars.” If the participant had a fall in a particular month, a phone call was made and an interview completed to obtain detailed information about the fall (Muir et al., 2008).

The results were that 58% of participants with BBS scores at or below 45 had a fall, and 39% of participants with a score above 45 had a fall. Eighty participants had one fall with a score less than or equal to 45, with 20 participants identified at an
increased risk for falling. Thirty-three participants had multiple falls with a score less than or equal to 45, with 14 participants identified at an increased risk of falling. Fifty-five participants had injurious falls with a score of less than or equal to 45, with 16 participants being identified at an increased risk of falling (Muir et al., 2008).

Participants in the three outcome groups had BBS scores ranging from 30-56 and were not definitive of fallers. When the ROC analysis was done, the BBS had good discriminative ability to predict multiple falls. The BBS, when used as a dichotomous scale with the threshold of less than or equal to 45, was not adequate in identifying the majority of people at risk for falling in the future. Fall risk did increase as scores increased using the BBS as a multilevel scale (Muir et al., 2008).

In the community sample used by Muir et al. (2008), the BBS was not adequate in predicting future fallers at the cutoff value of 45. Findings suggested that falls in older people are multifactorial, and that a dichotomous view of balance impairment alone will not quantify future risk. The findings were limited because the assessment of balance at variable times after falling did not establish an order of balance impairment and falling. The validity of using the BBS for multiple falls is more effective than other types of falls and eliminating the cutoff value of 45 will evaluate the risk across the whole range of scores in community dwelling elders.

Many falls result in deaths in people aged 75 years and older. Buatois, Perret-Guillaume, and Miget (2010) identified people at risk for having recurrent falls to assist in development of strategies for prevention of falls and rehabilitation. The purpose of the study was to: (a) develop and validate a clinical scale to stratify the risk of recurrent falls in a community-dwelling population who were healthy adults aged 65 years old, and (b)
to test the value of three commonly used balance clinical tests to predict the risk for recurrent falls.

The study took place at the Centre de Médecine Préventive (CMP) in Nancy, France that is linked to the French national health care system. The population-based study included 2,735 volunteers aged 65 years and older who were scheduled for a medical checkup between January 1, 2004 and June 30, 2005. There were 1,357 women and 1,378 men, with a mean age of 70.3 years. The participants were primarily community-dwelling, apparently healthy, and motivated (Buatois et al., 2010).

Data were collected on socio-demographic characteristics that included age, living status, weight, height, and physical activity during an interview. Participants were also asked questions regarding health history, falls in the previous year, alcohol consumption, and current pharmacological treatments with special attention to any psychotropic drugs (Buatois et al., 2010).

All participants had to complete the Mini-Mental State Examination. The participants had to perform the One Leg Balance (OLB) test, which tested the ability for the participant to remain upright on one leg for at least 5 seconds. The Timed Up and Go (TUG) was used to time the participants while rising from an armchair, walking 3m, turning, walking back, and sitting down again. The participants failed the TUG test if the duration was greater than 12 seconds. The Five Times Sit to Stand test (FTSS) was used to determine if the participants could stand up from a chair fives times as quickly as possible without pushing off with the threshold being 15 seconds and greater than 15 seconds was considered failing the test. The tests were valid and reliable. A follow up questionnaire was mailed to all participants in 2006 that included questions regarding
how many times the person had experienced a fall since the visit with the consequences and circumstances surrounding the fall (Buatois et al., 2010).

Buatois et al. (2010) found that older age, female gender, living alone, number of drugs used, use of psychotropic drugs, positive history of falls, and failure in the three clinical balance tests were more frequent among recurrent fallers. There were no differences in falls in terms of Mini-Mental State Examination scores or alcohol consumption. The OLB and TUG scores did not influence the percentage of recurrent falls. If the participants were moderate risk based on interview findings and preliminary test, and needed greater than 15 seconds to complete the FTSS there were twice as many recurrent falls compared with participants who performed the test in less than 15 seconds.

Buatois et al. (2010) confirmed that a history of falls in the previous year is a high predictor of recurrent falls, and that living alone is associated with recurrent falls. The authors concluded that results of the study may have a significant impact in the field of fall risk evaluation and that the FTSS could assist in fine-tuning the risk of recurrent falls for who are at moderate risk.

Summary of Findings

Incidence and Prevalence of Falls.

Examining the prevalence of falls and contributing factors in community dwelling adults 50 years and older was the purpose of Painter et al.’s (2009) study. Falls occurred in 61% of respondents and were significantly more frequent for participants who lived alone. The authors concluded that the general public needs education on fall prevention and fall risk factors.
The purpose of the study by Shumway-Cook et al. (2009) was to examine the incidence of falls, health care costs, associated factors, and provider responses among Medicare beneficiaries. Less than half of participants spoke with a health care provider about the fall. The authors concluded that the Medicare population needs consistent management and assessment of fall risk so that factors can be more properly managed to reduce health care costs and injuries related to falls.

*Fall Risk Factors.*

Investigating functional measures of balance mobility, balance self-efficacy, and falls incidence in a population of community-dwelling older adults was the purpose of Gunter et al.’s (2003) study. The authors found that only BSE scores were predictive of fall status. The authors concluded that improving function may improve balance self-efficacy and psychological health.

The purpose of Hatch et al.’s (2003) study was to: (a) examine the relationship between balance confidence, balance performance, and functional mobility and (b) to examine the extent that balance confidence can be explained by clinical measures of balance and functional mobility, as well as health-related, fall-related characteristics, and socio-demographic variables. The findings showed a strong correlation between ABC and BBS scores, between ABC scores and TUG scores, and between TUG and BBS scores. The authors concluded that there are balance impairments in people who have diminished confidence and this has important implications for developing rehabilitation programs for the elderly population.

The purpose of the study by Boulgarides et al. (2003) was to examine the data from five different balance tests: combined with data regarding fall history, number of
medications, dizziness, visual problems, use of an assistive device, sex, physical activity, and age. The authors concluded that due to the poor ability of fall prediction from the data obtained from the tools that were used, that new screening tools are needed for community-dwelling older adults that are active.

The purpose of the study by Leveille et al.’s (2008) study was to identify hazards for falling by assessing problems of pain, cerebral hypoperfusion, and foot disorders in the older population for future research studies. The results demonstrated that a population-based study that examines a novel set of risk factors is very feasible. The authors concluded that the project with the proposed set of risk factors will provide excellent information about falls that will advance the understanding of the causes of falls.

Pariente et al. (2008) examined the association between benzodiazepine use and the occurrence of falls with injuries in the elderly to estimate the impact on injurious falls. The results were that the use of benzodiazepines could be responsible for close to 20,000 falls with injuries for participants living in France, and for almost 1,800 deaths. The authors concluded that there is a significant association between the use of benzodiazepine use and the number of injurious falls in the participants 80 years of age and older.

The purpose of Innattiniemi et al.’s (2009) was to examine the risk factors of falls among home-dwelling seniors aged 85 years and older. The results of the study were that 49% of subjects did experience at least one fall. The fallers scored less in the lower extremity performance test, used a higher number of drugs, were more depressed, had worsening mental agility, feelings of anxiety, nervousness, or fear, difficulty in urination
during the last 2 weeks, had trouble with vision when moving, and used a psychotropic drug. The authors concluded that the results did not differ from findings presented in younger old populations.

The purpose of Wert et al.’s (2010) study was to compare characteristics of older adults that live in senior living residences and independent community residences on walking, physical activity, fear of falling, and fall history. The findings were that adults in the Senior Living Residences were more likely to live alone, were older, and had more comorbidities. The authors concluded that older individuals generally have a fear of falling.

**Fall Prevention Programs.**

The purpose of Nikolaus and Bach’s (2003) study was to focus on examining programs for home assessment and interventions for the effectiveness of reducing falls in community-living older persons who have a decline in functional mobility. The comprehensive geriatric assessment showed a functional limitation in all participants in mobility, but with good cognitive capabilities. There were over 200 recommendations made for home modification. The authors concluded that the intervention did reduce reported falls in a group of frail older people in the study.

**Instrumentation.**

The purpose of the study by Muir et al. (2008) was to examine the predictive validity of the Berg Balance Scale for three types of falls in community dwelling older people (any fall, multiple falls, or injurious falls). The results were that 58% of participants with BBS scores at or below 45 had a fall, and 39% of participants with a
score above 45 had a fall. The findings were limited because the assessment of balance at variable times after falling did not establish an order of balance impairment and falling.

The purpose of the study by Buatois et al.’s (2010) study was to: (a) develop and validate a clinical scale to stratify the risk of recurrent falls in community-dwelling population who were healthy adults aged 65 years old, and (b) to test the value of three commonly used balance clinical tests to predict the risk for recurrent falls. The study found that older age, female gender, living alone, number of drugs used, use of psychotropic drugs, positive history of falls, and failure in the three clinical balance tests were more frequent among recurrent fallers. The authors concluded that results of the study may have a significant impact in the field of fall risk evaluation and that the Five Times Sit to Stand test could assist in fine-tuning the risk of recurrent falls for who are at moderate risk.
Chapter III

Methodology

Introduction

Falls in the elderly population are the leading cause of death from injuries with more than one third of U.S. adults older than 65 years of age falling each year. The purpose of the study is to test a 12 month community-based intervention program on falls and fall risks in four groups of older adults, one group with group exercise 3 times per week, one group with fall prevention education, one group with a fall risk assessment, and a control group. This study is a replication of Shumway-Cook et al.’s (2007) study. This chapter includes information about the population, sample, procedure, measurements, methodology, and design used to guide this study.

Research Question

Are there differences in incidence of falls and risk factors in four groups of community-dwelling Elders based on treatment over time?

Population, Sample, and Setting

The population will be older adults age 65 years and older recruited from three local orthopedic clinics in Kokomo, Indiana. The three clinics see an average of 20 elderly patients each week in the office setting as a result of a fracture or injury from a fall. Many of the patients are scheduled for follow-up visits. The average number of new
falls seen each week in the elderly population for each clinic is five. In a 6 month period
the number of falls is approximately 90 in the three clinics. The anticipated sample for
participation in the study would be 45 patients, or 15 from each clinic.

Inclusion criteria are: age 65 years or older, community-dwelling, English
speaking, seen by the primary care physician within 3 years, ambulate independently,
willling to participate in group exercise classes for at least 6 months, have access to
transportation, minimal vision or hearing impairments, and no regular exercise within the
previous 3 months.

*Protection of Human Rights*

The study will be submitted for approval to the Institutional Review Boards of
Ball State University. Approval from three clinics will be secured. Each agency will be
presented with the study for approval prior to volunteering to participate. Voluntary
participation along with the right to refuse any part of the study will be explained to the
clinic physicians. Each participant will receive a letter with full disclosure of the study.
Each participant will receive a packet with an explanation of the study, the study tools
and consent form. The researchers will meet with clients at the three clinics to explain
the risks and benefits of the study. All data will be anonymous and only group data will
be used to report findings.

*Procedure*

After receiving the approval from the IRB, the research project will be introduced
to, and approved by clinic managers and physicians that are working in the three
orthopedic clinics in Kokomo, Indiana. The fall risk assessment will be mailed to the
physician with a copy of the Guidelines for the Prevention of Falls in Older Persons. The
patients will be contacted after checking the schedules at the offices to see when follow-up appointments have been scheduled. The participants that are included will be seen in the clinic to complete an initial questionnaire. The study will take place in physicians’ offices where all follow up appointments and testing will be completed by the researcher. Patients will be approached by the researcher after the visit.

Data Collection

A medical health history questionnaire will determine whether or not the person can participate. The results will determine group assignment. There will be four groups with three different treatments and a control group. The participants will be assigned to a group based on last name and by using alphabetical order due to not having a pre-selection process. Falls will be identified as coming to rest unintentionally on the ground or lower level.

Intervention

The multifaceted intervention, or control group will participate in group exercise classes for 1 hour three times per week for up to 12 months and participate in 6 hours of fall prevention group education classes. The intervention education will be six 1 hour classes presented one time per month and will include: fall risk and prevention, exercising after illness or injury, home safety, medication safety, footwear and use of gait devices, and strategies for exercise adherence. Study participants will be required to pass the Pfeiffer Short Portable Mental Status Questionnaire with fewer than five errors and complete a 10-foot Timed Up and Go Test in less than 30 seconds.
Instrumentation, reliability and validity

The Health History will have 20 questions that include: history of falls in the last 3 months, history of falls-related injuries in the last 3 months, fear of falling or activity self-restriction due to fear of falls, comorbid conditions, polypharmacy, use of an assistive device for walking, alcohol use of more than one drink daily, sensory impairment, impaired balance and gait, lower extremity weakness, and reduced participation in physical activity. The outcomes will be measured by the rate of falls using a 12-month calendar and self-reported data.

At the end of 1 year, a physical therapist will test leg strength with the Repeated Chair Stand Test, Berg Balance Test, and Timed Up and Go Test. The three tests for leg strength proved to be valid and reliable in other studies (Shumway-Cook et al., 2007).

Design

This will be a Quasi-Experimental design with three treatment groups and control group. A Quasi-Experimental design involves selecting groups, upon which a variable is tested, without any random pre-selection process. Group assignment is made without a random pre-selection process. Comparisons between the treatment and non-treatment conditions are made with same subjects prior to treatment (Burns & Grove, 2009).

Data Analysis

In this study a distribution free Monte Carlo method for analysis of fall incidence will be used. The fall incidence rate is the number of falls divided by the total follow-up time. For the analysis of leg strength, balance, and mobility there will be an estimated mean difference and CI values using a linear mixed model adjusted for baseline scores. The falls will be examined by instrumental variables analysis to compare fall incidence
rates among participants in the intervention arm who attended at least 2/3 of the exercise classes. The baseline characteristics from the intervention and control group will be examined using the chi-square test. For leg strength, balance, and mobility there will be continuous scores. There will be estimated mean differences and adjusted baseline scores. Incidence ratios will be calculated for the number of falls. This study will replicate a previous study by Shumway-Cook et al. (2007) to attempt to improve balance, mobility, and validate previous findings in attempt to implement a community-based falls prevention program.

Summary

The study will take place in order to evaluate the possibility and effectiveness of a community-based falls prevention program in Kokomo, Indiana. The study will need to ensure that the data is complete, there are few dropouts, compliance is good, and participation is strong in the group exercise and education classes. The findings will assist in understanding if there are differences in fall risk factors and incidence of falls in the population being studied. Study results will hopefully assist local physician offices in providing more education and fall risk information to this population to assist in prevention and management of falls.
References


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