



Evaluating the effectiveness of a home-based multifactorial fall prevention program for
community-dwelling older adults
by Shawna Marie Yates

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in
Health and Human Development
Montana State University
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Abstract:

Falls are a serious public health concern for older adults, with nearly 30 percent of adults over the age of 65 falling each year. Previous research has shown falls to be related to the number of fall-related risk factors. A number of investigations have been conducted to reduce the risk of falls in seniors. However, no published studies have investigated a multifactorial fall prevention program, targeting enhanced physical activity, proper nutrition, and environmental hazards education. Therefore, the purpose of this study was to determine if a home-based multifactor fall prevention program reduces select fall-related risks in a sample of rural dwelling seniors in southwest Montana. The researcher hypothesized that an intervention program targeting enhanced physical activity, proper nutrition, and environmental hazard education would positively change select fall-related risk factors: balance, upper body flexibility, ankle flexibility, bicep endurance, lower extremity power, mobility, environmental hazards, depression, falls efficacy, nutritious behavior, and nutritious locus of control.

A randomized, controlled 10 week intervention study was conducted on 37 subjects. Paired t-tests were done to determine mean change scores within groups for each dependent variable. Unpaired t-tests were run to determine mean difference between groups. Last, simple regression models were used to determine if group designation predicted change in outcome variables.

The analysis revealed statistically significant changes for the intervention group on balance, arm strength, leg strength, reduction of environmental hazards, and reducing the total number of fall-related risk factors in each of the statistical tests: t-test within group, t-test between group, and simple regression. The intervention was found to be predictive of changes in balance ($R^2=35.4\%$), bicep endurance ($R^2=29.6\%$), mobility ($R^2=9.1\%$), lower extremity power ($R^2=22.9\%$), nutritious behavior ($R^2=14.0\%$), and number of environmental hazards ($R^2=19.6\%$). Most importantly, the intervention explained almost half of the variance in the number of total fall-related risks ($R^2=47.4\%$).

In conclusion, the fall prevention intervention consisting of exercise programming, nutrition counseling, and environmental hazards education reduced six of the eleven fall-related risk factors evaluated.

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MONTANA STATE UNIVERSITY-BOZEMAN
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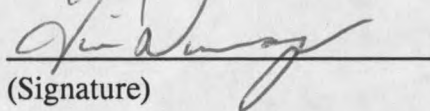
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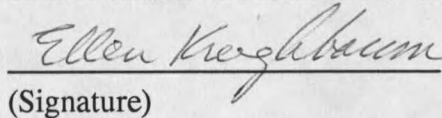
Timothy A. Dunnagan, EdD
Chairperson, Graduate Committee


(Signature)

11/11/99
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Approved for the Department of Health and Human Development

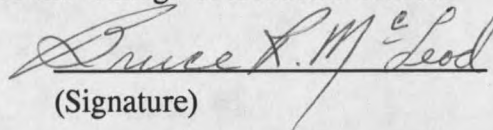
Ellen Kreighbaum, PhD
Department Head


(Signature)

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VITA

Shawna Marie Yates, daughter of Michael and Terrie Button, was born in Butte, Montana, on November 16, 1973. She attended public schools all over Montana, and graduated from Plains High School, in Plains, MT in 1992.

Ms. Yates graduated from Montana State University-Bozeman in 1996 with a B.S. in Sociology and an emphasis in Bio-Chemistry. She was also a graduate of the University Honors Program.

Ms. Yates entered graduate school at Montana State University-Bozeman in September, 1996, as a student in the Health, Exercise and Wellness option in the Department of Health and Human Development. She received her Master of Science degree in January, 1999.

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ABSTRACT

Falls are a serious public health concern for older adults, with nearly 30 percent of adults over the age of 65 falling each year. Previous research has shown falls to be related to the number of fall-related risk factors. A number of investigations have been conducted to reduce the risk of falls in seniors. However, no published studies have investigated a multifactorial fall prevention program, targeting enhanced physical activity, proper nutrition, and environmental hazards education. Therefore, the purpose of this study was to determine if a home-based multifactor fall prevention program reduces select fall-related risks in a sample of rural dwelling seniors in southwest Montana. The researcher hypothesized that an intervention program targeting enhanced physical activity, proper nutrition, and environmental hazard education would positively change select fall-related risk factors: balance, upper body flexibility, ankle flexibility, bicep endurance, lower extremity power, mobility, environmental hazards, depression, falls efficacy, nutritious behavior, and nutritious locus of control.

A randomized, controlled 10 week intervention study was conducted on 37 subjects. Paired t-tests were done to determine mean change scores within groups for each dependent variable. Unpaired t-tests were run to determine mean difference between groups. Last, simple regression models were used to determine if group designation predicted change in outcome variables.

The analysis revealed statistically significant changes for the intervention group on balance, arm strength, leg strength, reduction of environmental hazards, and reducing the total number of fall-related risk factors in each of the statistical tests: t-test within group, t-test between group, and simple regression. The intervention was found to be predictive of changes in balance ($R^2=35.4\%$), bicep endurance ($R^2=29.6\%$), mobility ($R^2=9.1\%$), lower extremity power ($R^2=22.9\%$), nutritious behavior ($R^2=14.0\%$), and number of environmental hazards ($R^2=19.6\%$). Most importantly, the intervention explained almost half of the variance in the number of total fall-related risks ($R^2=47.4\%$).

In conclusion, the fall prevention intervention consisting of exercise programming, nutrition counseling, and environmental hazards education reduced six of the eleven fall-related risk factors evaluated.

CHAPTER 1

INTRODUCTION

Humans are unique in their bipedal strategy for locomotion. Our complex postural control system helps us to walk upright and maintain balance in many challenging situations. However, problems can and do occur with this system. Our balance and gait can become disrupted. As one ages, the complex postural control system is often compromised, making it more and more difficult to avoid falls. Approximately 30 percent of the non-institutionalized people over the age of 65 fall each year (Sattin, Lambert Huber, & DeVito, 1990; Tinetti, Speechley, & Ginter, 1988). One-third of those who fall suffer moderate to severe injuries (Alexander, Rivara, & Wolf, 1992). Nearly 200,000 Americans fracture their hips each year, usually as a result of a fall (Wylie, 1977). The National Safety Council (1993) has cited death due to unintentional injury, such as falls, as the sixth leading cause of mortality among those 65 and older. Consequently, falls have serious repercussions for older adults due to their frequency and the morbidity associated with them.

Medical attention is often needed for fall-related injuries. A study done by Kiel, O'Sullivan, Teno, & Mor (1991) found a greater use of the health care system by those older adults who had fallen. Falls impinge on the economics of the health care system and the victims of falls. Urton (1991) reported that between \$75 and \$100 billion are

associated directly or indirectly with the cost of falls each year. Other costs include physical suffering, mental anguish, days in the hospital, transfers to extended care facilities and loss of an independent lifestyle.

Once an older person falls, a downward spiral often begins. They may live in constant fear, become less active, less independent, and less confident. One of the most common fears among the elderly is the "fear of falling" (Redford, 1991). Fear may result in tremendous impact on quality of life and physical decline (Walker & Howland, 1991).

This health concern is continually growing because America's population is aging. Due to the baby-boom during the middle third of this century, the age group over 65 is the fastest growing segment of society. Today there are 31 million people over the age of 65, comprising 12% of the U.S. population. By the year 2040, there will be a projected 66.6 million people over the age of 65 in the United States (Gelman, et al., 1985).

Significance of the Study

There is broad public consensus about the importance and need for fall prevention programming. The United States Public Health Service (1990) has joined in the campaign to prevent seniors from falling. In the Healthy People 2000: National Health Promotion and Disease Prevention Objectives, the policy makers have outlined a plan to reduce falls by the year 2000 (Kennedy & Coppard, 1987). Some of these objectives includes:

- reduce hospitalization for hip fractures in women over 85 years by 20%
- reduce mortality rate from falls in the 65-84 age group from 18 to 14.4 per 100,000

- reduce mortality rate from falls in the 85+ age group from 131 to 105 per 100,000

In order to reduce the consequences of falls for both the individual and society, it is imperative that preventive steps be taken to reduce the risk of falling for older adults. Studies have shown that incidence of falls is related to the number of fall-related risk factors (Cutson, 1994; Tinetti, et al., 1988). Reducing just one fall-related risk factor can have a great impact on the frequency and morbidity of falls. Reducing the incidence of falls among older adults will help reduce high health care costs for the individuals, their families, and the United States taxpayers. Most importantly, by reducing the falls suffered by older adults, their quality of life can be improved. They can become empowered to continue living an active and independent lifestyle.

The following fall prevention program is designed to inform and empower older adults about fall-related risk factors. It provides seniors with tools to begin an in-home exercise program, assess their nutritional health, and make changes to environmental hazards. The program is designed to motivate and educate the older adult about their role in fall prevention; and to reduce their overall risk of falling.

Statement of the Problem

The purpose of this study is to determine if a home-based multifactor fall prevention program reduces select fall-related risks in a sample of older adults from rural Montana communities.

Research Hypothesis

A home-based multifactor fall prevention program, targeting enhanced physical activity, proper nutrition, and environmental hazards education will positively change select fall-related risk factors in a sample of older adults.

Definition of Terms

For purposes of this study the following definitions will be observed:

Fall	will be defined as "an event which results in a person coming to rest inadvertently on the ground or other lower level and other than as a consequence of the following: sustaining a violent blow; loss of consciousness; sudden onset of paralysis, as in a stroke; or an epileptic seizure" (Kennedy & Coppard, 1987).
Older adults	will be defined as those persons over the age of sixty-five.
Multifactor	will be defined as targeting more than two fall-related risk factors. Multiple risk factors will be observed.
Community-dwelling	will be defined as those persons independently living in their own homes or apartments, but not those in nursing or assisted-living facilities.
Rural	The Office of Management and Budget definition includes any county with less than 100,000 people and no cities with more than 50,000 people (Office of Management and Budget, 1983). Montana has only two counties that qualify as urban (Metropolitan Statistical Areas): Cascade and Yellowstone. The remaining 54 counties are considered to have rural populations.

Limitations

- 1.) The study was limited by the self-reported nature of the data. This posits a limitation in that there can be under-reporting and over-reporting of health characteristics and falls.
- 2.) Results of this study are only generalizable to populations similar to Gallatin County, Montana.
- 3.) Recruiting subjects was difficult, thus the sample size ($N = 37$) was small.
- 4.) The researcher, who conducted all aspects of the study, may have introduced bias through diverse interactions with the subjects.

Delimitations

- 1.) Data was limited to the survey questions and statements used in the investigation (See Appendix E).
- 2.) Physical measures were limited to the fitness tests for upper body bicep endurance, shoulder and ankle flexibility, gait speed, balance, and lower body power.
- 3.) Psychometric measures were limited to a depression scale, a falls efficacy scale, locus of control for nutrition, and nutritious behavior scale.
- 4.) Information on background characteristics was limited to age, gender, marital status, living arrangement and education.
- 5.) Information on self-rated health characteristics was limited to vision, hearing, alcohol use, tobacco use, sedative use, high blood pressure, hospitalization in the last year, physical activity, foot problems, and the average number of prescription medications.

Assumptions

The investigator assumes the subjects were truthful and accurate on all information

reported throughout the study. The number of fall-related risk factors were presumed to increase a persons chances of falling, therefore a decrease in the number of risk-factors will decrease a person's risk of falling.

CHAPTER 2

REVIEW OF LITERATURE

For older people any loss of functional capacity can increase the risk of losing independence. This risk, coupled with the tendency to become more sedentary with age, leads to a population with much to lose- and much to gain.

(The United States Public Health Service, 1992)

Falls for older adults can be caused by any number of fall-related risk factors.

Many of the risk factors are considered as a natural part of aging, however, many adults are learning that physical activity over the length of the life-span can prevent many of the risk factors associated with falling. This chapter will review; 1) conceptual models surrounding falls and fall prevention, 2) select fall-related risk factors, and 3) previous fall reduction research conducted on senior populations.

Conceptual Models

For the past 40 years, researchers and physicians have been struggling to find an efficacious fall prevention model for the elderly. To this end, a number of conceptual models have been developed. The first is called the single cause model. The single cause model was developed on the intuition that a person's fall is based upon a single cause, such as a dangerously placed throw rug. However, the risk is typically multi-dimensional.

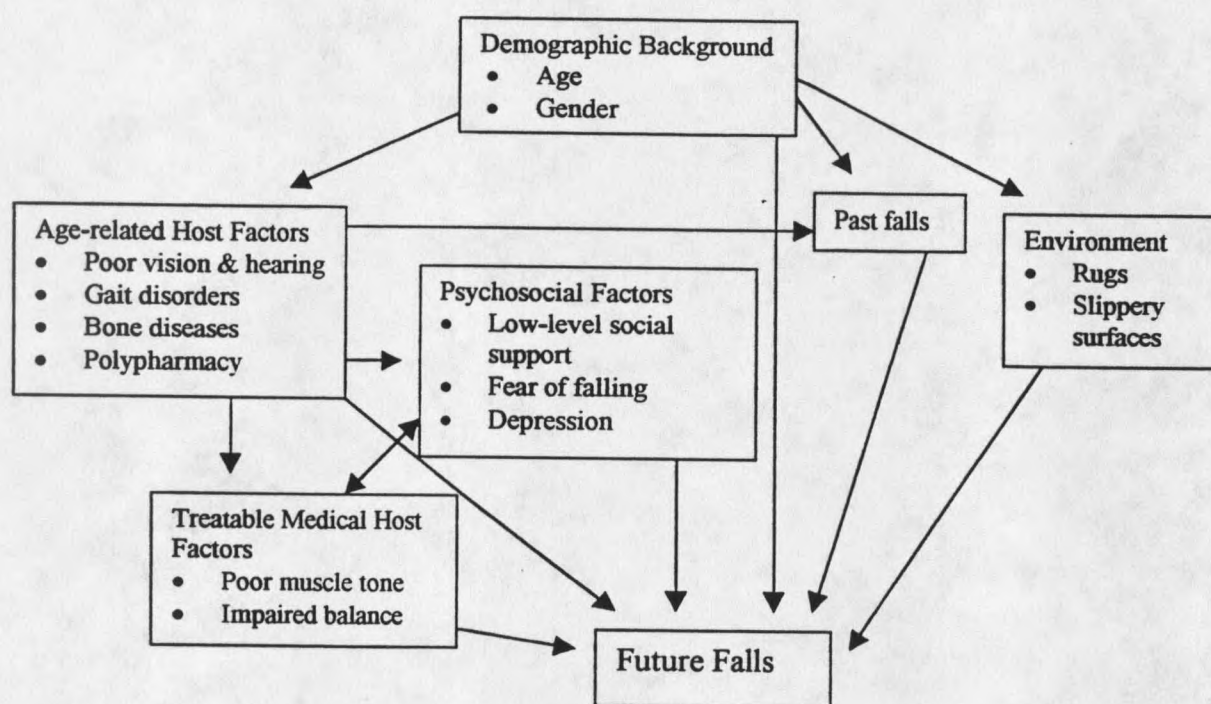
and may include problems with vision, strength, and balance; but the only cited cause for the fall was the rug. Therefore, Buchner (1997b) concluded that the single cause model did not adequately address the complexities associated with a comprehensive fall prevention program.

A more appropriate model for understanding falls is called the host-agent-environmental model, which is based upon injury control research (Fabrega, 1975). Hogue (1984) described this model in the institutional setting and called it the ecological model. He emphasized the interaction between the older person and the environment is divided into two phases. The first phase is the pre-injury phase and includes the risk factors associated with a fall. The second phase is the injury phase and includes risk factors for an injury. Conceptually, the phases provide a two step pathway that requires a host and environmental risk factor for a fall (poor balance & slippery surface) and a second set of risk factors for injury (weak bones & falling on a hard surface). The ecological model also takes into account that older persons are influenced by experiences of other older adults and attitudes expressed by health care professionals. For example, the knowledge of someone falling will dictate how one copes with the future possibility of falling. Based upon the ecological model a fall prevention plan must incorporate current beliefs about falls and treatment of an array of host-environment risk factors.

Because falls are associated with a heterogeneous group of events with complex causal pathways, investigators have also viewed fall prevention from a social epidemiological model (Cwikel & Fried, 1992). This model (Figure 1) incorporates many causal pathways that are associated with falls. For example, the model shows that past

falls alone can be an indication of future falls. Also, it incorporates the notion that age, gender, physical decline, depression and environment may all be related to future falls. Consequently, this model seems to be the most comprehensive approach to date and a logical framework to use in the development of fall prevention programming.

Figure 1: Schematic of social epidemiological model.

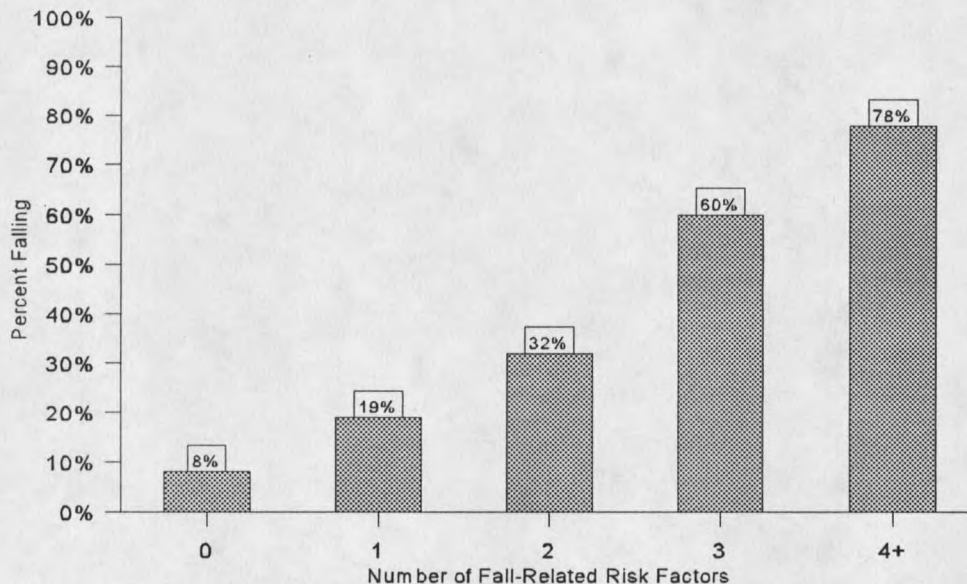


Review of Fall-Related Risk Factors

A number of studies have been conducted to identify fall-related risk factors (Clark, Jackson, & Cohen, 1996; Cutson, 1994; Dunne, Bergman, Rogers, Inglin, & Rivara, 1993; Hindmarsh & Estes, 1989; Nevitt, Cummings, & Hudes, 1991; Sudarsky, 1990; Tinetti, et al., 1988; and Tinetti, McAvay, & Claus, 1996). Tinetti et al. (1988)

found the risk of falling increased linearly with the number of risk factors, from 8 percent with no risk factors to 78 percent with four or more risk factors (Figure 2). In order to study the risk factors associated with falling, the researchers conducted a one-year prospective study using 336 persons 75 years and older who were living in the community. The risk factors studied included sedative use, cognitive impairment, lower-extremity disability, palmomental reflex, foot problems, and balance-and-gait abnormalities. It was concluded that a simple clinical assessment can identify those who are at a greater risk of falling and interventions targeting these risk factors can help reduce a person's risk of falling.

Figure 2: Occurrence of Falls According to the Number of Fall-Related Risk Factors



Based upon the results of a variety of studies, a number of modifiable risk factors have been identified (Figure 3). Because these fall-related factors are the areas that are

typically addressed in fall prevention programming, a review of each factor is provided.

Figure 3: Fall-related Risk Factors with Select Examples.

- | | |
|---|-----------------------------|
| • | Lack of Physical Activity |
| | ▸ Impaired balance |
| | ▸ Muscle weakness |
| | ▸ Reduced mobility |
| | ▸ Reduced flexibility |
| • | Environmental Hazards |
| | ▸ Improper footwear |
| • | Impaired vision and hearing |
| • | Polypharmacy |
| | ▸ Psychoactive medications |
| • | Orthostatic Hypotension |
| • | Fear of Falling |
| • | Depression |
| • | Lack of Social Support |

Lack of Physical Activity

Lack of physical activity creates a number of added difficulties for an aging person. For example, sedentary lifestyles can result in poor muscle strength, decreased bone mass, gait/balance disorders, and reduced flexibility (Sudarsky, 1990). All of these factors increase one's risk of falling, but can be modified with a regular exercise program (Campbell, Borrie, & Spears, 1989).

Exercise is considered the most effective behavioral and physical intervention plan for falls (Crilly, Williams, & Trenholm, 1989). Exercise programs that consist of strength training, balance activities, and flexibility development can quickly improve physical health. Weight-bearing activities have dramatic effects on muscle tone and strength even

in person's over the age of 65 (Fiatarone, Marks, Ryan, Meredith, Lipsitz, & Evans, 1990). Furthermore, exercise can improve an older person's body mechanics, which will help in making adjustments and enabling seniors to more effectively address environmental hazards. In short, exercise has been shown to be effective at reducing a variety of fall-related risk factors.

Environmental Hazards

Environmental hazards have been implicated in at least a third of the falls among older adults (AARP, 1993). For example, an older person may be sitting in an unstable chair, which is a common environmental hazard for the elderly. Consequently, whenever he/she tries to rise from the chair he/she is at risk for falling, because the chair may collapse or move just enough for the person to lose balance and fall. The ubiquitous problem of environmental hazards is significant because these hazards are found in every home. Fortunately, these factors are the easiest to modify (Cutson, 1994). They can be as apparent as a loose throw rug or as subtle as the height of a toilet seat. If one is made aware of the enormous risks within the home, steps can be taken to prevent falls from environmental hazards.

An important environmental hazard that needs to be considered is the footwear of most older adults. Inappropriate footwear has been cited as a contributory factor in home falls (Tinetti, Speechley, & Ginter, 1988). There is a complex interplay between footwear, walking, and balance. Shoes with slick surfaces, high heels, or thick soles can cause problems with proprioception in the foot and stability (AARP, 1990). Therefore, older

adults should be encouraged to wear sturdy shoes with laces and a non-skid sole (Dunne, et al., 1993).

Impaired Vision and Hearing

Sensory changes in vision and auditory abilities play a risk in falls. Thirty percent of older adults have significant hearing loss (Gray-Vickery, 1984). Hearing loss can place people at risk when out in public and within the home. For example, they may not hear the smoke detector sounding due to a fire. No warning will make it difficult for an older person to get to safety before the fire becomes life-threatening. Many instances, such as the smoke detector example, require quick reactions and may cause an older person to be frightened and hurried, which may result in a fall. It is recommended that older persons have their hearing checked yearly and wear hearing aids if their hearing is poor.

The association between vision and fall risk has been widely reported (Cohn & Lashley, 1985; Lord, Clark, & Webster, 1991; Tinetti, Williams, & Mayewski, 1986b). Impaired vision can disrupt one's depth perception and visual field (Clark, Jackson, & Cohen, 1996). Both may aid in slowing down a person's reaction time and judgement of environmental hazards (Kane, Ouslander, & Abrass, 1984). Moreover, this is important because, with aging, older persons increasingly use visual information compared with their use of other sensory inputs for controlling stability (Straube, Botzel, Hawken, Paulus, & Brandt, 1988). It is recommended that older adults have their vision screened yearly and use glasses with the correct prescription. Older adults may also use walking sticks and reflective tape on stairs to help with their environment.

Psychoactive Medications

The use of psychoactive medication also puts an older person at risk for falling. Psychoactive medications are sedatives, antidepressants, hypnotics and antipsychotics. Seventy-five percent of women over the age of 65 are taking at least one medication that fits in this category (AARP, 1993). Medications such as long-acting benzodiazepines and neuroleptics have been associated with increased hip fractures (Ray, Griffin, & Downey, 1989). These drugs can reduce mental alertness, worsen gait, and decrease systolic blood pressure (AARP, 1993). Seniors can be instructed to talk with their physician about the dangerous side-effects associated with these drugs and should reveal all medications (prescription and over-the-counter) they are currently using. Clear communication is important because many medications when taken together can have detrimental side effects, which are often associated with falling.

Orthostatic Hypotension

Orthostatic hypotension is one of the many physical disorders associated with falling. Orthostatic hypotension can be defined as a fall in blood pressure occurring upon standing. Common outcomes related to the blood pressure decrease include dizziness, blurred vision, and faintness. This condition is typically associated with malnutrition, certain medications (antihypertensives, neuroleptics and antiparkinsonian agents), or having poor vascular tone (Chipman, 1981; Gray, 1997). Older adults should be informed about the possible side-effects of the medications they are taking and be encouraged to

discuss this with their physicians. Focus on adequate nutrition can also be an important intervention for seniors. For example, re-hydrating can help the vertigo associated with orthostatic hypotension. Finally, regular exercise can enhance vascular tone. Typically, these types of interventions can be used to effectively address the senior's problems with orthostatic hypotension.

Fear of Falling

Up to 50 percent of those who have fallen admit to avoiding many activities for fear they will fall and injure themselves (Tideiksaar, 1996; Tinetti, Mendes de Leon, Doucette, & Baker, 1994a). Fear of falling can be viewed as a psychosocial risk factor of falls, and as a psychosocial outcome or consequence. Once older adults become fearful of falling, they may limit their mobility and restrict their activities. This behavior isolates older adults and reduces their independence. The fear of falling may also be associated with other fall-related risks. For example, once a person becomes fearful of falling and limits their activities, they are more likely to decrease physical activity and become weak (Arfken, Lach, Birge, & Miller, 1994). Exercise and modifying the home environment are possible interventions for seniors who are fearful of falling. Exercise can help seniors become stronger and more mobile, which will improve their confidence in performing the basic activities of daily living. Improving the safety of the home environment can also help seniors to feel more confident when maneuvering around their homes. Tinetti, et al. (1994a) found direct association between improved confidence and a decreased fear of falling.

Depression

According to Prudham and Evans (1981) falling is associated with depression. Clinical depression is a multifaceted disorder, characterized by affective distress, behavioral difficulties, and cognitive complaints (Teri, 1997). Depression is similar to fear of falling in that it may be a psychosocial risk factor of falls, and a psychosocial outcome or consequence. Among older adults depression may be an early sign of physical disease, a result of medication side-effects, lack of social network and/or any number of other causes. In relation to falls, depression must first and foremost be diagnosed by a trained health professional. Exercise has been shown to have a positive effect on depression by releasing endorphins that help one to feel better. Also positive social support can help people feel less lonely and blue. Older adults may begin an exercise program and increase social interaction to initiate treatment of depressive symptoms.

History of Fall Prevention

Seven intervention strategies for reducing falls among community-dwelling older adults have been reviewed: Urton (1991); Reinsch, MacRae, Lachenbruch, & Tobis, (1992); Tinetti, et al. (1994b); Cutson (1994); Lord, Ward, Williams, & Strudwick, (1995); Ryan & Spellbring (1996), and Buchner, et al., (1997a). The studies will be reviewed in relation to the conceptual framework explained earlier.

Single Cause Model

Urton (1991) developed a community-based home inspection program to reduce

the prevalence rate of injuries due to falls by eliminating environmental hazards. The program involved an inspection team to identify hazards and college students and other community volunteers to rectify the hazards with donations that were given by area merchants. Urton proposed this program as a public health approach to reducing falls. It is based upon the single cause model because it targets only environmental hazards. This proposed intervention was not implemented and therefore only provides an example of a possible strategy for fall prevention programming based upon the single cause model.

Host-Agent-Environmental Model

Cutson (1994) recommended that education of fall-related risk factors and environmental manipulations may be the only interventions necessary for fall prevention. This proposal suggests an in-home evaluation to be done by a physician or a physical therapist. The evaluation includes a history of falls, physical exam, review of medications, and functional testing. Once fall-related risks have been identified, the researcher suggested interventions to help maintain a person's functional abilities. For example, if an older adult is having difficulty rising from a chair, the physician or therapist would suggest physical therapy, pain control, or assistive devices (Cutson, 1994). Cutson's proposal is helpful in identifying fall-related risk factors, but does not offer a comprehensive approach to risk reduction programming.

Social Epidemiological Model

The remaining four intervention studies target a wide variety of the fall-related risk factors. They coincide with the idea that falls occur because of a complex causal pathway.

In a pilot study conducted by Ryan and Spellbring (1996), an education intervention on fall-related risk factors was conducted. The incidence of falls and number of fall-related risk factor changes were measured. Forty-five women from two (one urban, one rural) senior meal sites were recruited. Subjects were randomized to three groups: one group received fall prevention education, one group received individual fall prevention education by a nurse, and a control group received health promotion presentations. The fall prevention interventions and the health promotion presentations consisted of three one-hour sessions.

Outcome measures included the number of fall-related risk factor changes, the type of fall prevention changes, and the number of falls. The greatest number of fall prevention changes was seen in the fall prevention group format. Among the women receiving the fall prevention intervention seventy-three percent made at least one fall prevention change in either their personal behavior or living environment. The most common change (61%) was personal/no cost changes, such as avoiding the use of bath oils, avoid walking in stocking feet, or increasing their physical activity. The control group experienced more falls and fall-related injuries than either of the two intervention groups. However, it is difficult to say if fall prevention education programming reduces the frequency of falls because of the small sample size. The results of this study suggest fall prevention programming targeting education does reduce the number of fall-related risk factors in a sample of older women.

Reinsch et al. (1992) studied the effectiveness of exercise and cognitive-behavioral programs in reducing falls and injuries among 230 older adults over a one-year period.

The subjects were recruited from 16 senior centers. The centers were randomly assigned to one of four treatment groups (exercise, cognitive-behavioral, exercise-cognitive, and discussion control). The low-intensity exercise program was designed to improve balance and strength. The class met for one hour, three days a week. The cognitive-behavioral intervention used hour long classes on a weekly basis to address fall-related health and safety issues. The exercise-cognitive class followed the cognitive-behavioral protocol one day per week and the exercise protocol two days per week. The discussion control group met once a week and reviewed health topics not specifically related to falls.

Outcome measures included monitoring falls, injuries, perceived health, fear of falling, lower extremity muscular strength, and balance. Results revealed that the interventions were not successful in achieving a reduction in falls by improving lower extremity muscular strength and balance, or by improving awareness of environmental hazards and medically related risk factors. This study found low-intensity exercise and cognitive education of fall-related risk factors as ineffective interventions for fall prevention programming.

Similarly, Lord et al. (1995) conducted a randomized, controlled trial of exercise programming in a sample of 200 older women who were recruited from the community. The researchers hypothesized exercise to have beneficial effects on muscular strength, neuromuscular control, reaction time, body sway, and reducing fall frequency. The subjects participated in exercise classes, through an existing community-based program. The exercise program focused on conditioning and stretching. Hourly exercise sessions were offered two times a week for 10 to 12 week terms throughout a one year period.

The findings of this controlled trial revealed significant improvement in measures of lower limb strength, reaction time, neuromuscular control, and three of the four body sway measures. There was no significant difference in the proportion of fallers between exercise and control groups. However, fall frequency was related to exercise adherence, with those who attended seventy-five percent or more of the exercise classes had the lowest fall rate. Implications reveal exercise programming as an effective tool for reducing many fall-related risk factors among older adults.

A more recent study conducted by Buchner et al. (1997a) looked at an intervention of strength and endurance training to modify risk factors for falls. The study was a randomized, controlled trial of 105 older adults selected from a health maintenance organization. The subjects were randomized into one of three exercise groups or a control group. The groups included 1) the 6-month endurance training group (ET), which involved 30-35 minutes of aerobic activity three times per week, 2) the 6-month strength training group (ST), which involved 2 sets of 10 repetitions on 10 weight machines three times per week, 3) the 6-month strength training and endurance training group (ET+ST), which involved 20 minutes of endurance training and one set of the 10 strength training exercises three times per week, and 4) a control group. The classes ran for six months.

Outcome measures included strength, aerobic capacity, balance, gait, self-reported falls, and physical health status. Findings showed no effect of exercise on gait, balance, or physical health status for all three of the intervention groups. Strength improved for the ST and the ET+ST groups. Aerobic capacity increased for the ET and the ET+ST groups. All exercise groups displayed a significantly beneficial effect of exercise on time

to the first fall using the cox regression analysis (relative hazard=0.53). This study suggests that exercise by itself affects risk of falling.

Finally, a controlled study conducted by Tinetti et al. (1993 & 1994b) looked at the effectiveness of a multifactorial intervention in reducing the risk of falls among 301 community-dwelling older adults. The intervention subjects were given either an adjustment in their medications, behavioral instruction and/or exercise programming designed to modify their specific risks. Behavioral instruction included education on postural hypotension, sedative drugs, grab bars, etc. The exercise program involved graded levels of difficulty for strength and balance training. For example, the strengthening exercises increased in level of difficulty by advancing resistance of the Therabands used. Prescription for the exercise programs was twice a day for 20 minutes.

The primary outcome measure was incidence of falls. During a one year follow-up, fewer seniors in the intervention group (35%) fell, when compared to the control group (40%) ($p=0.04$). Among the subjects who had a particular risk factor at baseline, a smaller percentage of those in the intervention group than those in the control group still had the risk at reassessment, as follows: greater than 4 prescription medications, 63% versus 86% ($p=.009$); balance impairment, 21% versus 46% ($p=.001$); impairment in toilet-transfer skills, 49% versus 65% ($p=.05$); and gait impairment, 45% versus 62% ($p=.07$). Risk factor modification may explain the reduction in the number of falls. The results demonstrate the need for targeting multiple risk factors in the implementation of fall reduction interventions.

Summary

A number of intervention strategies are accessible for a fall prevention program. Conclusions from the majority of studies reveal that fall prevention education, exercise, and environmental modifications to be effective programming methods for reducing fall risk factors and/or the frequency of falls among older adults. However, none of the intervention strategies in the literature propose a program combining low intensity exercise, environmental modifications, and nutritional education. Future investigations should address intervention programs involving these three components, specifically the addition of nutrition interventions. National surveys indicate that 40-50% of older adults are at moderate to high risk for nutritional problems. And that an estimated 85% of non-institutionalized older adults have one or more chronic conditions that could improve with proper nutrition (Wallace, 1997).

CHAPTER 3

METHODOLOGY

Pilot Study

Prior to the implementation of the multifactorial fall prevention program, a pilot investigation was conducted to assess the efficacy of a low cost home-based exercise program designed by Kay Van Norman (1996). The study was initiated to evaluate the exercise portion of a multi-factor fall prevention program (Yates, Dunnagan, & Van Norman, 1998). The investigators used a one-group pretest-posttest pre-experimental research design. Eighteen seniors were recruited from Bozeman, Montana. The subjects were 83% female, 17% male, and had an average age of 77.3.

The subjects were given a variety of physical assessments prior to and following the 10 week exercise intervention. The test included (a) the arm curl test which evaluates muscular endurance and strength in the biceps, (b) the scratch test which evaluates upper body flexibility, (c) the get up and go test which evaluates mobility, agility, coordination, balance, and gait speed, (d) the chair stand which is designed to evaluate lower body strength and endurance, and (e) the Tinetti balance questionnaire which evaluates balance. The details of the arm curl test, scratch test, get up and go test, and the chair stand are detailed by Jones and Rikli (1997). The Tinetti balance test was developed by Tinetti and colleagues (1996).

During the intervention, the subjects kept a daily log of participation in each of the assigned activities (Appendix F). The subjects also received bi-weekly telephone calls to answer their questions about the exercise program. This data provided information related to subject adherence to the prescribed programming.

The exercise intervention, "Movement Matters," was a home-based program designed to maintain basic activities of daily living for senior populations (Van Norman, 1996). The intervention consisted of a series of chair-based and chair-assisted activities focused on improving coordination, balance, strength, and mobility.

The pretest and posttest data were described using descriptive statistics and student t-tests with an alpha set at 0.10. A statistically significant change was observed within the entire group for the arm curl test ($p=0.0019$). A similar trend was seen in the chair stand ($p=0.12$) and the scratch test ($p=0.13$). However, the change scores were not significant at the .10 level. No changes were observed in the scores for the get up and go test ($p=0.49$) or the Tinetti balance test ($p=0.77$) (Appendix H).

The subjects were divided into two groups to assess the difference between adheres and non-adheres to the exercise intervention. Those subjects (56%) who performed the exercises at least 12 times during the 10 week intervention were classified as exercise adheres. Subjects (44%) who exercised less than 12 times were classified as non-adheres. The t-tests showed that the exercise adheres showed more significant changes than the non-adheres. Specifically, significant changes were seen in the scratch test ($p=0.08$), arm curl test ($p=0.031$), and the get up and go test ($p=0.015$). The changes in the Tinetti balance test ($p=0.14$) and the chair stand test ($p=0.11$) did not show

significant changes during the 10 week intervention at the 0.10 level (Appendix H).

This pilot study had several limitations. Specifically, the pre-test post-test pre-experimental research design has a number of weaknesses. Without the use of a control group, it is impossible to say if the changes in this investigation were due to the intervention, history, or maturation (Campbell, & Stanley, 1963). Also, the sample size limits the power of the analysis. It is important to consider these limitations when interpreting the results.

However, the pilot study did reveal a number of important factors that needed to be considered in the multifactorial fall-risk reduction intervention (Yates, S. et al., 1998). First, the differences found between exercise adheres and non-adheres supports a large body of literature which discusses the importance of exercise adherence in the facilitation of health enhancement through exercise (Dishman, 1998; Dunnagan, 1987; Shephard, 1985). Therefore, a logical step in refining this home-based exercise program would be to use appropriate adherence techniques to magnify the changes within senior populations. The pilot study also revealed the difficulty in recruiting older adults. Originally the pilot study called for 40 participants, but the researchers were only able to recruit 20 seniors. It became apparent that adequate recruitment time and numerous recruitment techniques would need to be employed for the multifactorial fall-risk reduction intervention. Also, select physical and psychometric evaluation measures were also modified for the fall prevention study. Specifically, the chair stand was eliminated and an assessment of leg power was added. Finally, the depression scale was changed to a shorter, less repetitive instrument.

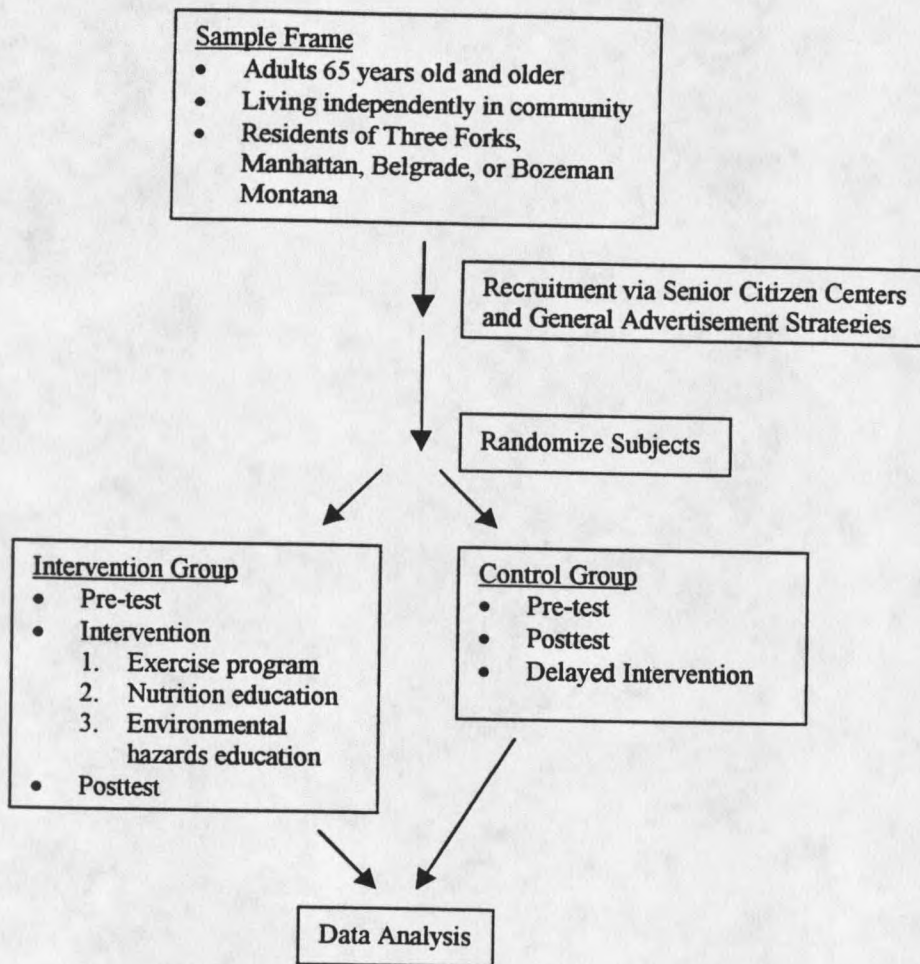
Multifactorial Intervention Research Design

The study was designed to evaluate the effects of a multifactorial home-based fall prevention program on select fall-related risk factors. This study follows a quasi-experimental pre-test post-test design (See Figure 3). The subjects were randomly assigned by alternating assignment to a treatment or delayed treatment group. All subjects were assessed prior to the intervention (pre-test) and following the 10-week intervention period (post-test). Each pre and post-test evaluation visit lasted an average of two hours and were conducted in the subjects' homes. The subjects were pre-tested in March, 1998 and post-tested in June, 1998. The experimental group received a three part intervention consisting of exercise programming, nutritional assessment and referral, and environmental hazards assessment and risk reduction education. The control group was idle for the 10 week intervention and received the intervention following the post-test assessments.

Human Subjects Committee Approval

A human subjects clearance form was submitted to the Montana State University Human Subjects Committee (HSC) on December 11, 1997 (Appendix B). The HSC approved the study procedures on January 14, 1998.

Figure 4: Schematic of Research Design



Recruitment of Subjects

Forty human subjects over the age of 65 were recruited from Three Forks, Manhattan, Belgrade, and Bozeman, MT. Specifically, the researcher visited each of the senior centers in these communities and presented the fall prevention research project. A brochure (Appendix C) describing the fall prevention intervention was given to older adults who participate in programs of the Three Forks Senior Citizen Club, the Manhattan

Senior Center, the Senior Citizen's Friendship Club of Belgrade, and the Bozeman Senior Citizen Center. Brochures were also given to the Three Forks area clergy, who agreed to distribute the information to seniors in their congregation. Next, a recruitment notice was distributed through the Three Forks newspaper and an article describing the entire fall prevention program was printed in the Prime Time News (a senior news publication). Last, a public service announcement was run on the area public broadcasting station (PBS) television channel. Consequently, the investigator used a variety of distribution channels to recruit older adults for the multifactorial fall prevention program.

The subjects were asked to sign an informed consent (Appendix D), as well as give permission to complete all testing procedures in their home. Physician's approval was obtained for each subject by the investigator by way of a release form through the mail (Appendix D). The subjects were randomly assigned to either the delayed treatment (control) or treatment group.

Instrumentation

During pre-testing and post-testing a seven page questionnaire was completed by the subjects with assistance from the investigator. After completing the questionnaire, the subjects performed a number of physical function assessments (Appendix E). The following is a synopsis of the self-rated health characteristics, psychometric, environmental, and functional measuring instruments used to assess the subjects' fall-related risk factors. Definitions for the fifteen fall-related risk factors used in calculating the cumulative fall risk for each subject is also provided.

Self-Rated Health Characteristics

Subjects were asked to rate their health on a number of characteristics. The self-rated health characteristics chosen for this study were all correlates of falls for older adults. Following are the definitions used to determine each health characteristic as a fall-related risk factor:

Poor Vision	individuals with glaucoma or macular degeneration.
Poor Hearing	classified by the investigator for those subject's who had trouble hearing normal conversation. Basically, if things had to be repeated often or in an elevated voice.
Alcohol Use	consuming more than two alcoholic beverages daily.
Tobacco Use	current use of cigarettes, cigars, pipes, or smokeless tobacco.
High Blood Pressure	individuals who have or are being treated for high blood pressure or hypertension.
Hospitalization in past year	overnight in the hospital for any medical reason.
Sedentary	not engaging in some sort of physical activity three or more times a week for at least ten minutes per session; i.e. walking, gardening, biking.
Foot Problems	bunions, corns, long toe nails, foot deformities, and/or any other unusual problems with the feet.
Sedative Use	use of any over the counter or prescription medication to help them sleep.

Prescription Medications

list of all prescription medications currently using (4+ medications was considered a risk)

Psychometric Assessments

1.) Falls Efficacy Scale (5 minutes):

The Falls Efficacy Scale was developed by Tinetti (1990) to help determine the extent to which fear of falling exerts an independent effect on functional decline among older adults (Tinetti, Richman, & Powell, 1990). It is based on Bandura's theory of self-efficacy (Bandura, 1987). Self-efficacy is defined as a person's perception of his or her capabilities within a particular domain of activities. In this 10 question instrument, falls efficacy represents the degree of confidence a person has in performing the common activities of daily living. Subjects rate their confidence on a scale of 1-10; a score of 10 connotes the lowest level of confidence.

Example.

How confident are you that you can prepare a simple meal?

Not at all Confident	Fairly Confident	Completely Confident
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2.) Depression Scale (5 minutes):

The depression scale is one dimension of the Hopkins Symptom Checklist (HSCL) (Derogatis, Lipman, Rickels, Uhlenhuth & Covi, 1974). Derogatis and associates determined this section of the questionnaire to have test re-test reliability of .81 and inter-rater reliability of .64. These results reveal

this instrument to be dependable and consistent predictor of depression.

The 11 question instrument measures symptoms of depression in the last two weeks. The subject's select one of five possible responses. The scores for the 11 questions were summed with the highest possible score being 55 and the lowest being 11. Lower scores are related to fewer depression symptoms.

Example.

In the last two weeks, how much were you bothered or distressed by feeling no interest in things?

Not at All	A Little Bit	Moderately	Quite a Bit	Extremely
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Nutrition Assessments

3.) Nutritious Food Behavior Scale (5 minutes):

The Nutritious Food Behavior Scale comes from Rotter's Social Learning Theory of Personality and Dietary Behavior. It is used to measure the dependent variable of reported food behavior. This nine question instrument measures food selection and avoidance. The nine questions considered foods that act as a prophylaxis against nutritional related illness in the elderly. The subject's choose one of three responses. The scores for the nine questions were summed with the highest possible score being 27 and the lowest being 9. The higher the score the more nutritious the food behavior. Basically, subjects receive high scores if they try very hard to

avoid salt, sugar, cholesterol, and excessive calories; frequently read labels on packaged items; and on a daily basis eat fruits and vegetables (Houts & Warland, 1989).

Example.

How hard do you try to avoid foods high in sugar?

Try Very Hard	Try Somewhat	Don't Worry About It
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4.) Locus of Control for Nutrition (5 minutes):

Locus of Control for Nutrition also comes from Rotter's Social Theory of Personality and Dietary Behavior. It was designed to measure locus of control expectancies in food behavior. A person with an internal locus of control believes the desired outcome is within his/her control. A person who indicates an external locus of control believes the outcome is not within his/her control, but controlled by someone or something else. This five question instrument measures locus of control expectancies in food behavior. A summation of the five scores can range from five to fifteen. Those with an internal locus of control will score highest on the continuum and those with an external locus of control will score lowest. Scores from 5 through 12 represented the "externals", scores 13 and 14 were the low-range "internals", and a score of 15 represented a high "internal" (Houts & Warland, 1989).

Example.

If qualified health professionals recommend eating certain foods, how likely is it you'll try them?

Very Much	Somewhat	Not Very Much
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Environmental Hazards Assessment

5.) In-Home Assessment (30 minutes):

The In-Home Assessment was developed by the investigator because there was no comprehensive environmental risk assessment available to researcher. It was compiled from the cited environmental risks in the literature (Cutson, 1994; Lange, 1996; Northridge, Nevitt, Kelsey, & Links, 1995; Sattin, Rodriquez, DeVito, & Wingo, 1998). This 40 question instrument measures environmental fall-related risk. The questions ask about various in-home hazards. A composite score of the number of environmental risk factors was determined by summing the total number of environmental risk factors. If the subject had more than four environmental risk factors within their home, they were considered to be at risk environmentally.

Example.

Is there a rug or rubber mat near the sink?

☐ Yes (1) ☐ No (0)

Physical Assessments

6.) Arm Curl (5 minutes):

This test is used to measure upper body bicep endurance. This test is similar to the AAHPERD arm curl test (Osness, Adrian, Clark, Hoeger, Rabb, & Wiswell, 1996). Test-retest reliability estimates for the arm curl test are .81 for males and .80 for females (Rikli & Jones, 1997). The subjects curl a 5 pound barbell through a full range of motion as many repetitions as possible during 30 seconds. The number of curls was counted and recorded.

7.) Scratch Test (5 minutes):

This test is used to determine overall shoulder range of motion. It is a modified version of Apley's scratch test, which has been used for years by therapists and orthopedic physicians as a quick evaluation for overall shoulder range of motion (Starkey & Ryan, 1996). Test-retest reliability estimates for the scratch test are .96 for males and .92 for females (Rikli & Jones, 1997). The subjects were asked to reach behind their head with one hand and behind the back with the other. They tried to touch their two middle fingers together behind the back. The distance between the two fingers was measured and recorded as a positive number. If the subject's fingers overlapped, their measurement was recorded as a negative number. The subjects were allowed one trial run prior to the actual measurement.

8.) Get Up and Go Test (5 minutes):

The Get Up and Go test was used to assess mobility, which involves gait speed, agility, balance and coordination (Mathias, Nayak, & Issacs, 1986). Get Up and Go performance has been found to be a significant predictor of falling (Tinetti, 1986a). This version of the Get Up and Go test has test-retest reliability estimates of .98 for males and .90 for females (Rikli & Jones, 1997). The test involves a chair with an eight foot course directly in front of the subject. The subject begins by sitting in the chair and upon the timers command rises from the chair and walks to the end of the eight foot course. After reaching the end of the course, the subject goes around a cone and returns to the chair in a seated position. This is a timed test and the subjects are allowed one practice run.

9.) Dorsiflexion of the ankles (2 minutes):

Measurement is taken to assess the flexibility of the ankle and determine if a subject is at risk for drop foot. Range of motion was determined in the basic planes by standard goniometric techniques (American Academy of Orthopedic Surgeons, 1965). The subjects foot was placed on a flexion board with an initial angle of measure at 104 degrees. They were asked to dorsiflex their foot and the final angle measured with a protractor. Two measurements were taken and averaged.

10.) Tinetti Balance Assessment (5 minutes):

Subjects began seated in a chair, they were asked to rise, make a 360

degree turn, close and open their eyes, and return to a seated position. The investigator assesses the subjects from 0=poor and unsafe, to 2=safe and steady on each of the nine questions. Subjects score between 0-16 with 16 being the best possible balance rating (Tinetti, 1986a).

11.) Power Test (5 minutes):

The power test was used to assess power of the lower extremities. The subjects were weighed on a bathroom scale provided by the researcher (F). Then their height was measured from a sitting position (H_1). The subject was then timed to see how long it takes to rise to a full standing position (t). Finally the height measurement upon standing was taken (H_2).

Collectively, these measures were calculated to determine the subjects ability to generate power (Nm/sec) from a sitting to a standing position using the following formula for power:

$$\text{Power (P)} = \text{Force (F)} \{ \text{Height}_2 (H_2) - \text{Height}_1 (H_1) \} / \text{Time (t)}$$

Cumulative Number of Fall-Related Risk Factors

Aside from assessing individual fall-related risk factors, the total number of risk factors were calculated for each subject and weighted equally. Definitions were taken from the literature when available or they were developed by the investigator using the mean score of the baseline data from each of the assessment measures. For example, the mean score for the baseline data of the depression scale was a score of 19. Subject's were cited as being at risk for depression if their score was greater than 19. Figure 5 lists the

fifteen fall-related risk factors assessed in this study and their definitions.

Figure 5: Fall-related risk factors and benchmarks used to determine fall risk

Fall-related Risk Factor	Definition of Being at Risk
1. Age	>80 years old ²
2. Low Social Support	living alone ²
3. Previous Falls	2+ previous falls ³
4. Depression	a score >19 on the depression scale ¹
5. Fear of Falling	a Falls Efficacy Score <125 ¹
6. Environmental Hazards	4+ hazards ¹
7. Polypharmacy	4+ prescription medications ²
8. Lack of Physical Activity	not engaging in 3 bouts of physical activity lasting 10 minutes or more ¹
9. Poor balance	a score <14 on the Tinetti Balance Assessment ¹
10. Lack of Bicep Muscular Endurance	arm curls <17 repetitions for males, and <13 repetitions for females ¹
11. Poor Shoulder Flexibility	a score >8 inches ¹
12. Poor Mobility	a score >6.2 seconds for males, and >7.4 seconds for females ¹
13. Lack of Power in the Lower Extremities	a score <315 Nm/sec for males, and <153 Nm/sec for females ¹
14. Low or High BMI	Males = $21.6 < x < 32.4$ Females = $22 < x < 33$ ⁴
15. Sedative Use	any medication used for sleep or relaxation ^{2 3}

¹ Determined by the investigator using the mean score of baseline data.

² Hindmarsh & Estes, 1989

³ Tinetti, Speechly & Ginter, 1988

⁴ Cotton (Ed), 1998

Intervention

The intervention period lasted 10 weeks beginning immediately after pre-testing. The subjects received a three part intervention to help reduce their fall-related risk factors. The intervention consists of exercise programming, nutritional counseling and/or referral, and environmental hazard education. The subjects in the delayed treatment group (controls) received the same intervention as the subjects in the treatment group after the 10 week intervention period.

Exercise Program

Prior to the initiation of the exercise program, all of the subjects in the treatment group were briefed on the importance of fall prevention. The researcher spent 20 minutes with each subject talking about the association of falling with poor vision, poor hearing, sedative use, multiple medications, orthostatic hypotension, depression, and lack of physical activity. This time was used as a motivational piece for the exercise intervention, hopefully educating seniors about various fall-related risks and their role in reducing these factors.

The exercise program was to adhere to the guidelines of the Movement Matters: Home Based Exercise Program, by Kay Van Norman (1996) at least three times a week (Appendix F). The exercise program begins with four exercises for warm-up and coordination. They include the Toe Touch, the Heel Press, Side Toe Touch, and the Elevator. The second component of the program focuses on balance and involves four exercises. They include the Knee Lift, Knee Bends and Tip Toes, Heel to Toe Walks, and

Achilles Stretch. The last section is for strength and mobility and involves 10 exercises. They include the Ankle Flexion/Toe Curls, Knee Lifts with weights, Knee Extensions with weights, Reach and Squeeze, Hand Mobility, Finger Stretch, Shoulder Press with weights, Bicep Curl with weights, Cross Arm, and the Elbow Lift. Each exercise session took approximately 15 minutes once the subjects became comfortable with the routine. To facilitate muscular strength and endurance development, each subject was given a set of five pound weights. Log sheets were maintained by the researcher in order to track exercise compliance. The subjects recorded how often and at what intensity they performed the exercises (Appendix F).

Nutrition Counseling

The nutrition component of this intervention used the Nutritional Screening Initiative (1991), which is a multifaceted national effort to promote nutrition screening and better nutritional care for older adults. The subjects completed the Nutritional Health Checklist (Appendix G) and received a score ranging from 0 to 25. If their score was 3-5 they received a Level I screen. The Level I screen includes nutrition education in the form of hand-outs and a list of community resources that can provide help with nutrition. If their score was 6 or more they received a Level II screen. The Level II screen involves a referral to a registered dietician, who was contracted to work on this study.

Environmental Hazard Education

During the pre-test visit an environmental assessment of the subject's home was conducted by the investigator. Any of the environmental hazards identified were noted.

Based upon this analysis, safety modifications to the home environment were outlined for each subject. For example, if the hallway leading downstairs is steep and dimly lit, the suggested modifications included night lights and/or new bulbs in the overhead lights. It was also suggested that fluorescent tape be placed on the first and last step in order to draw the subject's attention to these areas. The researcher also suggested that armrails be used and/or installed if they were absent. Each area of the subject's home that revealed hazards received a list of possible modifications.

Statistical Analysis

Data were entered into the statistical package Minitab 12. The data were cleaned by checking the possible values for each variable, for example, possible codes for gender were 1=male and 2=female. Each variable was checked to insure none of the values were outside of this range of scores. Dot plots were run to see if the distribution trends of the data. Box and whisker plots were run to show if there were any outliers for each variable at baseline, thus determining normal distribution. Next, descriptive statistics were done compare the two groups. Frequencies and percent distribution were calculated for age, gender, education, living arrangements, marital status, and number of falls. Frequencies and percent distribution were also calculated for the self-rated health characteristics: vision, hearing, alcohol use, tobacco use, sedative use, high blood pressure, hospitalization in the last year, physical activity, foot problems, and number of prescription medications. Chi squares and unpaired t-tests were run on baseline data for each of the descriptive characteristics to determine if there were any significant differences between the

intervention and the delayed intervention groups.

Paired t-tests were performed to determine mean change scores for each dependent variable in relation to group designation. Also, unpaired t-tests were run to determine mean differences between groups. The physical characteristics used as dependent variables included: balance, ankle flexion, bicep endurance, upper body flexibility, mobility, and lower extremity power. The psychometric measures used as dependent variables included: fall efficacy, and depression. The nutrition measures used as dependent variables included: nutritious food behavior, and locus of control for nutrition. The total number of environmental hazards and the total number of fall-related risk factors were also classified as dependent variables. Statistical significance was determined at the .05 level of significance. However, this analysis tests fourteen independent contrasts (dependent variables) and the threat of making one or more type I errors increases sharply. At an $\alpha=0.05$ the probability of a significant result occurring due to chance alone is 1 in 20, however when the number of dependent variables is fourteen the probability increases to 1 in 2 or 50% of the time. As the number of independent test increases, so does the probability of obtaining spuriously significant results (Kirk, 1982). Hence, for this analysis the alpha was adjusted according to the Bonferroni inequality (Glass & Hopkins, 1996). Therefore, all of the t-tests were also tested using the more conservative Bonferroni inequality adjustment ($\alpha=0.0036$).

Simple Regression

Simple regression models were used to determine if group designation predicted

the change in outcome variables. The physical characteristics used as dependent variables included: balance, ankle flexion, arm strength, upper body flexibility, mobility, and leg strength. The psychometric measures used as dependent variables included: fall efficacy and depression. The nutrition measures used as dependent variables included: nutritious food behavior, and locus of control for nutrition. The total number of environmental hazards and the total number of fall risk factors were also classified as dependent variables. Group designation was the sole independent variable used in the regression models. There were no additional independent variables added in the regression models, because the two groups were similar on all independent variables. Statistical significance was determined at the $\alpha = 0.05$ level of confidence.

CHAPTER 4

RESULTS

Introduction

The purpose of this chapter is to examine the effects of the fall prevention intervention on select risk factors. First, dot and box and whisker plots were constructed to show that the data were normally distributed. T-tests and chi squares were conducted on baseline data to compare the intervention and the delayed intervention groups. Next, paired t-tests were run to compare the mean change scores within groups. Unpaired t-tests were conducted to show the differences in mean scores between groups. Finally, regression models were used to determine if group designation predicted change in fourteen outcome variables. An $\alpha = 0.05$ was used throughout the analysis to determine statistical significance. Because multiple t-tests were used in this analysis, an adjusted level of significance ($\alpha=0.0036$) according to the Bonferroni inequality was also used to determine statistical significance for the t-tests.

A total of 40 subjects over the age of 65 were recruited for the fall prevention study. One subject was excluded from the analysis due to a pre-existing illness (multiple sclerosis). Two subjects did not finish the study (5% Attrition). Consequently, the analysis is based on a sample of thirty-seven ($N = 37$) subjects (eighteen subjects in the intervention group and nineteen subjects in the delayed intervention group).

Adherence to the exercise program was defined as performing the exercises at least 12 times during the 10-week intervention. This study revealed an adherence of 72.2% for the intervention group. Each subject in the intervention group also received the Nutrition Screening Instrument (NSI) (1991), if their score was 6 or higher they were labeled as high risk for malnutrition. Upon completion of this tool, 11% (2) of the intervention group were classified as high risk. Protocol of the NSI suggested high risk individuals see a doctor or dietitian. The subjects classified as high risk received referrals to a registered dietitian, however, neither of the subjects contacted the dietitian. Barriers reported for failure to contact the dietitian included: lack of time and belief that nutrition was adequate.

Distribution of Scores

The first analysis of the data was to look at the distribution of scores for each variable. In order to use inferential statistics, it is important to show that the data is normally distributed (Glass & Hopkins, 1996). The dot plots in Figure 6 show the distribution of baseline data for the physical outcome variables. The plots for dorsiflexion left, dorsiflexion right, arm curl, and scratch test left demonstrate that the data were normally distributed. The plots for scratch test right, get up and go, and power were positively skewed. The plot for balance was negatively skewed. The dot plots in Figure 7 show the distribution of baseline data for environmental hazards, psychometric, nutrition behavior, and total number of fall-related risk factors outcome variables. The plots for environmental hazards, depression scores, and total number of risk factors demonstrate

that the data were normally distributed. The plots for nutritious behavior and locus of control for nutrition were positively skewed. The plot for falls efficacy was negatively skewed.

Box and whisker plots were also run on the baseline data, in order to examine the distribution of scores. These plots are useful because they show outliers, which are values that fall above or below 1.5 times the value of the interquartile range (Glass & Hopkins, 1996). In order to analyze the data, the outliers must be addressed. Although some of the outcome variables were positively or negatively skewed, Figure 8 and Figure 9 show only the data for scratch test right has outliers which have dramatic impact on the group means. Baseline data for the scratch test right had two outliers which were three or more standard deviations above the mean (outside the outer fence). These outliers are shown as circles on the box and whisker plots (Figure 8). Both of these data points were from participants in the delayed intervention group. For purposes of this analysis these two scores were removed from the scratch test right t-tests and regression analysis, in order to meet the assumption of homogeneity of variance and normal distribution of scores. The values shown as asterisks on the box and whisker plots are possible outliers. These data points fall between two and three standard deviations above or below the mean. Outcome variables with these outliers should be evaluated carefully, but may still be analyzed using inferential statistics.

Figure 6: Dot plots of physical outcome variables at baseline.

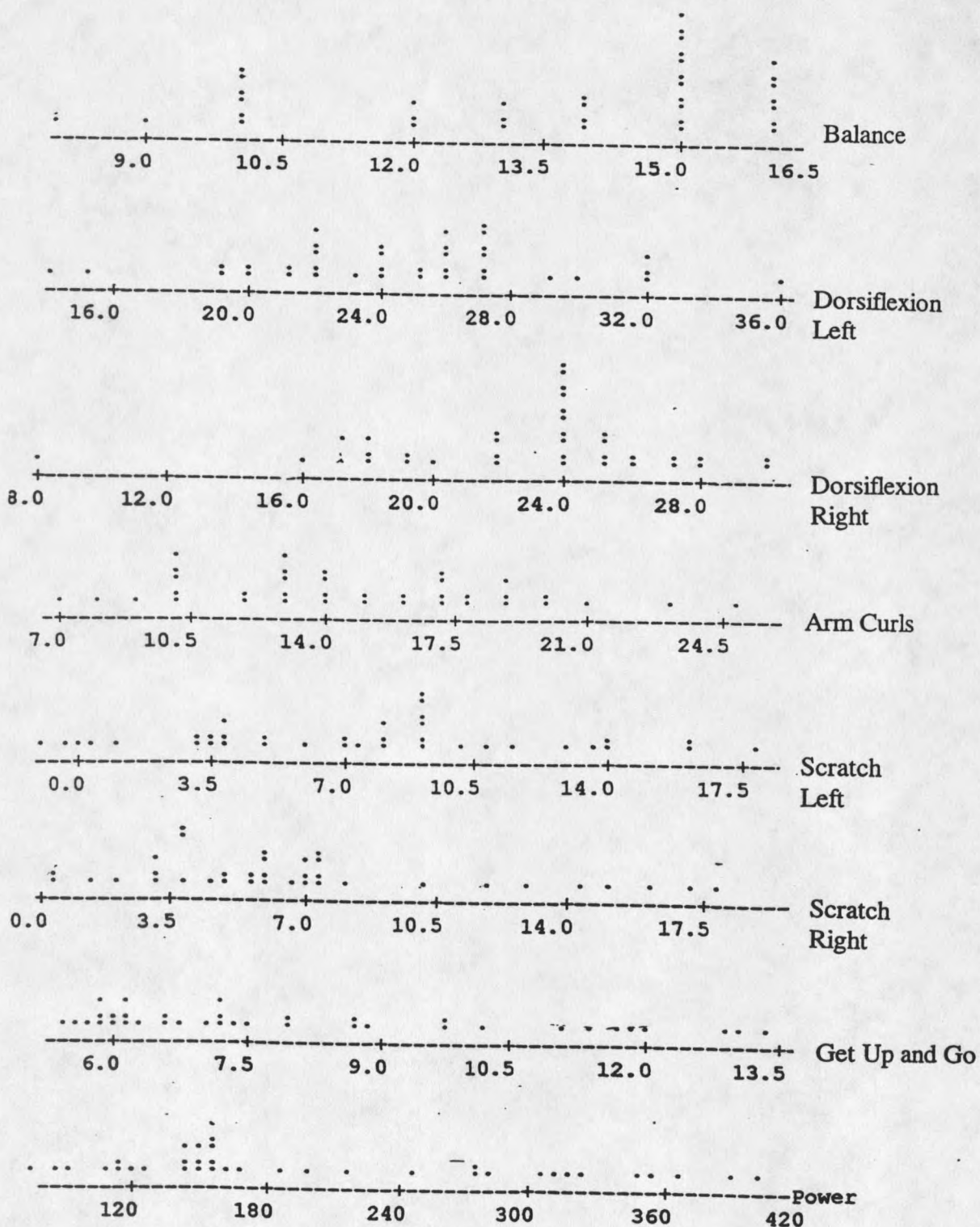


Figure 7: Dot plots of environmental hazards, psychometric, nutrition behavior, and total fall-related risk factor outcome variables at baseline.

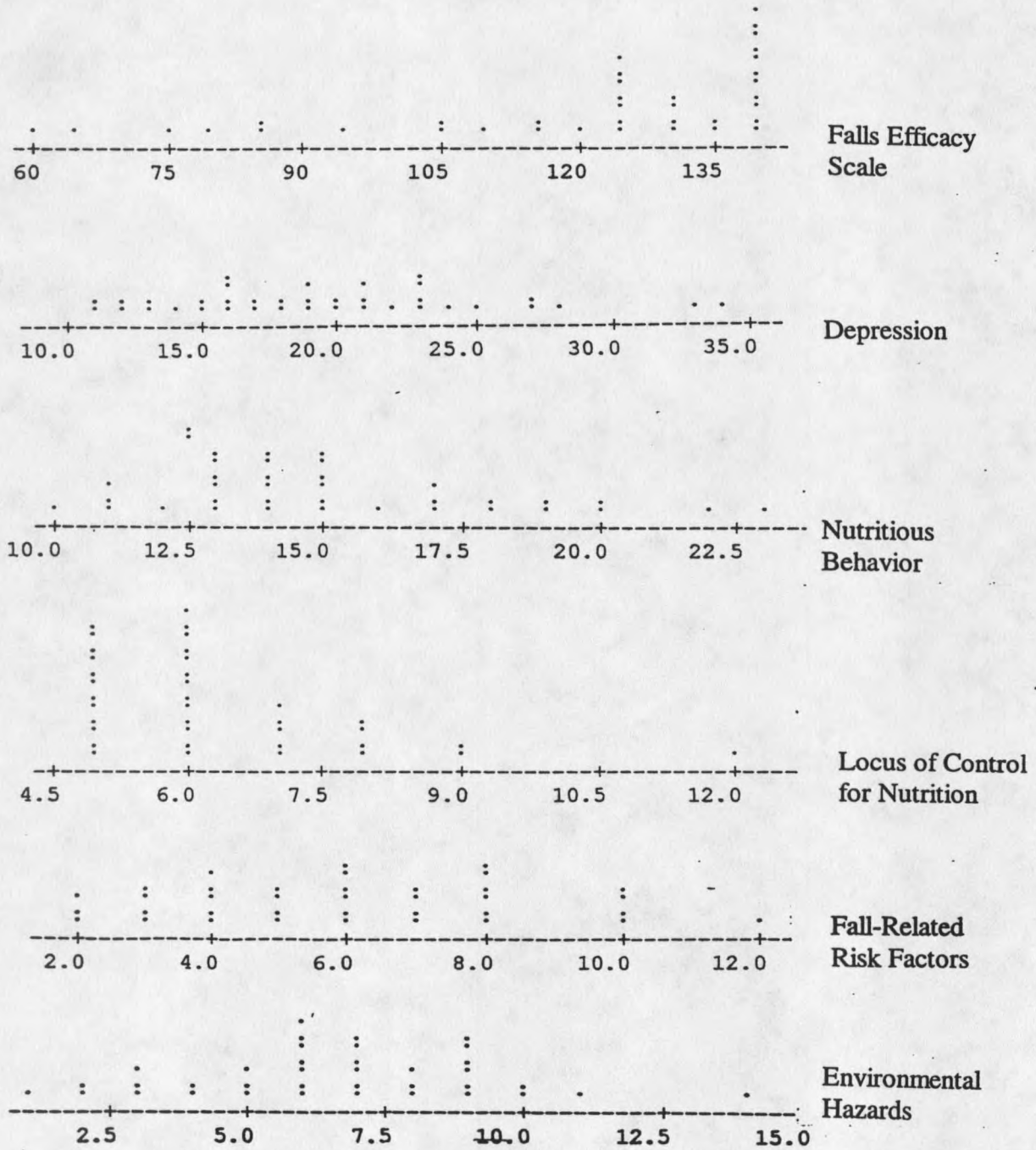


Figure 8: Box and whisker plots of the physical outcome variables at baseline.

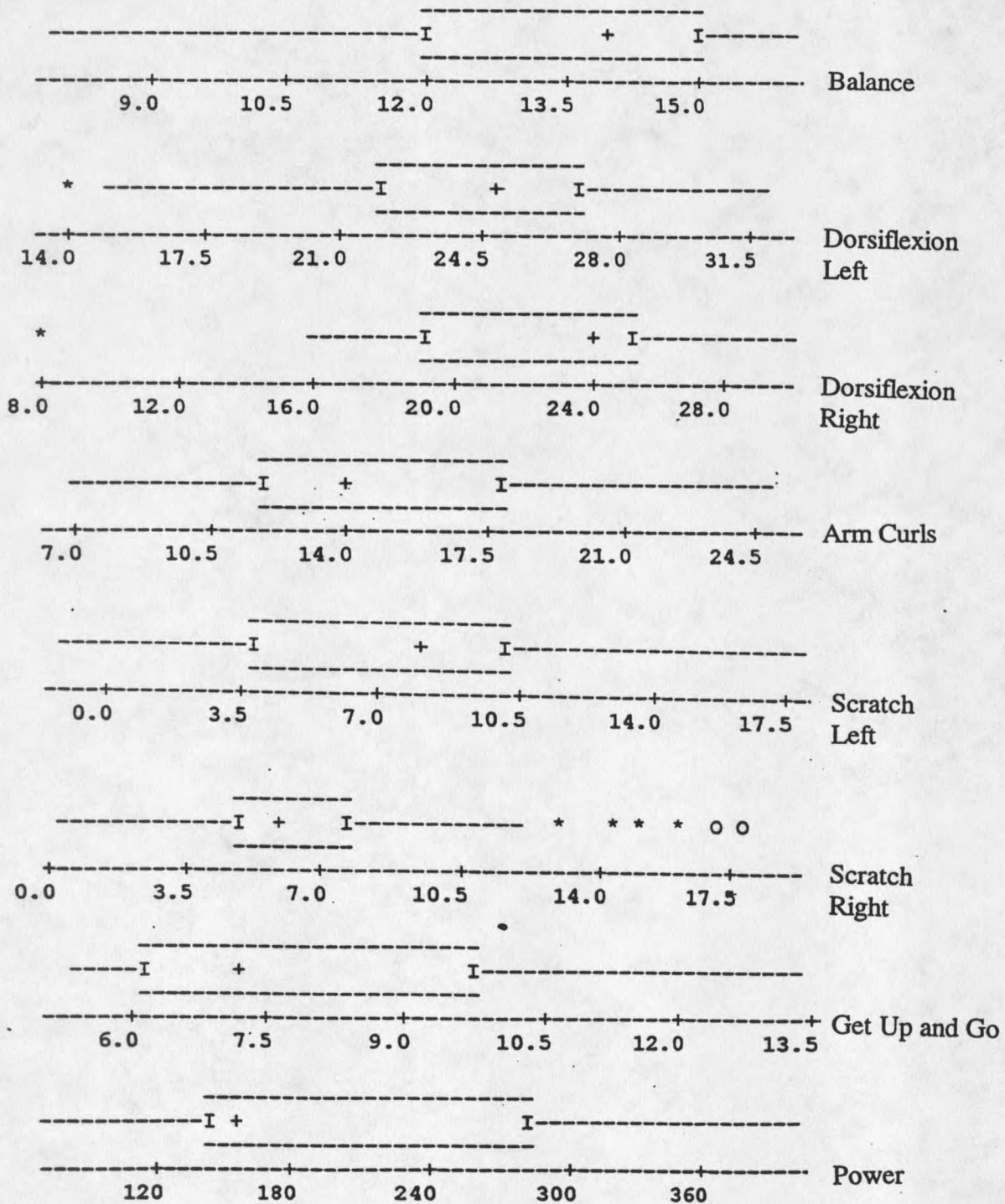
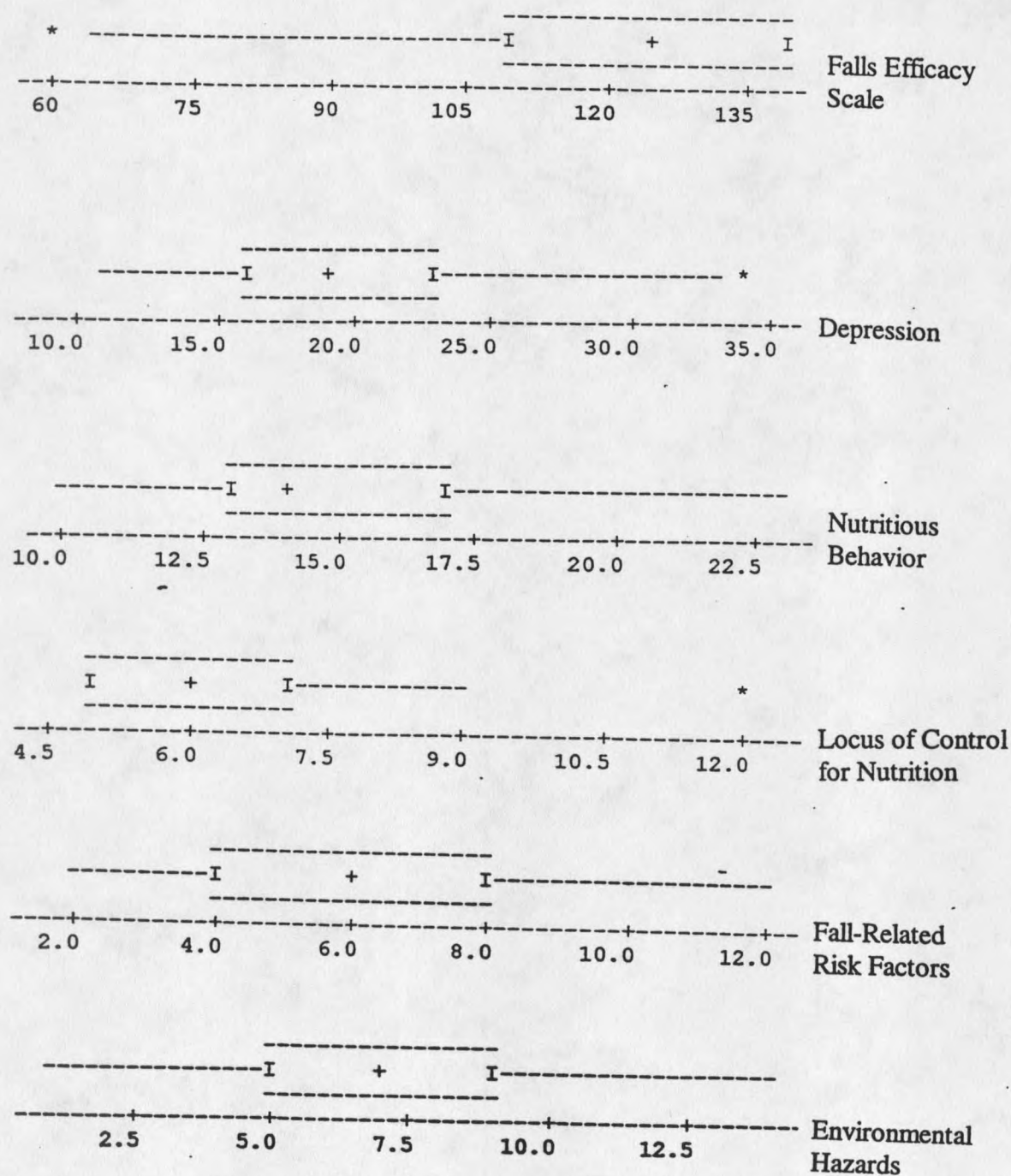


Figure 9: Box and whisker plots of the environmental hazards, psychometric, nutrition behavior, and total fall-related risk factor outcome variables at baseline.



Demographic and Health Characteristics

This section discusses the demographic and health characteristics of the study sample, providing relevant comparisons between the intervention group and the delayed intervention group. The purpose of this analysis was to see if the intervention and delayed intervention groups were similar. To this end, frequencies and percent distributions of demographics are shown in Table 1.

The two groups are very similar when compared by age, gender, education, marital status and living arrangements. The average age of the intervention group is 76.67 years old compared to an average of 78.21 years old for the delayed intervention group. The intervention group consisted of 72.2% percent female subjects compared to 68.4% females in the delayed intervention group. This sample of older adults was well educated with 83.3% of the intervention group having completed high school compared to 73.68% of the delayed intervention group. The intervention group reported 61.1% of the subjects as married and 33.3% of the subjects as widowed, none of the subjects were divorced and one was single. The delayed intervention group reported 36.8% of the subjects as married and 57.9% of the subjects as widowed, none of the subjects were divorced and one was single. Subjects were also classified as either living alone or with someone. Living alone has been cited in the fall prevention research as a risk factor for falls (Cwikel, 1992). The data reveal 44.4% of the intervention group and 52.63% of the delayed intervention live alone.

The two groups were also similar in the number of reported falls. The intervention

group reported that 22.2% of the subjects fell in the last month, compared to 21.1% in the delayed intervention group. Chi square analysis and unpaired t-tests were run to determine if any of the baseline differences between groups were statistically significant at $\alpha = 0.05$ (see Appendix I). The groups were found to be similar on age, gender, education, marital status, living arrangements, and fall status.

Table 1: Demographics of the intervention group and the delayed intervention group.

Variable	Intervention Group N = 18	Delayed Intervention Group N = 19
Age	76.67 $\pm$ 6.8 (67 - 90)	78.21 $\pm$ 4.61 (69 - 88)
Gender		
Male	27.8% (5)	31.6% (6)
Female	72.2% (13)	68.4% (13)
Education		
Completed High School	83.33% (15)	73.68% (14)
Did not complete	16.67% (3)	26.32% (5)
Marital Status		
Single	5.56% (1)	5.26% (1)
Married	61.11% (11)	36.84% (7)
Widowed	33.33% (6)	57.89% (11)
Divorced	0%	0%
Living Arrangements		
With Someone	55.56% (10)	47.39% (9)
Alone	44.44% (8)	52.63% (10)
Fell in the Last Month		
Yes	22.2% (4)	21.1% (4)
No	77.8% (14)	78.9% (15)
Average Number of Fall-Related Risk Factors	5.78 $\pm$ 1.93 (3-10)	6.21 $\pm$ 3.08 (2-12)

Information was also gathered on self-rated health characteristics. The literature on falls shows that many of these characteristics are related to increased fall risk. Frequencies and percent distributions of health characteristics are shown in Table 2. The health characteristics describing health status include: vision, hearing, high blood pressure, hospitalization, foot problems, number of medications, and total number of fall-related risk factors. The most notable difference between groups was for self-reported "poor" vision. The intervention group reported 27.78% with "poor" vision compared to 57.89% of the delayed intervention group. "Poor" hearing was reported by 38.89% of the intervention group and by 21.05% of the delayed intervention group. High blood pressure or controlled high blood pressure was reported by 55.56% of the intervention group and by 52.63% of the delayed intervention group. Only 11.11% of the intervention group and 15.79% of the delayed intervention group had been hospitalized in the last year. Problems with the feet, such as bunions, corns and long toenails have been shown as a risk factor for falling. For this sample of older adults, 33.33% of the intervention group and 36.84% of the delayed intervention group reported some kind of problem with their feet.

Older adults often take a number of medications for chronic health problems, this is known as polypharmacy. Multiple medications can be a source of fall risk due to drug interactions (Gray, S.L., 1997). On average this sample of older adults was not taking an exceptional number of medications; the intervention group reported an average 3.56 medications and the delayed intervention group reported 3.68 medications.

Last, a cumulative risk factor score was assigned to each subject based on the definitions in Figure 4. The total number of fall-related risk factors were calculated for

each subject and weighted equally. For example, subjects over the age of 80, living alone, having 2 or more previous falls, and 4 or more environmental hazards would receive a cumulative risk factor score of 4. Cumulative risk takes into account the demographic, physical, environmental, and psychological risk factors assessed in this study. The intervention group reported an average of 5.78 fall-related risk factors compared to an average of 6.21 for the delayed intervention group. Chi square analysis and unpaired t-tests were conducted to determine if any of the baseline differences between groups were statistically significant at $\alpha = 0.05$ (Appendix I). The groups were similar on all health status characteristics.

The health characteristics describing health behaviors included: alcohol use, tobacco use, sedative use, and physical activity. This sample of older adults had a very low reported use of alcohol and smoking behavior. Only 5.6% of the intervention group reported drinking 2 or more drinks daily compared to 10.53% of the delayed intervention group. The intervention group reported no smokers and the delayed intervention group reported one smoker or 5.26% of the group. Sedative use has been cited as a very important risk factor in determining falls in the elderly (Tinetti, et al., 1988). Sedatives were reportedly used by 44.44% of the intervention subjects and 36.84% of the delayed intervention subjects. Overall this group reported a high percentage of physically active individuals. The intervention group reported 77.78% of the subjects performed some form of physical activity at least three times a week for 10 minutes compared to 68.42% of the delayed intervention group. The majority of the subjects reported walking or gardening as their physical activity and much of this was done only during the warmer

months of the year. Chi square analysis and unpaired t-tests were run to determine if any of the baseline differences between groups were statistically significant at $\alpha = 0.05$

(Appendix I). The groups were similar on all health behavior characteristics.

Table 2: Percent and frequency of self-reported health characteristics by intervention group and delayed intervention group.

Health characteristics	Intervention Group N = 18		Delayed Intervention Group N = 19	
	Yes	No	Yes	No
Poor Vision	27.78% (5)	72.22% (13)	57.89% (11)	42.11% (8)
Poor Hearing	38.89% (7)	61.11% (11)	21.05% (4)	78.95% (15)
High Blood Pressure	55.56% (10)	44.44% (8)	52.63% (10)	47.37% (9)
Hospitalization in the Last Year	11.11% (2)	88.89% (16)	15.79% (3)	84.21% (16)
Foot Problems	33.33% (6)	66.67% (12)	36.84% (7)	63.16% (12)
Average No. of Medications Using (range)	3.56 $\pm$ 1.72 (1-8)		3.68 $\pm$ 2.40 (0-10)	
Average No. of Fall-Related Risk Factors (range)	5.78 $\pm$ 1.93 (3-10)		6.21 $\pm$ 3.08 (2-12)	
Alcohol Use	5.6% (1)	94.44% (17)	10.53% (2)	89.47% (17)
Smokers	0% (0)	100% (18)	5.26% (1)	94.74% (18)
Sedative Use	44.44% (8)	55.56% (10)	36.84% (7)	63.16% (12)
Physically Active (3x/wk for 10min.)	77.78% (14)	22.22% (4)	68.42% (13)	31.58% (6)

T-tests of Mean Change Scores Within Groups

Assuming homogeneity of variance (Glass & Hopkins, 1996), t-tests comparing pre-test and post-test means were conducted for the physical and psychometric outcome variables in each group. Table 3 displays t-tests of mean change scores within groups for the physical assessments. This analysis tests the null hypothesis that the mean change scores within group is different than zero. Scores are considered statistically significant at $\alpha = 0.05$. Because the chance of one or more type I errors increases when multiple t-tests are conducted, the results of statistical significance are also reported according to the Bonferroni inequality $\alpha=0.0036$.

The mean balance score increased 1.44 points for the intervention group ($p=.002$), however, the delayed intervention group revealed a 0.74 point decrease from pre-test to post-test ($p=.015$). This change is statistically significant for both groups, but the change for the delayed intervention group showed a significant decrease in balance. The mean change score for the intervention group was also significant for the Bonferroni adjusted alpha.

The changes in ankle flexibility (Dorsiflexion Left and Right) did not reveal statistical significance for either group. However, ankle flexion did increase slightly for the intervention group, and decreased for the delayed intervention group. The mean score for Dorsiflexion left increased by 0.94 points in the intervention group ($p=.129$) and decreased by 0.53 points in the delayed intervention group ($p=.58$). The mean score for Dorsiflexion right increased by 0.67 points in the intervention group ($p=.321$) and

decreased by 0.11 points in the delayed intervention group ($p=.867$). None of the changes were significant for either level of significance.

The mean change in arm curls for the intervention group was an increase of 3.33 repetitions, while the delayed intervention group decreased by 0.74 repetitions between the pre and post-test evaluations. Consequently, the change in dominant arm bicep endurance was statistically significant at both levels of significance for the intervention group ($p = .001$), while the change in the delayed intervention group was not statistically significant ($p=.21$).

Upper body flexibility (Scratch Test Left and Right) increased significantly for the intervention group in between the pre and post-test evaluations. The average change was a decrease of 1.44 inches on the left side ($p=.015$) and of 1.77 inches on the right side ($p=.002$) for the intervention group. The average change for the right side was also statistically significant when compared to the Bonferroni adjusted alpha. The delayed intervention group revealed an average decrease of 0.55 inches on the left side ($p=.413$) and an average increase of 1.25 inches on the right side ($p=.198$). The changes for the delayed intervention group were not significant for the left or the right side.

The mobility test (GUGT) did not reveal statistically significant changes for either group. However, the mean number of seconds it took the subjects in the intervention group to complete the mobility course decreased by 0.28 seconds ($p=.193$) and increased for the delayed intervention group by 0.37 seconds ($p=.11$).

The final physical assessment measured power from sitting to standing. The intervention group revealed a statistically significant increase in the mean of 34.2 Nm/sec

($p=.005$), while the delayed intervention had a decrease of 16.4 Nm/sec. ($p=.125$).

However, the changes in power were not statistically significant when compared to the Bonferroni adjusted alpha.

In total, a statistically significant change was observed within the intervention group for balance ($p = .002$), bicep endurance ($p = .001$), lower extremity power ($p = .005$), and upper body flexibility ($p = .015$) at an $\alpha = .05$. Also statistically significant changes were observed within the intervention group for balance ($p = .002$) and bicep endurance ($p = .002$) at the Bonferroni $\alpha=.0036$. There were no statistically significant changes in the favorable direction observed within the delayed intervention group.

Table 4 displays t-test of mean change scores within groups for environmental hazards and total fall-related risk factors. The intervention group showed a 1.39 average decrease in the number of environmental hazards found within the subjects' home ($p=.0000$). The mean change in environmental hazards for the intervention group was also statistically significant when compared to the Bonferroni adjusted alpha. The delayed intervention also showed a slight decrease (0.26) in the mean score from pre-test to post-test, although the change was not statistically significant ($p=.172$).

Each subject was also assigned a cumulative risk factor score based on the following fall-related risk factors: age, social support, fall history, depression, falls efficacy, environmental hazards, medication use, physical activity, balance, bicep endurance, lower extremity power, upper body flexibility, mobility, BMI, and sedative use. The definitions for each factor are provided in Figure 4, page 36. The average total number of fall-related risk factors decreased by 2.11 risks in the intervention group

($p=.000$) and increased by 0.47 risks in the delayed intervention group ($p=.187$). The mean changes observed in the intervention group were statistically significant at both level of significance.

Table 3: T-tests of mean change scores within group for the physical assessments.

Outcome Variable	Intervention Group					Delayed Intervention Group				
	N	Mean ¹	Std Dev	T St	P Val	N	Mean ¹	Std Dev	T St	P Val
TAT (Balance)(+)	18	1.44	1.69	-3.6	.002 ^{2,3}	19	-0.74	1.19	2.69	.015 ²
Dorsiflex-Left (+)	18	0.94	2.51	-1.6	.129	19	-0.53	4.07	0.56	.58
Dorsiflex-Right (+)	18	0.67	2.77	-1.0	.321	19	-0.11	2.70	0.17	.867
Arm Curl (+)	18	3.33	3.61	-3.9	.001 ^{2,3}	19	-0.74	2.47	1.30	.21
Scratch-Left (-)	18	-1.44	2.25	2.7	.015 ²	19	-0.55	2.87	0.84	.413
Scratch-Right (-)	17	-1.77	1.93	3.7	.002 ^{2,3}	16	1.25	3.71	1.35	.198
GUGT (-)	18	-0.28	0.89	1.4	.193	19	0.37	0.96	-1.6	.11
Power (+)	18	34.2	45.6	3.2	.005 ²	19	-16.4	44.3	-1.1	.125

¹ Change in Mean = Post-test Evaluation - Pre-test Evaluation.

² Statistically significant at $\alpha = 0.05$

³ Statistically significant changes at the Bonferroni adjusted $\alpha=.0036$

+ A positive mean change score represents a change in the favorable direction.

- A minus mean change score represents a change in the favorable direction.

In summary, a statistically significant change was observed within the intervention group for number of environmental hazards and change in total number of fall risk factors at both levels of significance. There were no statistically significant changes within the delayed intervention group for these two outcome variables.

Table 4: T-tests of mean change scores within group for the environmental hazards and total fall-related risk factors.

Outcome Variable	Intervention Group					Delayed Intervention Group				
	N	Mean ¹	Std Dev	T St	P Val	N	Mean ¹	Std Dev	T St	P Val
Environment (-)	18	-1.39	1.34	-4.4	.0000 ^{2,3}	19	-0.26	0.81	-1.4	.172
Total Number of Fall Risk Factors (-)	18	-2.11	1.83	-7.6	0.000 ^{2,3}	19	0.47	1.50	1.37	0.187

¹ Change in Mean = Post-test Evaluation - Pre-test Evaluation.

² Statistically significant at $\alpha = 0.05$

³ Statistically significant changes at the Bonferroni adjusted $\alpha = .0036$

+ A positive mean change score represents a change in the favorable direction.

- A minus mean change score represents a change in the favorable direction.

Table 5 displays t-test of mean change scores within groups for the psychometric and nutrition behavior measures. The Falls Efficacy scores range from 0-140 and measure confidence in performing the activities of daily living. The intervention group had a significant mean increase of 5.56 points between pre and post-test evaluations ($p = .042$). The delayed intervention group actually decreased in mean score by 0.53 points which was not statistically significant ($p = .830$). Neither mean change score was statistically significant at the Bonferroni adjusted alpha.

The depression scale did not reveal significant changes for either group. The mean change score within the intervention group decreased by 1.17 for the measure of depression, however this was not a statistically significant change at either level of significance ($p=.280$). The delayed intervention group also had a decrease in the mean change score of 0.95 points, but this change was also not significant ($p=.454$). Scores for the Depression Scale can range from 11 to 55.

The measures for nutritious behavior and locus of control for nutrition did not reveal significant changes at either level of significance within either the intervention or the delayed intervention group. The mean change score for nutritious behavior decreased by 1.33 points for the intervention group ($p=.067$) and increased by 0.84 points for the delayed intervention group ($p=.100$). Scores for the Nutritious Food Behavior Scale can range from 9 to 27. The mean change score for locus of control for nutrition increased by 0.167 points for the intervention group ($p=.644$) and increased by 0.474 points in the delayed intervention group ($p=.107$). Scores for the Locus of Control for Nutrition can range from 5 to 15.

In summary, a statistically significant change was observed within the intervention group for only the falls efficacy score ($p = .042$) when compared to an $\alpha=.05$. However, when compared to the Bonferroni adjusted alpha the result was no longer statistically significant. There were no statistically significant changes in the favorable direction observed within the delayed intervention group.

Table 5: T-test of mean change scores within group for psychometric measures and nutrition behavior.

Outcome Variable	Intervention Group					Delayed Intervention Group				
	N	Mean ¹	Std Dev	T St	P Val	N	Mean ¹	Std Dev	T St	P Val
Falls Efficacy Score (+)	18	5.56	10.7	2.2	.042 ²	19	-0.53	10.5	-0.2	.830
Depression (-)	18	-1.17	4.44	-1.1	.280	19	-0.95	5.4	-0.8	.454
Nutritious Food Behavior (-)	18	-1.33	2.89	-1.9	.067	19	0.842	2.12	1.74	.100
Locus of Control for Nutrition (-)	18	0.167	1.51	0.47	.644	19	0.474	1.22	1.69	.107

¹ Change in Mean = Post-test Evaluation - Pre-test Evaluation.

² Statistical significance at $\alpha = 0.05$

There are no statistical significant result at the Bonferroni $\alpha=.0036$.

+ A positive mean change score represents a change in the favorable direction.

- A minus mean change score represents a change in the favorable direction.

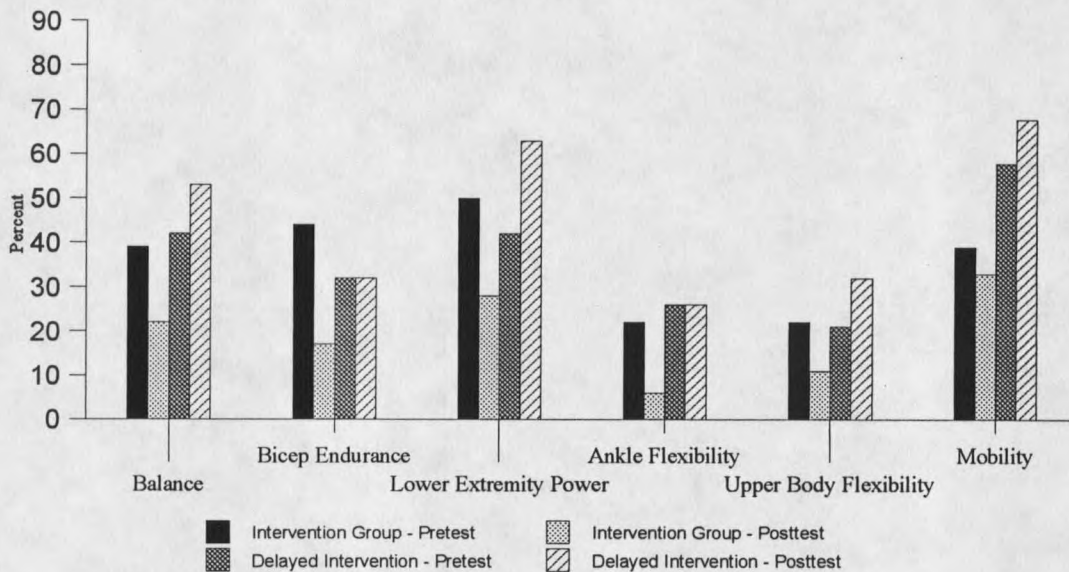
Percent of Subject's with Each of the Fall Risk Factors

Each of the physical, environmental, and psychometric outcome variables were defined as risk factors for falling. Figure 10 displays the percentage of subjects at pre-test and post-test who are at risk for each of the physical risk factors. There was a decrease in poor balance for the intervention group from 39% to 22%, while the delayed intervention group experienced an increase in the percentage with poor balance (42% to 53%). The percentage of subjects in the intervention group with poor bicep endurance

decreased from 44% to 17%, while the delayed intervention group maintained at 32%.

The percentage in the intervention group with poor lower extremity power decreased from 50% to 28%, while the delayed intervention group increased from 42% to 63%. Poor

Figure 10: Delayed and intervention group percentage of subjects at pre-test and post-test who are at risk for select physical risk factors.



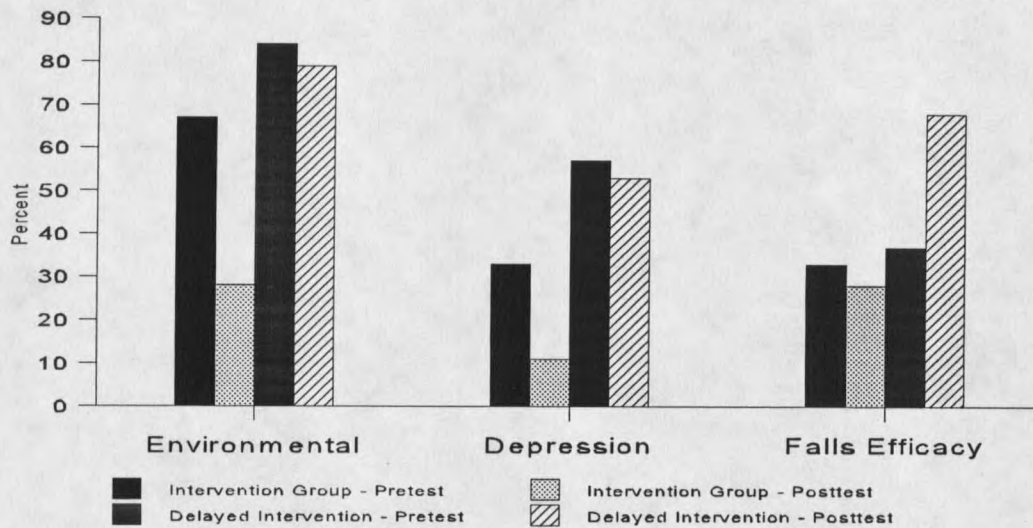
ankle flexibility was a risk factor for 22% of the intervention group at pre-test, but was reduced to 6% following the intervention. The delayed intervention group revealed 26% of the subjects to have poor ankle flexibility at both the pre and post-test evaluations. The percent of participants in the intervention group with poor upper body flexibility decreased from 22% at pre-test to 11% at post-test. The delayed intervention group saw an increase in the percentage of subjects with poor upper body flexibility (21% to 32%). Finally, poor mobility in the intervention group decreased from 39% to 33%, while the delayed intervention group had an increase in the percentage of subjects with poor mobility (58%

to 68%).

Figure 11 displays the percentage of subjects at pre-test and post-test who are at risk for the environmental and psychometric risk factors. The percentage of subjects in the intervention group with more than four environmental hazards decreased from 67% to 28% during the ten week intervention. In fact, seventy-two percent of the subjects in the intervention group reduced at least one environmental risk factor during the intervention period. The delayed intervention group had 84% of the subjects with more than four environmental risk factors at the pre-test and 79% at post-test. The percentage of subjects in the intervention group displaying symptoms of depression went from 33% at pre-test to 11% at post-test. The delayed intervention group had 57% of the subjects with depression symptoms at pre-test and 53% at post-test. The Falls Efficacy Scale, which has been associated with fear of falling, revealed a decrease in the fear of falling among the intervention group (33% at pre-test to 28% at post-test) and an increase among the delayed intervention group (37% at pre-test to 68% at post-test).

In summary, the results reveal a reduction in the percentage of persons in the intervention group with each of the following risk factors: poor balance, lack arm bicep endurance, lower extremity power, poor upper body and ankle flexibility, poor mobility, greater than four environmental risk factors, depression symptoms, and fear of falling. Conversely, the delayed intervention group revealed an increased percentage of persons with select fall-related risk factors.

Figure 11: Delayed and intervention group percentage of subjects at pre-test and post-test who are at risk for psychometric and environmental risk factors.



T-tests of Mean Change Scores Between Groups

T-tests comparing mean change scores between groups were conducted for the physical and psychometric outcome variables. Table 6 displays t-test of mean change scores between groups for the physical assessments. This analysis tests the null hypothesis that the difference between the two mean change scores is not equal to zero. Scores are considered statistically significant at $\alpha = 0.05$. The results of statistical significance are also reported according to the Bonferroni inequality $\alpha=0.0036$.

Improved scores on the Tinetti Balance Assessment are associated with improved balance. The difference in mean change scores between groups was statistically significant for balance at both levels of significance ($p=.0001$). The mean change score for the intervention group was an increase of 1.44 points and for the delayed intervention group

was a decrease of 0.74 points. The scores for the Tinetti Balance Assessment range from 0 to 16.

Improved scores for Dorsiflexion revealed an increase in ankle flexion. Specifically, the mean change score for the intervention group did increase by 0.94 degrees on the left and 0.67 degrees on the right. However, the analysis showed that the mean change scores between groups were not statistically significant for the left ($p=.19$) or right ($p=.40$) ankles. The delayed intervention group saw a decrease in mean change scores for both the left ankle (0.53 degrees) and the right ankle (0.11).

An increase in bicep endurance is associated with an increase in the number of arm curls performed in thirty seconds for this study. The mean number of arm curls increased for the intervention group by 3.33 repetitions and decreased for the delayed intervention group by 0.74 repetitions. This difference between groups was statistically significant at both levels of significance ($p=.0004$).

A decrease in scores for the Scratch Test revealed an increase in upper body flexibility. However, the difference in mean change scores between groups was not statistically significant for either left ($p=.30$) or the right ($p=.62$) arm in this analysis. The mean change scores for the intervention group increased by 1.44 inches on the left and 1.76 inches on the right. Also, the mean change scores for the delayed intervention group increased by 0.55 inches on the left and 1.25 inches on the right.

A decrease in the time it takes a person to complete the Get Up and Go Test is associated with increased mobility. The mean number of seconds it took the subjects of the intervention group to complete the Get Up and Go Test decreased by 0.28 seconds.

In the delayed intervention group the mean change score increased by 0.37 seconds. The difference between mean change scores for the two groups was statistically significant at an $\alpha=.05$ ($p=.039$). However, it was not significant when compared to the Bonferroni adjusted alpha.

In this analysis, increased power is associated with an increase in lower extremity power. The mean change in power for the intervention group increased by 34.2 Nm/sec and decreased by 16.4 Nm/sec for the delayed intervention group. The mean difference between groups was significant at both levels of significance for the measure of power ($p=.0017$).

In summary, mean change scores between groups were significant for balance ($p=0.0001$), bicep endurance ($p=0.0004$), mobility ($p=0.039$), and lower extremity power ($p=0.0017$) at an $\alpha=.05$. When compared to the Bonferroni adjusted $\alpha=.0036$ the mean change scores between groups were significant for balance, bicep endurance, and lower extremity power. However, the mean change scores between groups were not significant for the scratch test or dorsiflexion.

Table 6: T-tests of mean change scores between groups for the physical assessments.

Outcome Variable	Means Change Score for Intervention Group ¹	Means Change Score for Delayed Intervention Group ¹	T St	P-Value
TAT (+)	1.44	-0.74	4.51	0.0001^{2,3}
Dorsiflex- Left (+)	0.94	-0.53	1.33	0.19
Dorsiflex- Right (+)	0.67	-0.11	0.86	0.40
Arm Curl (+)	3.33	-0.74	3.98	0.0004^{2,3}
Scratch- Left (-)	1.44	0.55	1.05	0.30
Scratch- Right (-)	1.76	1.25	0.50	0.62
GUGT (-)	-0.28	0.37	2.15	0.039²
Power (+)	34.2	-16.4	3.42	0.0017^{2,3}

¹ Change in Mean = Post-test Evaluation - Pre-test Evaluation.

² Statistical significance at $\alpha = 0.05$

³ Statistically significant changes at the Bonferroni adjusted $\alpha = .0036$

+ A positive mean change score represents a change in the favorable direction.

- A minus mean change score represents a change in the favorable direction.

Table 7 displays t-test of mean change scores between groups for the environmental hazards and the total number of fall-related risk factors. The average number of environmental hazards decreased for the intervention group by 1.39 hazards and in the delayed intervention group by 0.26 hazards. The difference in mean change scores between groups was significant at an $\alpha = .05$ ($p = .005$). However, when the difference in mean change scores between groups was compared to the Bonferroni adjusted alpha it was no longer statistically significant.

For each of the subjects a total number of fall risk factors was calculated. The

results revealed a decrease in total fall risk factors of 2.11 risks for the intervention group and an increase of 0.47 risks for the delayed intervention group. The mean difference between groups was significant at both levels of significance ($p=.000$).

Table 7: T-tests of mean change scores between groups for environmental hazards and total fall-related risk factors

Outcome Variable	Means Change Score for Intervention Group ¹	Means Change Score for Delayed Intervention Group ¹	T St	P-Value
Environmental Hazards (-)	-1.39	-0.26	3.09	0.005²
Total Number of Fall Risk Factors (-)	-2.11	0.47	5.79	0.000^{2,3}

¹ Change in Mean = Post-test Evaluation - Pre-test Evaluation.

² Statistically significant at $\alpha = 0.05$

³ Statistically significant changes at the Bonferroni adjusted $\alpha=.0036$

+ A positive mean change score represents a change in the favorable direction.

- A minus mean change score represents a change in the favorable direction.

Table 8 displays t-test of mean change scores between groups for the psychometric measures and nutrition behavior. An increase in cumulative score on the Falls Efficacy Scale suggests an increase in confidence performing basic activities of daily living. The scores can range from 0 to 140. The intervention group showed a mean increase of 5.6 points for falls efficacy, and the delayed intervention group had a mean decrease of 0.5 points. However, this difference in mean change scores between groups was not significant ($p=.091$).

A decrease in cumulative score on the depression scale is associated with

decreased symptoms of depression. Scores for the depression scale can range from 11 to 55. The mean score on the depression scale increased for both groups. The intervention group had an increase in mean change score of 1.17 and the delayed intervention group had an increase in mean change score of 0.95. The difference between groups on the depression indicator was not significant ($p=.89$).

The locus of control for nutrition scale indicates that subjects with lower scores were more internal with their nutritional control. Scores for this scale can range from 5 to 15. The data evaluated for locus of control for nutrition revealed a decrease in mean change scores for both groups. The intervention group mean decreased by 0.17 points and the delayed intervention group mean decreased by 0.47 points. This difference between groups was not statistically significant ($p=.50$).

A decrease in cumulative score for Nutritious Food Behavior is associated with more nutritious eating habits. Scores for this scale can range from 9 to 27. The intervention group mean decreased by 1.33 points and the delayed intervention group mean increased by 0.84 points. This difference between means was significant at an $\alpha=.05$ ($p=0.014$). However, when the difference between means was compared to the Bonferroni adjusted alpha the results were no longer significant.

In summary, mean change scores between groups were significant for environmental hazards ($p=.005$), total number of fall risks ($p=.000$), and nutritious food behavior ($p=.014$) at an $\alpha=.05$. When compared to the Bonferroni adjusted $\alpha=.0036$ only the total number of fall risks was statistically significant. The mean change scores between groups were not significant for fall efficacy, depression, or locus of control for nutrition.

Table 8: T-tests of mean change scores between groups for the psychometric measures and nutrition behavior .

Outcome Variable	Means Change Score for Intervention Group ¹	Means Change Score for Delayed Intervention Group ¹	T St	P-Value
Falls Efficacy Score (+)	5.6	-0.5	1.74	0.091
Depression (-)	1.17	0.95	0.14	0.89
Nutritious Food Behavior (-)	-1.33	0.84	2.60	0.014²
Locus of Control for Nutrition (-)	-0.17	-0.47	0.68	0.50

¹ Change in Mean = Post-test Evaluation - Pre-test Evaluation.

² Statistical significance at $\alpha = 0.05$

There were no statistically significant changes at the Bonferroni adjusted $\alpha = .0036$

+ A positive mean change score represents a change in the favorable direction.

- A minus mean change score represents a change in the favorable direction.

Simple Regression Results

Simple linear regressions were performed to see if group designation was predictive of changes in the outcome variables. Separate simple regressions were run using each of the physical, environmental hazards, nutrition behavior and psychometric outcome variables as the dependent variable and group designation as the independent variable. Group designation was assigned as a dummy variable. There were no other independent variables added to the regression model because the two groups were found to be similar on all of the demographic and health characteristics measured in this study.

Table 9 displays the outcome variables, β -coefficients, adjusted r-squared, and the

p-value for the physical outcomes evaluated in this study. When the change in balance was regressed on group designation 35.4% of the variance was explained. A p-value of 0.000 indicates the intervention group as a significant predictor of positive changes in balance. When the change in bicep endurance was regressed on group designation 29.6% of the variance was explained. Intervention group designation was a significant predictor of increase in bicep endurance ($p=.000$). When the change in mobility was regressed on group designation 9.1% of the variance was explained. The intervention group was a significant predictor of increased mobility ($p=.039$). When the change in lower extremity power was regressed on group designation 22.9% of the variance was explained. A p-value of 0.002 indicates the intervention group as a significant predictor of increased lower extremity power.

However, when ankle flexibility was regressed on group designation only 2.0% of the variance was explained for the left ankle and 0% of the variance for the right ankle. The intervention group was not a significant predictor of positive changes in ankle flexibility (left, $p=.198$; right, $p=.397$). When the change in upper body flexibility was regressed on group only 2.9% of the variance for the right side was explained and 0% of the variance for the left side. The intervention group was not predictive of positive changes in upper body flexibility (right, $p=.159$; left, $p=.329$).

In summary, the intervention group was significantly predictive of changes in balance (0.000), bicep endurance (0.000), mobility (0.039), and lower extremity power (0.002). Group designation, however, was not predictive of changes in either of the flexibility tests for ankle flexion or upper body flexibility.

Table 9: Simple regression of physical outcomes on intervention group designation.

Physical Outcome	Predictor Variables	β Coefficients	Standard Errors	P-Value	Adj. R ²
Balance	Constant	-0.74	0.333	0.034	35.4%
	Intervention group	2.18	0.479	0.000¹	
Ankle Flexion	Constant	-0.11	0.63	0.868	0.0%
	Intervention group	0.77	0.90	0.397	
Right	Constant	-0.53	0.78	0.505	2.0%
	Intervention group	1.47	1.12	0.198	
Left	Constant	-48.87	51.20	0.346	2.9%
	Intervention group	105.62	73.41	0.159	
Upper Body Flexibility	Constant	-37.74	27.63	0.181	0.0%
	Intervention group	39.18	39.18	0.329	
Right	Constant	-0.74	0.71	0.304	29.6%
	Intervention group	4.07	1.01	0.000¹	
Left	Constant	-0.37	0.21	0.092	9.1%
	Intervention group	0.65	0.30	0.039¹	
Bicep Endurance (dominant)	Constant	-16.35	10.30	0.121	22.9%
	Intervention group	50.53	14.77	0.002¹	
Mobility	Constant	-0.37	0.21	0.092	9.1%
	Intervention group	0.65	0.30	0.039¹	
Lower Extremity Power	Constant	-16.35	10.30	0.121	22.9%
	Intervention group	50.53	14.77	0.002¹	

¹ Statistical significance at $\alpha = 0.05$

Table 10 displays the outcome variables, β -coefficients, adjusted r-squared, and the p-value for environmental risk factors and total number of fall risk factors evaluated in this study. When the change in environmental risk factors was regressed on group designation 19.6% of the variance was explained. When the change in total fall-related risk factors was regressed on group designation 47.4% of the variance was explained. Group designation was significantly predictive of both the environmental changes ($p=.004$)

and changes in total number of fall-related risk factors ($p=.000$).

Table 10: Regression of environmental hazards and total fall-related risk factors on intervention group designation

Physical Outcome	Predictor Variables	β Coefficients	Standard Errors	P-Value	Adj. R²
Environmental Hazards	Constant	0.26	0.251	0.302	19.6%
	Intervention group	1.12	0.360	0.004¹	
Total Number of Fall-related Risk Factors	Constant	-0.47	0.312	0.137	47.4%
	Intervention group	2.58	0.447	0.000¹	

¹ Statistical significance at $\alpha = 0.05$

Table 11 displays the outcome variables, β -coefficients, adjusted r-squared, and the p-value for psychometric and nutrition behavior outcomes evaluated in this study. When the change in nutritious behavior was regressed on group designation 14.0% of the variance was explained. Intervention group designation was predictive of the changes in nutritious behavior scores ($p=0.013$). When the change in falls efficacy was regressed on group designation 5.4% of the variance was explained. The intervention group was not a significant predictor of changes in fall efficacy ($p=.090$). The regression models for depression and locus of control for nutrition did not explain any of the variance. Therefore, intervention group designation was not a significant predictor of depression ($p=.894$) or locus of control for nutrition ($p=.499$). In summary, the intervention group designation was predictive of changes in nutritious behavior, but not in fall efficacy, depression, or locus of control for nutrition.

Table 11: Regression of psychometric and nutrition behavior outcomes on intervention group designation

Physical Outcome	Predictor Variables	β Coefficients	Standard Errors	P-Value	Adj. R ²
Locus of Control	Constant	-0.47	0.31	0.139	0.0%
	Intervention group	0.31	0.45	0.499	
Nutritious Behavior	Constant	-0.84	0.58	0.154	14.0%
	Intervention group	2.17	0.83	0.013¹	
Depression	Constant	0.95	1.14	0.410	0.0%
	Intervention group	0.22	1.63	0.894	
Falls Efficacy Scale	Constant	-0.53	2.43	0.830	5.4%
	Intervention group	6.08	3.49	0.090	

¹ Statistical significance at $\alpha = 0.05$

CHAPTER 5

DISCUSSION

Summary

The purpose of this study was to determine if a multifactor fall prevention program consisting of exercise programming, nutrition education, and environmental hazard reduction decreased select fall-related risk factors. The analysis revealed statistically significant changes for the intervention group on balance, bicep endurance, lower extremity power, reduction of environmental hazards, and reducing the total number of fall-related risk factors in each of the three statistical tests at an $\alpha=0.05$: t-test within group, t-test between group, and simple regression. More importantly, the analysis revealed statistically significant mean changes between groups for balance, bicep endurance, lower extremity power, and total number of fall risks when compared to the Bonferroni inequality $\alpha=0.0036$.

Functional Assessments

Balance

Balance can be improved in old age as long as individuals participate in regular training activities. Prior to the intervention, 39% (7) of the intervention group (IG) and 42% (8) of the delayed intervention group (DG) reported poor balance. Following the

intervention, 22% (4) of the IG and 53% (10) of the DG reported poor balance. T-tests of mean change scores revealed a statistically significant change for the intervention group (0.002). T-test of mean change scores between groups was also significant (0.0001). Both t-tests for mean changes in balance were significant at the Bonferroni adjusted alpha. The simple regressions revealed that group designation (IG) for this intervention was predictive of positive changes in balance scores on the Tinetti Balance Scale (Adj. $R^2=35.4\%$).

Bicep Endurance

Older adults, who possess sufficient arm strength, may have an easier time catching themselves during a fall. Prior to the intervention, 44% (8) of the IG and 32% of the DG reported lack of bicep endurance. Following the intervention, 17% (3) of the IG and 32% (6) of the DG reported lack of bicep endurance. T-tests of mean change scores revealed a statistically significant change for the intervention group (0.001). The t-test of mean change scores between groups was also significant (0.0004). Both t-tests for mean changes in bicep endurance were significant at the Bonferroni adjusted alpha. The simple regressions revealed that group designation (IG) for this intervention was predictive of positive changes in bicep endurance (Adj. $R^2=29.6\%$).

Lower Extremity Power

Lower extremity power is used when getting in and out of a chair, up and down off of the toilet, in and out of a car, etc. It is very important in helping older adults maintain their independence. Prior to the intervention, 50% (9) of the IG and 42% (8) of

the DG reported lack of lower extremity power. Following the intervention, 28% (5) of the IG and 63% (12) of the DG reported lack of lower extremity power. T-tests of mean change scores revealed a statistically significant change for the intervention group (0.005). The t-test of mean change scores between group was also significant at both levels of confidence (0.0017). The simple regressions revealed that group designation (IG) for this intervention was predictive of positive changes in lower extremity power (Adj. $R^2=22.9\%$).

Upper Body Flexibility

Upper body flexibility is extremely important for older adults in preventing forward slouch. Most of the activities we do on a daily basis are directly in front of us: driving, writing, cooking, washing, and reading. Due to poor posture, individuals are more likely to slouch while engaging in these activities. The exercise program stressed the importance of sitting up straight during the exercises to facilitate proper breathing. Prior to the intervention, 22% (4) of the IG and 21% (4) of the DG reported poor flexibility in their upper body. Following the intervention, 11% (2) of the IG and 31% (6) of the DG reported poor upper body flexibility. Within group t-tests of mean change scores revealed a statistically significant change for the intervention group (Right 0.015, Left 0.002). However, the t-test of mean change scores between group was not significant. Only the t-test within for the left scratch test was held statistically significant when compared to the Bonferroni adjusted alpha. When upper body flexibility was regressed on group designation (IG) it did not explain a significant portion of the variance (Right Adj.

$R^2=2.9\%$, Left Adj. $R^2=0.0\%$).

Mobility

Mobility is defined as a person's ability to walk and change position with ease. Older adults often experience problems with their gait and performing transfers (i.e. sitting to standing). Prior to the intervention, 39% (7) of the IG and 57% (11) of the DG reported low mobility scores. Following the intervention, 33% (6) of the IG and 68% (13) of the DG reported low mobility scores. Within group t-tests did not reveal a statistically significant change in mobility scores for the intervention group. However, the t-test of mean change scores between groups was significant (0.039). T-tests on mobility change scores were not significant when compared to the Bonferroni adjusted alpha. The simple regressions revealed that group designation (IG) for this intervention was predictive of positive changes in mobility scores (Adj. $R^2=9.1\%$).

Ankle Flexion

Decreased ankle flexion and lower leg strength can result in a problem known as "drop foot". This is a serious problem for older adults because it causes them to drag their feet and results in tripping. Prior to the intervention, 28% (5) of the IG and 42% (8) of the DG reported poor ankle flexion. Following the intervention, 22% (4) of the IG and 26% (5) of the DG reported poor ankle flexion. These changes were not statistically significant for the intervention group or the delayed intervention group for any of the analyses performed.

Environmental Hazards

Environmental hazards have been cited as one of the top risk factors for falling among older adults. Prior to the intervention, 67% (12) of the IG and 89% (17) of the DG reported greater than four environmental hazards. Following the intervention, 28% (5) of the IG and 84% (16) of the DG reported greater than four environmental hazards. Seventy-two percent of the intervention group made at least one change in the environmental hazards within their home. Within group t-tests of mean change scores revealed a statistically significant change at both levels of significance for the intervention group (0.000). The t-test of mean change scores between groups was also significant (0.005). The simple regressions revealed that group designation (IG) for this intervention was predictive of environmental modifications (Adj. $R^2=19.6\%$).

Psychometric Assessments

Falls Efficacy

Falls efficacy is a measure of an older person's confidence performing a number of the activities of daily living. Tinetti et al. (1994) found falls efficacy to be associated with a person's fear of falling. The interventions were geared to improve a person's strength, coordination, balance and flexibility; which in turn should improve confidence in performing activities of daily living. Prior to the intervention, 33% (6) of the IG and 37% (7) of the DG reported lower than average fall efficacy. Following the intervention, 28% (5) of the IG and 63% (12) of the DG reported lower than average falls efficacy. Within

group t-tests of mean change scores revealed a statistically significant change for the intervention group (0.042). However, this change was no longer statistically significant when compared to the Bonferroni adjusted alpha. The t-test of mean change scores between group was not significant. The simple regressions revealed that group designation (IG) was not predictive of improved fall efficacy (Adj. $R^2=5.4\%$), however there was a $p\text{-value}=.09$.

Depression

Depression has been linked to lack of social support among older adults. Both have been identified as fall-related risk factors. This fall prevention study measured depression in order to determine if this home-based program could reduce the number of depressive symptoms in this sample of older adults. Prior to the intervention, 33% (6) of the IG and 52% (10) of the DG reported depressive symptoms. Following the intervention, 11% (2) of the IG and 47% (9) of the DG reported depressive symptoms. These changes were not statistically significant for the intervention group or the delayed intervention group for any of the analyses performed.

Nutrition Assessments

Nutritious Food Behavior

The Nutritious Food Behavior Scale assessed the subjects' behavior for healthy eating. Proper nutrition is important for older adults, because of the role it plays in physical decline, cognitive imbalance and orthostatic hypotension. All of these factors

have been cited as risks for falls among older adults. The within group t-test of mean change scores within groups was not significant. T-tests of mean change scores between groups was statistically significant (0.014). However, when compared to the Bonferroni adjusted alpha it was no longer significant. The simple regressions revealed that group designation (IG) was predictive of improved nutritious behavior (Adj. $R^2=14.0\%$).

Locus of Control

The measure for locus of control was used to determine if the subjects were more likely to believe their health was in their control. There were no statistically significant changes identified in locus of control for either group in any of the analyses performed.

Cumulative Number of Fall-Related Risk Factors

Even small changes in an older persons fall-related risk can have dramatic impact on the prevalence of falls (Tinetti, et al., 1988). Prior to the intervention, 67% (12) of the IG and 68% (13) of the DG reported greater than four fall-related risk factors. Following the intervention, 22% (4) of the IG and 78% (15) of the DG reported greater than four fall-related risk factors. T-tests of mean change scores revealed a statistically significant change for the intervention group (0.000). The t-test of mean change scores between groups was also significant (0.000). The results of both t-test within and between were held to be significant when compared to the Bonferroni adjusted alpha. The simple regressions revealed that group designation (IG) for this intervention was predictive of a decreased number of total fall-related risk factors. The simple regression model for

cumulative fall-related risk showed that group designation explained 47.4% of the variance between groups.

Conclusions

Based upon the data collected and the statistical methods applied in this study, the following conclusions were made:

1. Participation in the home-based multifactorial fall prevention intervention predicted positive changes in the following select fall-related risk factors when compared to an $\alpha=.05$:
 - ▶ balance improved
 - ▶ bicep endurance increased
 - ▶ mobility increased
 - ▶ lower extremity power increased
 - ▶ nutritious behavior increased
 - ▶ number of environmental fall-related risk hazards decreased
 - ▶ composite number of fall-related risk factors decreased
2. When t-tests were run between groups, the intervention revealed a number statistically significant changes. The robustness of this test is shown by using the more conservative Bonferroni adjusted level of significance ($\alpha=.0036$).
 - ▶ balance improved
 - ▶ bicep endurance increased
 - ▶ lower extremity power increased
 - ▶ composite number of fall-related risk factors decreased
3. Astoundingly, when the change in total number of fall-related risk factors was regressed on group designation (IG) 47.4% of the variance was explained.

Direction of Future Research

Most fall research on seniors has been conducted to identify risk factors. Most intervention studies to date primarily focus on large urban populations and involve the use of health professionals. Therefore, future studies should consider the following:

1. Researchers should implement the multifactorial fall prevention program in a group setting. This could be done through rural senior citizen centers or community hospitals. The group setting would be a good way to educate the seniors and would be more cost efficient.
2. The recruitment of community-dwelling subjects was extremely difficult. In the future researchers should consider recruitment via mailings that are generated through letters to persons over 65 who are registered voters or registered with the department of motor vehicles.
3. Researchers should consider using the transtheoretical stages of change model to address recruitment and adherence of older adults. To date, research has not been conducted on the application of the stage of change model (Prochaska & DiClemente, 1982) in the recruitment and adoption of exercise programming for senior populations. This application has tremendous potential in moving older adults through the stages of exercise adoption, thereby reducing their over-all fall-related risk.

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APPENDICES

APPENDIX A
GRANT APPLICATION

COLLEGE OF EDUCATION, HEALTH AND HUMAN DEVELOPMENT

RESEARCH AND CREATIVITY GRANT

APPLICATION FORM

97-98

Name of Applicant Tim Dunnagan Date 10/1/97Project Title Senior Citizen Fall Prevention Project

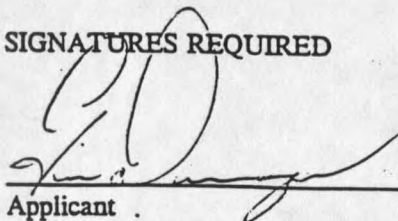
BUDGET SUMMARY

1.	Release time	\$ _____
2.	Summer contract	\$ <u>1,000.00</u>
3.	Assistance or contracted services	\$ <u>1,500.00</u>
4.	Supplies, materials, travel, etc.	\$ <u>1,675.00</u>
5.	Equipment	\$ _____
	TOTAL	\$ <u>4,175.00</u>

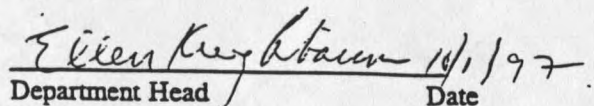
ATTACHMENTS REQUIRED

1. Narrative statement, including three requisite topics identified in the guidelines. (maximum of three pages)
2. For each entry on lines 1-5, Budget Summary, above, provide a complete explanation of each intended expenditure, including itemization. (Identify as Attachment A)

SIGNATURES REQUIRED


Applicant

Date


Department Head

Date

SENIOR-CITIZEN FALL PREVENTION PROJECT

Introduction

Falls among older adults are a serious public health issue. The number of deaths, disabilities and high costs associated with falls make them an important concern for health care professionals, policy makers and the general public. It is important to realize most falls can be prevented even among the frail elderly.

A closer look at falls helps us to understand the importance of a fall prevention program. Many older people injured by a fall suffer from acute morbidity, long term loss of function, and substantial risk of institutionalization and an increased risk of death. Studies have reported a mortality rate as high as 43% due to injury suffered from a fall. Hip fractures are the most commonly treated fall related injury. Every year 250,000 older adults are treated for hip fracture; a quarter of them will die within six months. Falls increase a person's chance of institutionalization: many lose their ability to live independently and perform a number of daily living activities. Half of all independently-dwelling older adults, who sustain an injury from a fall, will move to a nursing home after hospitalization.

These statistics make a strong impact on the lives of many older adults. Many seniors cite a strong "fear of falling." This fear is associated with decreased independence, decreased quality of life and an increased risk of falling. "Fear of falling" causes severe psychological and social concerns for aging adults. Individuals may become afraid to leave their homes and begin to restrict themselves from social activities. This fear can contribute to increased frailty, depression, and risk of falling.

The facts associated with injury from falls are an important concern for policy makers and the public because of the enormous costs. Nearly \$10 billion are spent each year treating fractures caused by falls. The medical costs are even greater when one considers the costs of institutionalization or medical care beyond just treating the fracture. This financial burden puts "strain on those who fall, their families and our health care system." Fall prevention programs can help save millions of dollars and lives.

Most Montanans have a special need for programs that help older adults take charge in caring for their health. About 17 percent of Montanans are over the age of 60 years, as compared to the national average of 14 percent. Dorothea Neath, chairwoman of the Governor's Council on Aging for Montana said, "It truly is a crisis; there is already a shortage of nursing home space and services such as Meals on Wheels." The fall prevention program that we propose would be initiated in the small rural town of Three Forks. Many older adults in Three Forks may have to travel to Bozeman or Billings to receive health care services. This fall prevention program is designed to instill confidence in their physical abilities. It is designed to identify those seniors at risk of falling and allow them to take control of the situation.

Why Base This Programming At MSU?

This project will serve as a pilot to show the effectiveness of a unique and cost effective Senior Citizen Center-based fall prevention program. Once the potential of this intervention is demonstrated, we would then take steps to secure funding for programming throughout rural Montana.

Montana State University is uniquely suited to develop and administer this rural oriented statewide initiative. There is exceptionally qualified personnel working at the University and the University has a strong presence throughout the state. I am an assistant professor of Health Promotion with the Department of Health and Human Development. Over the last 10 years I have been implementing worksite and community-based health promotion programming. On campus we have the Area Health Education Center headed by Robert Flaherty, M.D.. This office directs health education and outreach across the state. Dr. Flaherty has offered full support to this program. Mamie Cranston is a registered dietician. She works for the State Department of Health and Human Services, with her office here on the MSU-Bozeman campus. Her project focuses on the nutritional needs of rural Montana.

elderly by involving the eleven Area Agencies on Aging. Kay Van Norman is director of the Young at Heart Program. The Young at Heart program was started by a HHD graduate student over 10 years ago and still resides in the Department of Health and Human Development. This program offers exercise programming for Senior Citizens. Kay is the author of Exercise Programming for Older Adults, published by Human Kinetics Publishers and has developed a number of home-based exercise brochures for homebound senior citizens. Shawna Button is a graduate student in the Department of Health and Human Development. She has been interested in the area of aging since she was in high school and has specifically been reviewing the literature on falls for over two years. The Center for Gerontology also resides on the MSU-Bozeman campus. This center brings together a number of experts in the field of aging. The goal of the Center for Gerontology is to promote healthy aging for all Montanans across the lifespan. All of these individuals focusing on the tremendous problem of falls will produce a comprehensive fall prevention program.

Project Overview

The project is a Senior Citizen Center-based fall prevention program that targets physical activity, nutrition and home environmental hazards. This approach is unique in that we propose combining these three primary risk factors. To date, there are no documented programs that address these three areas through community Senior Citizen Centers. In fact, the majority of the interventions have addressed one area of concern such as nutrition within an institutional setting. These models typically require hospital or physician involvement. However, this approach can be implemented by health educators and community volunteers, consequently the practical applications are tremendous.

Project Objectives

- 1.) Reduce the number of fall-related risk factors for persons 65 and older and thereby reduce the morbidity and mortality associated with falling.
- 2.) Improve flexibility, coordination, and strength of adults 65 years and older.
- 3.) Screen and provide solutions for improper nutrition that may contribute to fall-related risks.
- 4.) Identify and modify environmental hazards that are associated with falls.

Implementation

Initial Screening

The project will be based out of the Senior Citizen Center in Three Forks. Fifty participants will be recruited from Three Forks and the surrounding area. All participants must be 65 years old or older and sign an informed consent. Initially, the participants will undergo an extensive interview to determine their health status, mental well-being, previous fall history and any identifiable fall-related risks.

Intervention

The participants will then move to the next phase of the program, which is the six month intervention. An educational talk will be given at the Senior Citizen Center to initiate the process. All of the participants and the public will be invited. This talk will help inform the participants and the community of the fall prevention program. The participants are then introduced to the three components of fall prevention: 1) Exercise Program, 2) Nutritional assessment and counseling and 3) Environmental

hazards identification and modification.

Exercise

The exercise component involves a home-based program that was recently developed by Kay Van Norman. Each subject will be given a set of 5-lb. weights and an illustrated copy of the exercise brochure. The participants will be tested in five areas to determine their strength, flexibility and coordination. They will then be asked to perform the prescribed exercise routine for six months three times a week. During the exercise program the participants will be required to keep a log to measure adherence and they will receive weekly phone calls to answer any of their questions. After the six month intervention, the participants will again be measured on strength, flexibility and coordination.

Nutrition

The nutrition component will involve a short visit with the researcher to identify areas where nutrition can be improved. They will answer a short screening tool from the Nutrition Screening Manual for Professionals Caring for Older Adults. Education regarding their nutritional weaknesses will be provided and referrals made if necessary to Meals on Wheels. After the six month intervention, the same screening tool will be administered to chart changes in nutrition. Marnie Cranston, a registered dietician will oversee the nutritional assessment and will guide the researcher on proper modifications and referrals.

Environmental Hazards

The last phase of the intervention will be an in-home questionnaire that identifies home hazards that put one at risk of falling. Some examples include loose throw rugs, commonly used dishes and appliances that are out of reach, poorly lit hallways and entrances, etc. The questionnaire will help the participants realize the conditions within their homes that put them at risk. They will receive instruction on possible modifications and a copy of the Home Safety Checklist for Older Consumers. If possible the participants will be referred to resources in the community that could help with the modifications. After the six month intervention, the participants will once again complete the questionnaire so that changes in environmental hazards can be measured.

Upon completion of the program the participants will be interviewed to assess their satisfaction with the program. Collectively the evaluation will assess changes in fall-related risk factors and the program effectiveness.

Publication and Future Funding Plans

During the summer of 1997 Shawna Button and Kay Van Norman conducted a pilot study which evaluated the effectiveness of home based exercise programming for elderly adults. This study was partially funded through PQO money that I received through the Provost's office. We plan to analyze this data this fall and submit the results of the pilot study in a journal such as the "Journal of Gerontology", "The Gerontologist", or "Geriatrics." Similarly, we would submit the results of this investigation to one of these journals.

It is essential that we publish this preliminary data so that we can be competitive for funding of a statewide program through sources such as Health and Human Services, Office on Aging. Publications which document the efficacy of our approach, the infrastructure that is available at MSU, and Support through the State Office of Aging Health and Human Services would make our approach very attractive to potential funding sources. Therefore, our plan is to publish these studies and then attempt to secure funding for a statewide program.

Attachment A (Itemization)**Summer Contract:**

<i>Dr. Tim Dunnagan -- Principal Investigator</i>	\$1,000.00
Project Direction/Supervision	
Supervise Program Implementation	
Supervise Data Collection and Analysis	
Write the final report	

Assistance or Contracted Services:

<i>Shawna Button -- Project Coordinator</i>	\$1,200.00
Solicit and Train Volunteers	
Administering the Nutritional Assessments	
Preparing and giving the Educational Talk	
Administering Environmental Assessments	
Data Collection and analysis	

<i>Mamie Cranston</i>	\$300.00
-Supervise the nutritional assessments	
-Provide dietary recommendations	

Sub Total-\$2,500.00**Supplies, Materials, Travel, Per Diem, Ect.***Educational Talk*

-Presentation materials such as slides and posters	\$200.00
-refreshment	\$50.00

Exercise Component

-Exercise brochures	(50 @ \$3.00)	\$150.00
-5-lb weights	(50 @ \$4.00)	\$400.00

Nutrition Component

-Pamphlets	(50 @ \$3.00)	\$150.00
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Environmental Component

- In-home questionnaire	(50 @ \$2.00)	\$100.00
- Home Safety Checklist for Older Consumers	(50 @ \$3.00)	\$150.00

Photocopying

- Pre/Post Analysis Quest.	(100 @ \$2.00)	\$200.00
-Educational Materials		\$100.00

Travel

Three Forks -- 70 miles round-trip from Bozeman	\$175.00
10 trips = 700 miles @ \$.25	

Sub Total- \$1,675.00

TOTAL.....	\$4,175.00
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Attachment A (Budget Narrative)

Summer Contract

Tim Dunnagan- Ultimately, Dr. Dunnagan will be responsible for all aspects of the project supervision, implementation, and evaluation. Dr. Dunnagan will also be responsible for submitting a manuscript based upon the project results to a refereed journal, interim progress reports, and the final report/presentation. The summer stipend of \$1,000 will provide partial payment for these efforts and to begin the development of a proposal which will solicit funding for a statewide fall prevention program.

Assistance or Contracted Services

Shawna Button- Shawna is a graduate student in HHD who is intensely interested in conducting research in the area of fall prevention programming for the elderly. This project would provide her with the opportunity to actualize this goal. Consequently, she will be the person who provides the relevant training to volunteers, educational presentations, data collection, data entry, and makes the necessary contacts within the community. The \$1,200.00 stipend will provide her with partial compensation for her work in this project.

Marnie Cranston- Marnie is a registered dietitian who has extensive experience working with elderly populations. Marie will oversee the nutritional assessments and develop necessary dietary modifications for the senior-citizen who are at risk. The \$300.00 stipend will pay for these services.

Supplies, Materials, Travel, Per Diem, Etc.

Educational Talks/Initial Presentation - For the initial presentation to the senior-citizens a slide show will be given to generate interest in the programming. Also, presentations will be developed on the three components of the fall prevention program (exercise, nutrition, and environmental assessment). The cost to develop these presentations is \$200.00.

Brochures, Pamphlets and Checklists- The written nutritional, exercise, and environmental education materials are essential to the implementation of the home based interventions. The cost for these materials is \$450.00.

Weights- A major component to the exercise programming involves the use of weights. The participants will use the weights during the six month intervention. At the end of the study the participants are given the weights so that they can continue their exercise regime at the end of the testing period. The cost of the weights is \$450.00.

Photocopying/Questionnaires- Questionnaires will be needed to evaluate the needs of the senior-citizens and the effectiveness of the interventions. Specifically, the In-home Questionnaire (\$100.00) is used to evaluate needed changes within the participant's home. Furthermore, the effectiveness of the program is partially evaluated through the Pre/Post Analysis Questionnaires (\$200.00). Finally, photocopies which relate to the areas of nutrition, exercise, and environmental safety will be made for the participants.

Travel- The intervention is being conducted in Three Forks, Mt which is approximately 35 miles from Bozeman. This will require that the researchers make a number of trips to Three Forks for presentations, interviews and environmental assessments. The travel cost are \$175.00.

APPENDIX B
HUMAN SUBJECTS COMMITTEE FORMS

Date 12/11/97

Approval	Date	Application #

I. Investigators and Associates (application will be filed under name of first person listed)

II. Title of Proposal Senior Citizen Fall Prevention Project

IV. Type of Grant (if applicable)

____ Classroom Experiments/Projects ____ Other (Specify)

V. Name of Funding Agency to which Proposal is Being Submitted
(if applicable) College of Education, Health and Human Development Research and Creativity Grant

VI. Signatures

Submitted by Investigator Shawna Yates
Typed Name

Signature _____ Date _____

Faculty sponsor (for student) Tim Dunnagan
Typed Name

Signature

Date

VII. Summary of Activity. Provide answers in spaces. (Add sheets when needed.)
Do not refer to an accompanying grant or contract proposal.

A. RATIONALE AND PURPOSE OF RESEARCH (What question is being asked?)

Many older adults are at high risk for losing their independence due to lost physical function. Extending one's independence in later years is of critical importance for quality of life to older adults. Consequently, programming which addresses fall-related risks is needed. Therefore, the purpose of this study is to determine the efficacy of a three month fall prevention intervention at increasing older adults functional mobility and perceptions of well-being. Specifically, the investigators will evaluate if the intervention improves measures of strength, coordination, nutrition, self-efficacy and home environmental safety.

B. RESEARCH PROCEDURES INVOLVED. Provide a short description of sequence and methods of procedures that will be performed with human subjects. Include details of painful or uncomfortable procedures, frequency of procedures, time involved, names of psychological tests, questionnaires, restrictions on usual life patterns, and follow up procedures.

Sixty human subjects over the age of 65 will be recruited from Three Forks, MT and its surrounding area. Specifically, a letter of recruitment will be sent to older adults who participate in programs of the Three Forks Senior Citizen Center or are involved in the area churches. The subjects will be asked to sign an informed consent. They will be randomly assigned to either the delayed treatment (control) or the treatment group. They will also be asked for permission to complete the testing procedures in their homes. This study will follow a quasi-experimental pre-test post-test design.

Pre-testing/Post-Testing

All of the subjects will undergo the pre-tests and the post-tests which will take approximately two hours. The subjects will be pre-tested in February, 1998 and post tested in June, 1998. There are a number of measures that will be used and are listed as follows:

Psychometric Scales

- 1.) Falls Efficacy Scale (5 minutes):
This ten question instrument measures fear of falling. It addresses the level of confidence each subject has performing ten nonhazardous activities of daily living (ADL's). Subjects rate their confidence on a scale of 1-10, ten connotes the lowest level of confidence (Tinetti, M.E., et al., 1990).
- 2.) Depression (5 minutes):
This eleven question instrument measures depression. The instrument uses a five point Likert scale.
- 3.) Social Support Questionnaire (10-15 minutes):
This six question instrument measures the perceived number of social supports in a person's life and the degree to which they are personally satisfied with that support. Each question has two parts. First the subjects are asked to list those people either by name or relationship who offer such support. Second, they are to rate their satisfaction with that level of support.

Nutrition

4.) Nutritious Food Behavior Scale (5 minutes):

This nine question instrument measures food selection and avoidance. The nine questions ask about foods that act as a prophylaxes against nutritional related illness in the elderly. The subject will choose one of the three responses. The scores for the nine questions will be summated with the highest possible score being 27 and the lowest being 9. The highest score reflects the most reported nutritious food behavior. Subjects scoring very high report trying very hard to avoid salt, sugar, cholesterol and calories and eating fruit and vegetables; frequently reading labels on packaged items; and on a daily basis eating fruits and vegetables (Houts, S.S. & Warland R.H., 1989).

5.) Locus of Control for Nutrition (5 minutes):

This five question instrument measures locus of control expectancies in food behavior. A summation of the five scores can range from 5-15. Those with an internal locus of control will score highest on the continuum and those with an external locus of control will score lowest. A person with an internal locus of control believes the desired outcome is within his/her control. A person who indicates an external locus of control believes the outcome is not within his/her control, but controlled by someone or something else (Houts, S.S. & Warland R.H., 1989).

Environmental Hazards

6.) In-Home Assessment (30 minutes):

This forty question instrument measures environmental fall-related risk. The questions ask about various in-home hazards. The scores range from 11 (low risk) to 40 (high risk)

Functional Assessments

7.) Arm Curl (5 minutes):

Its purpose is to measure upper body bicep endurance. The subject will be asked to curl a 5 lb. barbell through a full range of motion as many repetitions as possible during 30 seconds. The number of curls will be counted and recorded.

8.) Scratch Test (5 minutes):

This test is used to determine overall shoulder range of motion. The subjects will reach behind the head with one hand and behind the back with the other. They will try to touch their two index fingers together behind the back. The distance between the two fingers will be measured and recorded. The subjects are allowed one practice measurement.

9.) Get Up and Go Test (5 minutes):

Its purpose is to assess mobility, which involves gait speed, agility, balance and coordination. The test involves a chair with an eight foot course directly in front of the subject. The subject begins by sitting in the chair and upon the timers command rises from the chair and walks to the end of the 8' course. After reaching the end of the course, the subject goes around a cone and returns to the chair in a seated position. This is a timed test and the subjects are allowed one practice run.

10.) Dorsiflexion of the ankles (2 minutes):

Measurement is taken to assess the flexibility of the ankle and determine if a subject is at risk for drop foot. The subjects foot will be placed on a flexion board with an initial angle of measure at 104°. They are asked to dorsiflex their foot and the final angle is measured with a protractor. Two measurements will be taken and averaged.

11.) Tinetti Balance Assessment (5 minutes):

This nine question instrument assesses balance. Subjects score between 0-16 with sixteen being the best possible balance rating.

13.) Power Test (5 minutes):

Its purpose is to assess power in the lower body. First, the subjects will be weighed on a bathroom scale. Next, the subject's height will be measured from a sitting position. Finally, the subject will be timed to see how long it takes to rise to a full standing position. After the subject is in a standing position, another height measurement will be taken. Collectively, these measures will be calculated to determine the subjects ability to generate power from a sitting to a standing position.

Intervention

The intervention period will last three months beginning March 1, 1998.

Treatment Group

The subjects will be briefed on the importance of fall prevention. They will receive education about the fall-risk factors by the investigator. The subjects assigned to the treatment group will receive a three part intervention to help reduce their of fall-related risk factors. The intervention consists of exercise programming, nutritional counseling and/or referral, and environmental hazard education.

1.) Exercise Program

The exercise program prescription is to follow the Movement Matters: Home Based Exercise Program, by Kay Van Norman at least three times a week. Each exercise session should take around fifteen minutes once they become comfortable with the routine. To facilitate muscular strength and endurance development, each subject will be given a set of 5-lb. weights. Log sheets will be included to evaluate exercise compliance. (See Appendix B).

2.) Nutrition Counseling

Those subjects that scored between nine and eighteen on the Nutritious Food Behavior Scale during the first site visit will receive nutrition education materials provided by a Registered Dietician.

3.) Environmental Hazard Education

During the first home visit an environmental assessment of the subject's home will be conducted by the investigator. Based upon this analysis, safety modifications to the home environment will be outlined for the subject.

Delayed Treatment (Control) Group

After the 3 month intervention period the delayed treatment group will receive the exercise, nutrition, and environmental safety interventions.

- C. DECEPTION - If any deception (withholding of complete information) is required for the validity of this activity, explain why this is necessary and attach debriefing statement.

None

D. SUBJECTS

1. Approximate number and ages

	How Many	Age Range
Patients	30	65-95
Normal/Control	30	65-95

2. Criteria for selection

The subjects will be chosen from a population of seniors who are at least 65 years old and living within 30 miles of Three Forks, MT. They must agree to volunteer as a subject and sign the informed consent.

3. Criteria for exclusion

Subjects will be excluded if they are currently 1) living in an institution, 2) confined to a wheelchair or 3) participating in an exercise program outside of their home.

4. Source of Subjects (including patients)

All subjects will be residents of the Three Forks area. The subjects will be recruited from the Three Forks Senior Citizen Center and through the area Ministries.

5. Who will approach subjects and how? Explain steps taken to avoid coercion.

A recruitment letter will be sent to all participants of the Meals on Wheels program and the elders of the area churches. Also an announcement will appear in the local newspaper. The recipients of the letter will be asked to contact Shawna Yates for more information and to sign-up for the study. All promotional materials used in the recruitment efforts will stress that participation is strictly voluntary.

6. Will subjects receive payments, service without charge, or extra course credit? X Yes No. If yes, what amount and how? Are there other ways to receive similar benefits?

Each of the subjects will receive a one-time payment of ten dollars for their time in filling out the questionnaires and doing the functional assessments. Each of the subjects will also receive the Fall Prevention interventions, educational materials and a set of 5 lb. ankle weights.

7. Location(s) where procedures will be carried out.

Pre-testing and post-testing will take place in the subject's homes.

E. RISKS AND BENEFITS (ADVERSE EFFECTS)

1. Describe nature and amount of risk and/or adverse effects (including side effects), substantial stress, discomfort, or invasion of privacy involved.

There is a small risk inherent in any exercise program. Each of the subjects will be required to get the Physicians Consent Form signed by their family physician. This exercise program is primarily functional-based and does not tax the cardiovascular system. Please see the exercise brochure which is included in Appendix B. The remainder of the intervention and testing measures are not associated with any risk, however they may be seen as an invasion of privacy when asked questions about their domain, mental state and nutrition. They will be informed of these questions prior to enrollment.

2. Will this study preclude standard procedures (e.g., medical or psychological care, school attendance, etc.)? If yes, explain.

No

3. Describe the expected benefits for individual subjects and/or society.

One-third of all persons over the age of 65 fall every year. The number of deaths, disabilities and high costs associated with falls make them a serious public health concern. This fall prevention project is aimed at independent older persons in the community and focuses on keeping them independent. This project is unique in that it combines nutrition, exercise and environmental safety to help individuals keep control of their lives. It will help them to remain strong and physically functional. The intervention can help prevent a number of illnesses and a cascade of fall-related risk factors. Most importantly it will improve their sense of confidence and help them to remain active and leading independent lifestyles

F. ADVERSE EFFECTS

1. How will possible adverse effects be handled?
 ___by investigator(s), Xreferred by investigator(s) to appropriate care
 ___other (explain)
2. Are facilities/equipment adequate to handle possible adverse effects? X
 Yes ___No. If no, explain.
3. Describe arrangements for financial responsibility for any possible adverse effects.
 ___MSU compensation (explain) ___sponsoring agency insurance
Xsubject is responsible ___other (explain)

G. CONFIDENTIALITY OF RESEARCH DATA

1. Will data be coded? XYes ___No

2. Will master code be kept separate from data? ☒ Yes ☐ No
3. Will any other agency have access to identifiable data?
☐ Yes ☒ No. If yes, explain:
4. How will documents, data be stored and protected?
☒ locked file ☒ computer with restricted password ☐ other
(explain):

VIII. Checklist to be Completed by Investigator(s)

- A. Will any group, agency, or organization be involved?
☐ Yes ☒ No. If yes, please confirm that appropriate permissions have been obtained.
- B. Will materials with potential radiation risk be used (e.g. x-rays, radioisotopes)?
☐ Yes ☒ No
 1. Status of annual review by MSU Radiation Sources Committee (RSC).
☐ Pending ☐ Approved. If approved, attach one copy of approval notice. N/A
 2. Title of application submitted to MSU RSC (if different).
- C. Will human blood be utilized in your proposal?
☐ Yes ☒ No. If yes, please answer the following:
 1. Will blood be drawn? ☐ Yes ☒ No. If yes, who will draw the blood and how is the individual qualified to draw blood? What procedure will be utilized?
 2. Will the blood be tested for HIV? ☐ Yes ☒ No
 3. What disposition will be made of unused blood? N/A
 4. Has the Biosafety Committee been contacted?
☐ Yes ☒ No.
- D. Will non-investigational drugs or other substances be used for purposes of the research? ☐ Yes ☒ No

Name Dose Source How Administered Side effects

- E. Will any investigational new drug or other investigational substance be used?
Yes X No. If yes, provide information requested below and once copy of: 1) available toxicity data; 2) reports of animal studies; 3) description of studies done in humans; 4) concise review of the literature prepared by the investigator(s); and 5) the drug protocol.

Phase of

<u>Name</u>	<u>Dose</u>	<u>Source</u>	<u>How Administered</u>	<u>IND Number</u>	<u>Testing</u>
-------------	-------------	---------------	-------------------------	-------------------	----------------

- F. Will an investigational device be used? Yes X No. If yes, provide name, source description of purpose, how used, and status with the U.S. Food and Drug Administration (FDA). Include a statement as to whether or not device poses a significant risk. Attach any relevant material.
- G. Will medical or academic records be used? Yes X No.
- H. Will audio-visual or tape recordings or photographs be made?
 Yes X No.
- I. Will written consent form(s) be used? X Yes No. If no, explain.



WWAMI Medical Program
326 Leon Johnson Hall
PO Box 173080
Montana State University
Bozeman, MT 59717-3080
Telephone 406-994-4411
FAX 406-994-4398

TO: Tim Dunnagan

FROM: Stephen Guggenheim
Chair, Human Subjects Committee

DATE: December 18, 1997

SUBJECT: Senior Citizen Fall Prevention Project

The above proposal was considered by the Human Subjects Committee at its meeting of December 18, 1997. The committee requested the following changes or clarifications.

- a. Page 3 of the proposal indicates that the barbell to be used is 5 lbs., whereas the consent form indicates a 2.5 lb barbell. The committee would like these brought into agreement.
- b. In the consent form, the committee felt that the term "instrument" might not be easily understood by all subjects and requests the use of some other term such as "form" or "questionnaire."

Once these changes have been received by the committee, the proposal can be approved without further deliberation by the committee.



WWAMI Medical Program

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FAX 406-994-4398

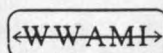
TO: Tim Dunnagan

FROM: Mark Quinn *Mark J. Quinn*
Acting Chair, Human Subjects Committee

DATE: January 14, 1998

SUBJECT: Senior Citizen Fall Prevention Project

Thank you for submitting the revisions and clarifications requested by the Human Subjects Committee. This proposal is now approved for a period of one-year. At the end of this period you will receive a follow-up form which will be used to evaluate this proposal for renewal. Please remember that subjects should receive a copy of the consent form. If there are any changes in the research protocol or if there are any adverse effects of the research on the subjects, the committee should be informed as soon as possible.



APPENDIX C

RECRUITMENT LETTERS AND BROCHURE



**Department of Health
and Human Development**

Hosaeus PE Complex
P.O. Box 173360
Bozeman, MT 59717-3360

Telephone (406) 994-4001
Fax (406) 994-6314

March 17, 1998

Dear Meals on Wheels Participants;

For just a moment, I would like to tell you about a special program I am offering. It is titled a Fall Prevention Program and is described in the yellow brochure. I also like to look at it as a *let's get tuned up for summer program*. Many seniors find themselves less active during the winter, due to the snow, ice and cold. However if we are less active, we become weaker. Specifically, we will be working on things to make you stronger, healthier, and happier.

I need at least 40 people over the age of 65. The program will begin as soon as you sign up, because your program will be unique for you. Some of the benefits include:

- * \$10 incentive for completing the program
- * Improve strength, flexibility, coordination, and balance
- * Receive a free set of weights for your exercises
- * Become educated about falls and fall prevention
- * Learn how to make your home safer
- * All activities take place in your home, there is no traveling to my office or the Senior Center

Please join me! This program is going to be a lot of fun and you will learn a great deal of useful things. If you have any questions or are interested in signing-up, please fill out the flap in the yellow brochure and mail it or call me at 994-4001.

Let's jump into spring together!!!

Sincerely,

Shawna Yates

Shawna Yates

Graduate Student, Health and Human Development



**Department of Health
and Human Development**

Hosaeus PE Complex
P.O. Box 173360
Bozeman, MT 59717-3360

Telephone (406) 994-4001
Fax (406) 994-6314

March 17, 1998

Dear Seniors;

Happy St. Patrick's Day!

For just a moment, I would like to tell you about a special program I am offering. It is titled a Fall Prevention Program and is described in the yellow brochure. I also like to look at it as a *let's get tuned up for summer program*. Specifically, we will be working on things to make you stronger, healthier, and happier.

I need at least 40 people over the age of 65. The program will begin as soon as you sign up, because your program will be unique for you. Some of the benefits include:

- * \$10 incentive for completing the program
- * Improve strength, flexibility, coordination, and balance
- * Receive a free set of weights for your exercises
- * Become educated about falls and fall prevention
- * Learn how to make your home safer
- * All activities take place in your home, there is no traveling to my office or the Senior Center

Please join me! This program is going to be a lot of fun and you will learn a great deal of useful things. If you have any questions or are interested in signing-up, please fill out the flap in the yellow brochure and mail it or call me at 994-4001.

Let's jump into spring together!!!

Sincerely,

Shawna Yates
Shawna Yates

Graduate Student, Health and Human Development

- ◆ Become educated about falls and fall prevention.
- ◆ Improve strength, flexibility, coordination and balance.
- ◆ Learn some easy secrets to better nutrition.
- ◆ Reduce your fall-related risk factors.
- ◆ Work closely with an expert in the area of fall prevention.

If you have questions about this program please call Shawna Yates at 994-4001.

We would really like your help in order to determine if this program should be used state wide. Falls are a serious problem and we are on the frontier of making them a thing of the past for many older adults.

Benefits of this Program

- ◆ Reduce fear of falling.
- ◆ Learn how to make your home safer.
- ◆ Receive a \$10 incentive for completing the program.
- ◆ Receive a set of weights for the exercise programming.
- ◆ Maintain your independence for years to come.

Please Join Us

Fall Prevention

It Makes A Difference



Fall Prevention Project

Dept. Health and Human Development
Montana State University, PEC 101
Bozeman, MT 59717

(406) 994-4001

Our mission is to help older adults maintain physical independence by providing fall prevention education.

Falls are the leading cause of fatal and non-fatal injuries in people 65 and older in the United States. Falls can happen at any time, but most falls by people 65 and older occur in the home during everyday activities.

The cost of falls is outstanding. Every year the United States spends over \$20 billion for the treatment of falls. More important are the costs to the individual, such as reduced independence, decline in quality of life, and severe physical and emotional pain.



There is a pattern to falls among older adults - fear of falling, decreased independence and mobility, injury, followed by hospitalization, and possible relocation to a nursing or residential facility.

- ♦ 30% of people over 65 fall each year
- ♦ 90% of the 300,000 hip fractures every year are due to falls

**Falls are *not* natural occurrences.
You Can Prevent Falls**

FALL-RELATED RISK FACTORS

- ♦ Lack of Physical Activity
- ♦ Osteoporosis
- ♦ Environmental Hazards
- ♦ Impaired Vision
- ♦ Use of Psychoactive Medications
- ♦ Depression
- ♦ Social Isolation
- ♦ Poor Nutrition
- ♦ Poor Balance

Fall Prevention Program Begins March 19, 1998

The College of Education, Health and Human Development at Montana State University is sponsoring a Fall Prevention Program that will help you to reduce your number of fall-related risk factors. The program begins March 2, 1998 and is of no cost to you. There will be a \$10 incentive to all participants who complete the program. The program is three months long. All of the program activities will take place in your home. If you are interested please return the response



Description of Program

All of the participants will undergo some testing in March to determine fall-related risks. At this time the investigators will obtain your permission and your physician's permission in order to ensure your safe participation in the program.

Participants will be randomly divided into two groups. One group will receive the intervention in March and the other will need to wait until May.

Again in May all participants will

undergo the same testing procedures to determine if there was a reduction in fall-related risks.

The intervention, which lasts 10 weeks will include:

- a simple exercise routine,
- an evaluation of your nutrition with simple suggestions for improvement,
- and an assessment of environmental hazards in your home with education about improvements.

All of the intervention and pre/post testing will take place in your home. The investigators will visit with you and answer any questions you may have.

Fall Prevention Program

☐ Yes, I would like to participate in this Fall Prevention Program.

☐ Please call me with more information regarding this Fall Prevention Program.

Name: _____

Address: _____

Telephone #: _____

Please Mail To:

Shawna Yates
Department of Health and Human Development
PEC 101
Montana State University - Bozeman
Bozeman, MT 59717

APPENDIX D

SUBJECT CONSENT AND PHYSICIAN CONSENT FORMS

**SUBJECT CONSENT FORM
FOR
PARTICIPATION IN HUMAN RESEARCH
MONTANA STATE UNIVERSITY**

Fall Prevention Program for Older Adults

You are being asked to participate in a study of a fall prevention program. Older adults experience functional decline as they age, however at least 50 percent of this loss is preventable or reversible with appropriate intervention. This fall prevention program may help us understand if an intervention consisting of exercise programming, nutrition counseling and environmental safety assessment will help reduce a person's fall-related risks. You have been chosen as a participant for the study because you meet the criteria of being over the age of sixty-five, you live independently and you are not currently enrolled in an exercise program outside of your home.

This study will consist of a treatment group, which will receive the three part intervention during the first three months (March-May, 1998) and a delayed treatment group, which will receive the intervention June-August, 1998. All of the participants will be randomly assigned to either the treatment group or the delayed treatment group. All components of the study will take place within your home.

If you agree to participate this study will be seven months in length. It will begin February 1, 1998, and conclude by the end of August, 1998. First, you will be asked to participate in a two hour session for pre-testing. The tests involved during this session are described below:

* **Power Test** (5 minutes) - You will be asked to rise from a seated position to a standing position. This interval will be timed. You will also be weighed on our bathroom scale. From these measurements power will be calculated for the lower body.

* **Arm Curl** (5 minutes) - A 2.5-lb. weight will be placed in your

preferred hand, while in a seated position. For 30 seconds you will be asked to curl the weight thru a full range of motion. The number of repetitions will be counted.

* **Scratch Test** (5 minutes) - While standing you will be asked to place your preferred hand over the same shoulder and reach as far down your back as you can. Your other hand will be placed behind your back and reaching up as far as you can. The object is to touch your fingers together. The distance between or the distance between will be measured.

* **Get Up and Go** (5 minutes) - You will begin in a seated position with a cone placed 8 feet in front of you. On the signal "go" you will be asked to rise from the chair, walk around the cone and return to a seated position in the chair. The test will be timed.

* **Dorsiflexion of the ankle** (2-3 minutes)- The flexion of your ankle will be measured with a goniometer.

* **Tinetti Balance Scale** (5 minutes)- Your balance will be assessed in the seated position, the standing position, eyes closed, and turning a 360° circle.

* **Falls Efficacy Scale** (5 minutes) - This ten question form measures fear of falling. It addresses the level of confidence you have performing ten nonhazardous activities of daily living (ADL's).

* **Depression** (5 minutes) - This eleven question form measures emotional state.

* **Social Support Questionnaire** (10-15 minutes) - This six question form measures the perceived number of social supports in your life and the degree to which you are personally satisfied with that support. Each question has two parts. First, you are asked to list those people either by name or relationship who offer such support. Second, you are to rate your satisfaction with that level of support.

* **Nutritious Food Behavior Scale** (5 minutes) - This nine question form measures food selection and avoidance. The nine questions ask about foods that act as a prophylaxes against nutritional related illness in old age.

* **Locus of Control for Nutrition** (5 minutes) - This five question form measures locus of control expectancies in food behavior.

* **In-Home Assessment** (30 minutes) - This forty question form measures environmental fall-related risk. The questions ask about various in-home hazards. For 30 minutes you and the investigator will walk through your home answering these 40 questions.

After the pretests have been completed those in the treatment group will receive a three part intervention. First you will be set up with an exercise program. You will receive a set of 5-lb. weights and an exercise brochure. You will be asked to follow the brochure and complete the exercise program at least three times a week. During the 3 month intervention you will also be asked to keep a log of the exercise you do and any other physical activity. Each of the subjects in the treatment group will also receive nutrition counseling and outlined recommendations on how to modify environmental risks. Those who are assigned to the delayed treatment group will have no responsibilities for the study until May when they begin their three month intervention. Upon completion of the 3 month intervention the same tests as above will be reassessed. If you are assigned to the delayed treatment group you will perform the assessment tests at the beginning of the study (February, 1998), at the end of the first intervention (May, 1998), and following your intervention time period (August, 1998).

During the functional testing and when performing the exercise intervention you will be instructed to never push yourself to the point of overexertion or beyond a point where you feel safe. As with any kind of exercise program there is a risk of injuring yourself. If you experience chest pain, joint pain, and/or dizziness please stop the exercise program and contact the researchers and your physician.

This study is offered at no cost to you. As an incentive you will receive a payment of ten dollars for your time. You will also keep all of the educational materials and the exercise brochure and weights. This fall prevention program may help you improve your strength, coordination and balance. It will also make you more aware of your nutritional habits and the environmental risk within your home that put you more at risk for a fall. If you have any questions please feel free to ask the researchers at any time.

The researchers will treat your identity and test results with professional standards of confidentiality. The information obtained in this study may be published in scientific journals, but your identity will not be revealed.

In the unlikely event your participation in this research results in injury to you, medical treatment will be available, but there is no compensation for such injury. Further information about medical treatment may be obtained by calling Dr. Tim Dunnagan at 994-6330.

If you have any questions regarding the rights of Human Subjects in research, please contact the Chairman of the Human Subjects Committee, Stephen Guggenheim at (406) 994-4411.

AUTHORIZATION: I have read the above and understand the discomforts, inconvenience and risk of this study. I, _____
agree to participate in this research. I understand that I may later refuse to participate, and that I may withdraw from the study at any time. I have received a copy of this consent form for my own records.

Signed

Witness _____

Investigator _____

Date _____

Medical Recommendation Form
For
Participation in Human Research
Montana State University

To: **FIELD**(Physician).
Fr: Tim Dunnagan, Assistant Professor, Department of Health and Human Development,
MSU-Bozeman
Re: **FIELD**(Subject); to participate in a Fall Prevention program

This letter is to inform you that your patient named above has enrolled in a Fall Prevention Study at Montana State University. This program is designed to reduce the number of fall related risk factors that an older adult might have. Specifically, this program focuses on muscular strength, range of motion, balance, coordination and proper nutrition. It consists of a three part intervention program: exercise programming, nutrition counseling, and environmental safety assessment. The exercise intervention is a three month program as described in the enclosed brochure. The subject will also receive nutrition education from a Registered Dietician. As part of the evaluation measures the participants will perform five functional tests which include the **Lower Extremity Power Test**, the **Arm Curl**, the **Scratch Test**, the **Timed Get Up and Go**, the **Tinetti Balance Test**, and a measurement of **Dorsiflexion of the ankle**.

* **Lower Extremity Power Test** - Involves the subject standing one time from a seated position.

* **Arm Curl** - A 2.5-lb. weight will be curled with the bicep of the preferred arm for a maximum number of repetitions in 30 seconds

* **Scratch Test** - While standing the participant will be asked to place their preferred hand over the same shoulder and reach as far down their back as they can. The other hand will be placed behind their back and reach up as far as they can. The object is to touch the fingers together. The distance of overlap or the distance between will be measured.

* **Timed Up and Go** - The participant will begin in a seated position with a cone placed 8 feet in front of them. On the signal "go" they will rise from the chair, walk around the cone and return to a seated position in the chair. The test will be timed.

* **Dorsiflexion of the ankle** - The flexion of both ankles will be measured with a goniometer.

*** Tinetti Balance Test** - The participants will have their balance assessed while they are sitting, upon standing, with their eyes closed and while turning in a 360° circle.

In order for the staff to provide a safe and beneficial fall prevention program, it is necessary to determine the appropriateness of involvement in the program. Your cooperation will be greatly appreciated. If you have any questions please call Dr. Tim Dunnagan at 994-6330. Please check one of the following.

_____ This patient has no contraindications or restrictions which will prevent them from participating in this fall prevention program.

_____ This patient has the following contraindications, but can still participate in this fall prevention program.

_____ I do not recommend that this patient participate in this fall prevention program for medical reasons.

_____, M.D.

Date _____

Phone _____

(Please print or type name)

APPENDIX E
QUESTIONNAIRE

PRE-TEST _____
POST-TEST _____

Section A - Demographics

Please answer the following questions for our records. All of the information will be held confidential.

A1. What is your name? _____

A2. What are the last four digits of your social security number? _____

A3. What is your current age? _____

A4. What is your gender?

☐ Male ☐ Female

A5. What is your marital status?

☐ Single

☐ Married

☐ Widowed

☐ Divorced

A6. Have you fallen in the last month?

☐ Yes ☐ No

A6a. If yes, how many times? _____

A7. Did you graduate from high school?

☐ Yes ☐ No

Section B - Falls Efficacy Test

How confident are you that you can. . .

	Not Confident At All	Fairly Confident	Completely Confident
B1. Get dressed and undressed.			
B2. Prepare a simple meal.			
B3. Take a bath or a shower.			
B4. Get in/out of a chair.			
B5. Get in/out of bed.			
B6. Answer the door or telephone.			
B7. Walk around the inside of your house.			
B8. Reach into cabinets or closets.			
B9. Light housekeeping.			
B10. Simple shopping.			
B11. Using transportation.			
B12. Crossing roads.			
B13. Light gardening or hanging out the wash.			
B14. Using front or rear steps at home.			

Section C - Depression Scale

The following is a list of problems or complaints that people have. Indicate how much each has bothered or distressed you in the last two weeks, including today.

In the last two weeks, how much were you bothered or distressed by:

	Not at All	A Little Bit	Moderately	Quite a Bit	Extremely
C1. Crying easily?					
C2. Blaming yourself for things?					
C3. Feeling lonely?					
C4. Feeling no interest in things?					
C5. Feeling blue?					
C6. Thoughts of ending your life?					
C7. Feeling hopeless about the future?					
C8. Heavy feelings in your arms or legs?					
C9. Loss of sexual interest or pleasure?					
C10. Feeling low in energy or slowed down?					
C11. Poor appetite?					

Section D - Social Support Questionnaire

The following questions ask about people in your environment who provide you with help or support. Each question has two parts. For the first part, list all the people you know, excluding yourself, whom you can count on for help or support in the manner described. You may either give the person's initials or their relationship to you.

For the second part, circle how satisfied you are with the overall support you have.

If you have no support for a question, check the word "No One", but still rate your level of satisfaction. Do not list more than nine persons per question.

Please answer all questions the best you can. All your responses will be kept confidential.

D1. Whom can you really count on to listen to you when you really need to talk?

D1a. How satisfied are you with this support?

Very Satisfied	Moderately Satisfied	Satisfied	Dissatisfied	Moderately Dissatisfied	Very Dissatisfied
-------------------	-------------------------	-----------	--------------	----------------------------	----------------------

D2. Whom could you really count on to help you out in a crisis situation, even though they would have to go out of their way to do so?

D2a. How satisfied are you with this support?

Very Satisfied	Moderately Satisfied	Satisfied	Dissatisfied	Moderately Dissatisfied	Very Dissatisfied
-------------------	-------------------------	-----------	--------------	----------------------------	----------------------

D3. Whom can you really count on to be dependable when you need help?

D3a. How satisfied are you with this support?

Very Satisfied	Moderately Satisfied	Satisfied	Dissatisfied	Moderately Dissatisfied	Very Dissatisfied
-------------------	-------------------------	-----------	--------------	----------------------------	----------------------

D4. With whom can you totally be yourself?

D4a. How satisfied are you with this support?

Very Satisfied	Moderately Satisfied	Satisfied	Dissatisfied	Moderately Dissatisfied	Very Dissatisfied
----------------	----------------------	-----------	--------------	-------------------------	-------------------

D5. Who do you feel really appreciates you as a person?

D5a. How satisfied are you with this support?

Very Satisfied	Moderately Satisfied	Satisfied	Dissatisfied	Moderately Dissatisfied	Very Dissatisfied
----------------	----------------------	-----------	--------------	-------------------------	-------------------

D6. Whom can you count on to console you when you are very upset?

D6a. How satisfied are you with this support?

Very Satisfied	Moderately Satisfied	Satisfied	Dissatisfied	Moderately Dissatisfied	Very Dissatisfied
----------------	----------------------	-----------	--------------	-------------------------	-------------------

Section E - Nutritious Food Behavior Scale

How hard do you try to do the following. . .

E1. Avoid foods high in salt	Try Very Hard	Try Somewhat	Don't Worry About It
E2. Eat plenty of vegetables	Try Very Hard	Try Somewhat	Don't Worry About It
E3. Avoid foods high in sugar	Try Very Hard	Try Somewhat	Don't Worry About It
E4. Avoid foods high in cholesterol and saturated fat	Try Very Hard	Try Somewhat	Don't Worry About It
E5. Eat plenty of fruit	Try Very Hard	Try Somewhat	Don't Worry About It
E6. Avoid food high in calories	Try Very Hard	Try Somewhat	Don't Worry About It

How often do you. . .

E7. Check nutrition and ingredient labels to see what's in a food product.	Frequently	Sometimes	Seldom or Never
--	------------	-----------	-----------------

How often do you. . .

E8. Eat some kind of vegetable.	Everyday	Almost Everyday	2 or 3 Times a Week
E9. Eat some kind of fruit.	Everyday	Almost Everyday	2 or 3 Times a Week

Section F - Locus of Control for Nutrition

F1. How much of an effect do you feel what you eat will have on your future health?

Very Much	Somewhat	Not Very Much
-----------	----------	---------------

F2. To what extent do you feel your health depends on how you take care of yourself?

Very Much	Somewhat	Not Very Much
-----------	----------	---------------

F3. Some people feel that if you're going to be sick, you'll be sick - how much do you feel it's possible to prevent sickness?

Very Much	Somewhat	Not Very Much
-----------	----------	---------------

F4. If qualified health professionals recommend eating certain foods, how likely is it you'll try them?

Very Much	Somewhat	Not Very Much
-----------	----------	---------------

F5. Are you more concerned about what you eat than you used to be?

Definitely	Maybe	Not really
------------	-------	------------

Section G - In-Home Assessment**Kitchen:**

G1. Are kitchen items stored where they can easily be reached?

☐ Yes ☐ No

G2. Is there a lot of bending or reaching needed for the subject to get things from the cupboards?

☐ Yes ☐ No

G3. Is there a foot stool?

☐ Yes ☐ No

G4. Is the kitchen table sturdy?

☐ Yes ☐ No

G5. Are the kitchen chairs sturdy?

☐ Yes ☐ No

G6. Do the chairs have armrests?

☐ Yes ☐ No

G7. Is the floor waxed regularly?

☐ Yes ☐ No

G8. Is there a rug or rubber mat near the sink?

☐ Yes ☐ No

G9. Are the dials on the stove easy to read?

☐ Yes ☐ No

Bathroom:

G10. Does the bathtub or shower have a slippery surface?

☐ Yes ☐ No

G11. Does the side of the tub have a support or transfer rail?

☐ Yes ☐ No

G12. Does the toilet have a stable grab rail?

☐ Yes ☐ No

G13. Is the toilet seat lower than 40 centimeters high?

☐ Yes ☐ No

G14. Is there a lock on the door?

☐ Yes ☐ No

Stairways:

G15. Is the rise between steps consistent for all inclines?

☐ Yes ☐ No

G16. Is there a handrail?

☐ Yes ☐ No

G17. Does the handrail extend the full length of the stairs?

☐ Yes ☐ No

G18. Is the stairway long and steep?

☐ Yes ☐ No

G19. Are there non-skid treads or secure carpet on each of the stairs?

☐ Yes ☐ No

G20. Is there adequate lighting?

☐ Yes ☐ No

G21. Are there any objects stored on the steps?

☐ Yes ☐ No

G22. Are the top and bottom steps marked in some fashion?

☐ Yes ☐ No

G23. Are the steps in good repair?

☐ Yes ☐ No

General Household:

G24. Is the lighting adequate throughout the whole house or apartment?

☐ Yes ☐ No

G25. Are the lights accessible upon entering each room?

☐ Yes ☐ No

G26. Do any of the carpets need repairing?

☐ Yes ☐ No

G27. Are all the rugs tacked down or consist of nonskid backs?

☐ Yes ☐ No

G28. Are hallways cluttered with furniture or other obstacles?

☐ Yes ☐ No

G29. Are there adequate pathways through each room?

☐ Yes ☐ No

G30. Are all tables stable and sturdy?

☐ Yes ☐ No

G31. Do the chairs have armrests and high backs?

☐ Yes ☐ No

G32. Is the temperature of the house kept between 68-76 degrees Fahrenheit?

☐ Yes ☐ No

G33. Are there any cords in the walking paths?

☐ Yes ☐ No

Yards and Entrances:

G34. Are there any cracks in the pavement of the sidewalk or driveway?

☐ Yes ☐ No

G35. Do the stairs have handrails?

☐ Yes ☐ No

G36. Are the stairs clear of debris?

☐ Yes ☐ No

G37. Are there any holes in the lawn?

☐ Yes ☐ No

G38. Is the lawn clear of tools, rocks, hoses, and any other objects that could be hazards?

☐ Yes ☐ No

G39. Are the walkways well lit?

☐ Yes ☐ No

G40. Are the sidewalks clear of ice and debris?

☐ Yes ☐ No

H. -- Physical Function Assessments

	PreTest	PostTest
H1. Tinetti Assessment Tool		
H2. Dorsiflexion	L. R.	L. R.
H3. Arm Curl		
H4. Scratch Test		
H5. Get Up and Go	1. 2.	1. 2.
H5. Power Weight =		
H1=		
t =		
H2 =		
$P = W (H2-H1)/ t$		

I. Self-Rated Health Characteristics

	Yes	No
Poor vision		
Poor hearing		
Alcohol use		
Smoker		
Sedative use		
High Blood Pressure		
Hospitalization in the last year		
Physically active		
Foot Problems		
No. of medications currently taking		

APPENDIX F

EXERCISE BROCHURE AND ADHERENCE LOG

MOVEMENT MATTERS!!!

HOME BASED EXERCISE PROGRAM



MAINTAINING INDEPENDENCE THROUGH MOVEMENT

WARM-UP / COORDINATION

These exercises should be performed in *neutral forward position*: seated slightly forward in the chair, back straight, shoulders and arms relaxed. Choose a chair that has a firm seat and back, no arms, and is high enough so your feet comfortably touch the floor when seated.



♥ **Toe Touch:** Extend the right foot forward, touching the toe to the front (count 1), bring it back to *neutral* (2). Then touch the left toe to the front (3), and bring it back to *neutral*

(4). Continue this pattern for 16 counts. The arms can swing naturally (one forward, one backward), in opposition - when the right leg is forward the left arm swings forward.

♥ **Heel Press:** Repeat the same sequence described in toe touches except instead of touching with the toes press the heel out with the foot flexed.



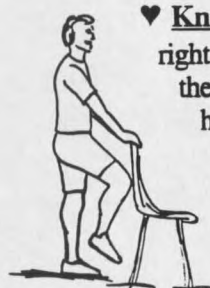
♥ **Side Toe Touch / Heel Press:** Repeat these exercises, touching the toe or heel side to side as the arms swing from side to side in opposition (as shown).

♥ **Elevator:** Begin with the feet a comfortable distance apart and arms relaxed by legs. Stand up slowly by imagining you are an elevator rising 3 floors, stopping briefly (by holding your position for a slow 2 counts - 1001, 1002 - at each "floor"). Don't hold your breath! Return to a seated position making the same "stops" at each position.



BALANCE

If possible balance exercises should be done in stocking or bare feet to allow your feet and toes to work freely. Use caution and bare feet if the flooring is slick. Begin by standing behind the chair in *neutral position*; feet a comfortable distance apart with toes pointing straight forward, back straight, shoulders relaxed and the hands resting lightly on the back of the chair. Do not grip the chairback or lean forward onto the chair.



♥ **Knee Lift Balance:** Lift the right knee up until the foot is off the ground and the lower leg hangs loosely. Hold this position for a slow 4 counts, then return to *neutral position*. Repeat with the left leg. Repeat 4 times on each leg. Become aware

of feeling your balance without relying on the chair. With practice you may progress to holding the balanced position longer (8-12 counts), & when this is mastered may also try the exercise with the hands held slightly off of the chair. Keep an upright posture! Breathe!



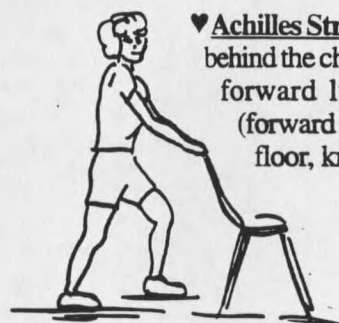
♥ **Knee Bends/Tip Toes:** Slowly bend the knees keeping them in a direct line over the toes (counts 1-4 bending), then straighten the legs (counts 5-8). Now with straight legs raise to the toes and hold this position (1-4), return to *neutral* (5-8).

Repeat the full sequence 4-8 times. When you feel more confident, you may progress to lifting your hands slightly off of the chair while balancing on your toes.



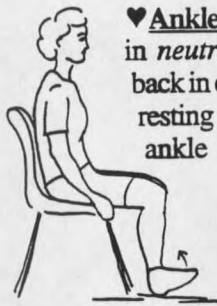
♥ **Heel to Toe Walks:** Stand in an upright posture behind the chair with the right hand resting lightly on the corner of the chairback, eyes focused forward (not down). Begin walking forward by placing the heel of one foot directly in front of the other (heel touching the toe).

Your hand should slide along the top of the chairback. Walk as far as you can while still maintaining an upright posture and contact with the chair. Return to the starting position by repeating the same heel to toe walk backwards. Repeat walking forward then backward 4 times. Then turn to the other side so the left hand is resting on the chair and repeat the full sequence.



♥ **Achilles Stretch:** Standing behind the chair in a left-leg-forward lunge position (forward foot flat on the floor, knee bent), press the right heel toward the floor (right leg straight), hold for a slow count

of 16. Return to *neutral*. Repeat on the opposite side in right-leg-forward lunge position.

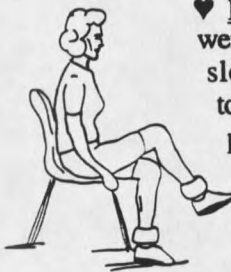


♥ **Ankle Flexion/Toe Curls:** Seated in *neutral-back position* (scooted back in chair, with back straight but resting on the chairback). Flex the ankle as far as possible while keeping the heels on the floor. Hold for 8 counts. Relax feet to *neutral* then curl the toes under (4 counts), flex toes up

and wiggle them freely, (8 counts), relax to *neutral*. Repeat full sequence 4 - 8 times beginning with ankle flexion. 

STRENGTH / MOBILITY

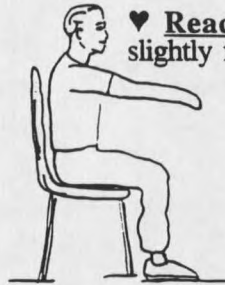
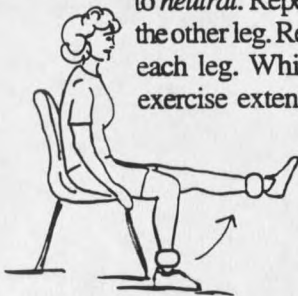
The strength exercises use a set of 5 pound soft ankle/wrist weights (each weight is 2 1/2 pounds). Begin seated in the *neutral back position* as described above.



♥ **Knee Lifts:** Place the weights around the ankles, slowly bring the knee towards the chest, as far as possible while still keeping your back straight (counts 1-2). Return to *neutral* (3-4). Repeat with the other

leg (up 5-6, down 7-8). Repeat full sequence 4-8 times.

♥ **Knee Extensions:** Extend your leg to the front and hold for 8 counts, then bend the knee to return to *neutral*. Repeat the exercise with the other leg. Repeat 4-8 times with each leg. While performing this exercise extend only through the pain-free range of motion.



♥ **Reach & Squeeze:** Seated slightly forward in the chair with the back straight and shoulders relaxed, extend both arms forward at shoulder level- palms down (counts 1-2). Now keeping elbows up and out to sides (as if using

a rolling pin), slowly pull the elbows back by squeezing the shoulder blades together (3-4). Hold (5-8). Repeat 4 to 8 times. Breathe normally! When you become stronger you can do this exercise with the weights held in your hands.



♥ **Hand Mobility:** Seated in a relaxed position, bring your hands up to shoulder level with palms facing forward. Slowly make a fist and then open to beginning position. Repeat 4 times. Now spread the fingers wide open and close 4 times. Then relax the arms to the sides and shake the hands loosely. Repeat entire sequence 4-8 times.



For Comments or Information Write:

Kay Van Norman
Dept. of HHD
Montana State University
Bozeman, MT 59717
Phone: 406-994-6316



♥ **Finger Stretch:** Rest the hands palms down on top of the legs. Using the left hand gently lift the first finger of the right hand to a stretched position and hold for 8 counts, then release. Repeat with each finger and the thumb. Release the right arm to the side and shake the hand gently. Repeat the full sequence stretching the fingers of the left hand.

The following exercises begin in the neutral forward position; seated slightly forward in the chair with the back straight, the feet flat on the floor, and the arms relaxed at sides.



♥ **Shoulder Press:** Holding a weight in each hand, bend the elbows and place the hands at shoulder level (palms facing in toward body). Slowly press the weights straight overhead. Slowly return

the weights to shoulder level. Repeat this sequence 8-12 times. Breathe normally.



♥ **Biceps Curl:** Still holding a weight in each hand, begin with the arms hanging relaxed at the sides, palms facing toward body. Slowly flex the elbows to bring the hands to the shoulders, then return the arms to the sides in a slow controlled manner. Repeat the sequence 8-12 times.



♥ **Cross Arm:** With empty hands reach your right arm across the front of your chest to the left. Hold the right forearm with the left hand and gently stretch the right shoulder for a slow 8-16 counts. Release the arm opening it around to the front and returning to neutral (4 counts). Repeat the stretch with the left arm crossing the chest to the right. Repeat 4 times each arm.

♥ **Elbow Lift:** With empty hands place the right palm on the back of the right shoulder blade. Now slowly raise the right elbow as far as you can, supporting the elbow with the left hand and gently pressing upwards to a stretched position. Hold for 4-8 counts. Maintain an upright posture and

Keep Breathing! Release the elbow bringing the right arm down to the side shaking gently. Repeat on the left raising the left elbow and assisting with the right hand. Repeat the entire sequence 4 times.



YOU CAN MAKE A DIFFERENCE !!

Numerous studies have proven that increased physical activity can have a significant effect on maintaining and improving your physical function. It is clear that disuse invites decay. Decay invites dependence. Increasing your physical activity is a GREAT way to take an active role in maintaining your independence and thus your quality of life! This simple program is designed to help you maintain strength, mobility, coordination and balance.

You will need approximately 15 minutes, a chair with no arms which allows you to sit forward comfortably with your feet flat on the floor and one set of 5 pound ankle weights (2½ pounds each). Please contact me if you have difficulty finding appropriate weights.

The warm-up/coordination exercises should be performed at a moderate tempo, swinging the arms freely. Loss of coordination occurs rapidly if a person does not engage in activities which require performing coordinated patterns. The objective of this segment is to warm-up the joints of the body, challenge your coordination (don't be discouraged if opposition is difficult at first), and have some fun. Experiment freely with arms swinging in opposition, and in unison (same arm forward as leg), as well as adding completely different arm movements such as pushing the palms overhead, out to side, straight out to the front, etc.. Using music you enjoy can also add some motivation!

The "elevator" exercise helps maintain the leg function necessary for rising from a chair. Another fun variation is the use of a rhyme where you "act out" some of the words. "The Noble Duke of York, he had 10,000 men he marched them (up) the hill and marched them (down) again. When they were (up) they were up, and when they were (down) they were down, and when they were only halfway up, they were neither (up) nor (down). Each time "up" occurs in parentheses, stand up, and each time "down" occurs in parentheses, sit back down. At the phrase "when they were only halfway up", stand in a crouched position, knees slightly bent, straightening the knees fully only at the next "up".

The balance segment is designed to help you practice and challenge your balance. The loss of balance resulting in increased falls is of great concern to many older adults. Studies document that the gradual loss of strength and mobility, as well as lack of confidence in balance strongly influence the likelihood of falls. Research also shows that balance can be regained with practice! Please begin with caution. Do not lean heavily on the chairback as this could result in the chair falling over backwards. Use good posture -

don't look down! You will receive the most benefit if you perform the balance exercises in stocking or bare feet which allow the feet and toes to move freely. Be cautious of slippery flooring if you are in stocking feet.

When you have mastered each of the balance activities you may increase the time spent in the "balanced" phase of the exercise and/or you may change your arm position. For example in the knee lift you may begin with the hands resting on the chair, then lift them slightly from the chair, then progress to raising them outstretched to the sides. A variation of the heel/toe walks can easily be performed down a hallway with your hand resting on the wall as you progress forward and backward. Proceed slowly, mastering each exercise for several weeks before progressing to more difficult variations.

Don't underestimate the importance of the Achilles stretch and the ankle flexion/toe curls. The loss of mobility in the ankle, weakness in the front of the leg (shin), tightness in the back of the leg (calf) and mobility of the feet and toes contributes significantly to falls. The ankle flexion/toe curls is a great exercise to do anytime you find yourself sitting around waiting for something, watching TV, reading, etc., the more the better!

Strength & Mobility of the hips, knees, ankles, shoulders, wrists and hands are all important factors in maintaining the ability for self-care, identified by the medical profession as Basic Activities of Daily Living (BADL's). The strength exercises are designed to be performed with a set of soft ankle weights. An ankle weight can be held in the hand for the upper body exercises or strapped to the ankle for the lower body exercises. If you can easily perform the strength exercises with 2 ½ pounds and prefer to use more weight, you may use both ankle weights on one leg (for a total of 5 pounds) while performing the seated knee lifts and the knee extensions. However, with both weights on one leg, rather than alternating legs, perform a full exercise sequence on one leg (for example, left knee lift 4-8 times, then left knee extension & hold 4-8 times; then repeat the sequence with the weights on the right leg).

Finally, if you are over the age of 40 you should consult with your physician before beginning any exercise program. If you begin to feel dizzy or fatigued, or experience pain you should discontinue the program and consult your physician.

Kay has a masters degree in Physical Education/Health and is the director of "Young at Heart" an exercise program for senior citizens based at Montana State University. She is also the author of "Exercise Programming for Older Adults", published by Human Kinetics Publishers. You may contact Kay with comments/questions at (406) 994-6316.

Name _____ Date _____

*Please check off each box as you complete the exercises for that day.

WARM-UP / COORDINATION

♥ Toe Touch



Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ Heel Press:



Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ Side Toe Touch / Heel Press



Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ Elevator



Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ Knee Bends / Tip Toes



Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---



Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ Heel to Toe Walks



Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

BALANCE

♥ Knee Lift Balance



Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ Achilles Stretch



Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ Ankle Flexion / Toe Curls



Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

STRENGTH/MOBILITY♥ **Knee Lifts**

Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ **Finger Stretch**

Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ **Knee Extensions**

Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ **Shoulder Press**

Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ **Reach & Squeeze**

Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ **Biceps Curl**

Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ **Hand Mobility**

Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ **Cross Arm**

Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

♥ **Elbow Lift**

Week 1

M	T	W	T	F	S	S
---	---	---	---	---	---	---

Week 2

M	T	W	T	F	S	S
---	---	---	---	---	---	---

APPENDIX G
NUTRITION HEALTH CHECKLIST

DETERMINE YOUR NUTRITIONAL HEALTH

Read the statements below and circle the corresponding number if you answered yes to that statement. Then total the numbers circled and find your level of nutritional risk at the bottom of the page based on your score.

Use the second and third columns for subsequent reassessments according to the instructions on the bottom of this page.

Dates			
I, or someone close to me, have an illness or condition that has caused me to change the amount and/or kind of food I eat.	Yes 2	Yes 2	Yes 2
I eat fewer than 2 meals per day.	3	3	3
I eat few fruits or vegetables a day.	2	2	2
I eat or drink few milk products (i.e. milk, yogurt, cheese) a day.	2	2	2
I drink less than 5 cups (8 oz) of fluid a day (i.e. water, juice, tea).	2	2	2
I have 3 or more drinks of beer, wine, or liquor almost everyday.	2	2	2
I have tooth or mouth problems that make it hard for me to eat.	2	2	2
I don't always have enough money to buy the food I need.	4	4	4
I eat alone most of the time.	1	1	1
I take 3 or more different prescribed or over-the-counter drugs a day.	1	1	1
Without wanting to, I have lost or gained 10 pounds in the last 6 months.	2	2	2
I am not always physically able to shop, cook and/or feed myself.	2	2	2
TOTAL			

Resource: The Nutrition Screening Initiative, Geriatric Nutrition by Ronni Chernoff

CHECK OFF YOUR TOTAL LISTED BELOW AND FOLLOW THE RECOMMENDED INTERVENTION.

TOTAL SCORE:

0-2 GOOD! Recheck your score in 6 months. Read about the warning signs of poor nutritional health listed on the back of this form and learn what to watch for.

3-5 YOU ARE AT MODERATE RISK FOR MALNUTRITION. See what can be done to improve your eating habits and your lifestyle by contacting the Office on Aging, senior nutrition program, senior citizens center or Extension Service. Ask for specific written materials and register for the next education/counseling session at your closest senior citizens center. More in-depth analysis including checklists for intervention support within your community may also be available. Recheck your score in 3 months.

6 YOU ARE AT HIGH RISK FOR MALNUTRITION. Make an appointment for a nutrition assessment with (or more) your doctor, dietitian or other qualified health care professional. Bring this checklist with you. In most cases, Medicare, Medicare supplement, or third party payment will cover the costs with a nominal co-payment. A team of qualified health care professionals, including a registered dietitian, will be available to follow up with you to find ways to improve your nutritional health.

REMEMBER THAT THESE WARNING SIGNS SUGGEST RISK BUT DO NOT REPRESENT DIAGNOSIS OF ANY CONDITION.

Date for next assessment: _____

APPENDIX H
PILOT TEST RESULTS

Table 12: T-Test of mean change scores for select physical assessments from pilot study.

Physical Assessments	N	Mean	Standard Deviation	T Statistic	P Value
Tenetti Balance	17	-0.118	1.654	-0.29	0.77
Scratch Test	16	1.470	4.73	1.24	0.23
Arm Curl Test	18	2.389	2.768	3.66	0.002
Chair Stand Test	16	1.406	3.441	1.63	0.12
Up and Go Test	15	-0.565	3.119	-0.70	0.49

Table 13: T-test of mean change scores for select physical assessments for exercise adheres and non-exercise adheres from pilot study.

Physical Assessments	N	Mean	Standard Deviation	T Statistic	P Value
Adheres Tenetti Balance	9	0.667	1.225	1.63	0.14
Adheres Scratch Test	9	3.167	4.789	1.98	0.083
Adheres Arm Curl Test	10	2.900	3.604	2.54	0.031
Adheres Chair Stand Test	9	2.500	4.198	1.79	0.11
Adheres Up and Go Test	8	-1.880	1.651	-3.22	0.01
Non-Adheres Tenetti Balance	8	-1.000	1.690	-1.67	0.14
Non-Adheres Scratch Test	7	.710	3.94	0.48	0.65
Non-Adheres Arm Curl Test	8	1.750	1.035	4.78	0.002
Non-Adheres Chair Stand Test	7	0.000	1.414	0.00	1.00
Non-Adheres Up and Go Test	7	0.937	3.819	0.65	0.54

APPENDIX I

CHI SQUARES AND T-TESTS OF BASELINE DATA

Chi Square Test for Independence between Group and Demographic Variables

Cell Contents -
counts
expected frequency

Table 14: Chi Square for Gender

	Female	Male	
Intervention Group	13 12.65	5 5.35	18
Delayed Intervention Group	13 13.35	6 5.65	19
	26	11	37

$\chi^2 = 0.064$
DF = 1
P-Value = 0.800

Table 15: Chi Square for Marital Status

	Single	Married	Divorced	
1	11 0.97	6 8.76	18 8.27	18
1	7 1.03	11 9.24	19 8.73	19
2	18	17	37	37

$\chi^2 = 2.331$
DF = 2
P-Value = 0.140

Table 16: Chi Square for No. Fallers

	Non-Fallers	Fallers	
Intervention Group	14 14.11	4 3.89	18
Delayed Intervention Group	15 14.89	4 4.11	19
	29	8	37

$\chi^2 = 0.007$
DF = 1
P-Value = 0.931

Table 17: Chi Square for Education

	High School Ed.	No High School Ed.	
15	3 14.11	18 3.89	18
14	5 14.89	19 4.11	19
18	17	37	37

$\chi^2 = 0.508$
DF = 1
P-Value = 0.476

Table 18: Chi Square for Vision

	Poor Vision	Good Vision	
Intervention Group	5 7.78	13 10.22	18
Delayed Intervention Group	11 8.22	8 10.78	19
	16	21	37

$\chi^2 = 3.416$
 DF = 1
 P-Value = 0.065

Table 19: Chi Square for Hearing

Poor Hearing	Good Hearing	
7 5.35	11 12.65	18
4 5.65	15 13.35	19
11	26	37

$\chi^2 = 1.408$
 DF = 1
 P-Value = 0.235

Table 20: Chi Square for Alcohol Use

	Alcohol Users	Alcohol Non-users	
Intervention Group	1 1.46	17 16.54	18
Delayed Intervention Group	2 1.54	17 17.46	19
	3	34	37

$\chi^2 = 0.307$
 DF = 1
 P-Value = 0.580

Table 21: Chi Square for Smoking

Smokers	Non-smokers	
0 0.49	18 17.51	18
1 0.51	18 18.49	19
1	37	37

$\chi^2 = 0.974$
 DF = 1
 P-Value = 0.521

Table 22: Chi Square for Sedative Use

	Sedative Users	Sedative Non-users	
Intervention Group	8 7.30	10 10.70	18
Delayed Intervention Group	7 7.70	12 11.30	19
	15	22	37

$\chi^2 = 0.222$
 DF = 1
 P-Value = 0.638

Table 23: Chi Square for High Blood Pressure

Yes HBP	No HBP	
10 9.73	8 8.27	18
10 10.27	9 8.73	19
20	17	37

$\chi^2 = 0.032$
 DF = 1
 P-Value = 0.858

Table 24: Chi Square for Hospitalized in Last Year

	Yes	No	
Intervention Group	2 2.43	16 15.57	18
Delayed Intervention Group	3 2.57	16 16.43	19
	5	32	37

$\chi^2 = 0.173$
 DF = 1
 P-Value = 0.677

Table 25: Chi Square for Physically Active

Yes	No	
14 13.14	4 4.86	18
13 13.86	6 5.14	19
27	10	37

$\chi^2 = 0.410$
 DF = 1
 P-Value = 0.522

Table 26: Chi Square for Foot Problems

	Yes	No	
Intervention Group	6 6.32	12 11.68	18
Delayed Intervention Group	7 6.68	12 12.32	19
	13	24	37

$$\chi^2 = 0.050$$

$$DF = 1$$

$$P\text{-Value} = 0.823$$

Table 27: Chi Square for Living Arrangements

Live Alone	Live w/ Someone	
8 8.76	10 9.24	18
10 9.24	9 9.76	19
18	19	37

$$\chi^2 = 0.248$$

$$DF = 1$$

$$P\text{-Value} = 0.618$$

Table 28: Unpaired t-tests of baseline data between groups.

	Intervention Mean N = 18	Delayed Intervention Mean N = 19	T St	P Value
Age	76.67 ± 6.8	78.21 ± 4.6	-0.81	0.42
Total Fall Risk Factors	5.78 ± 1.9	6.21 ± 3.1	-0.51	0.61
Environmental Hazards	5.83 ± 2.9	7.32 ± 2.5	-1.67	0.10
Balance Scores	13.44 ± 2.7	13.21 ± 2.4	0.28	0.78
Dorsiflexion Left	24.56 ± 4.12	24.68 ± 5.12	-0.08	0.93
Dorsiflexion Right	23.00 ± 3.5	22.26 ± 5.3	0.50	0.62
Arm Curls	14.33 ± 4.9	15.42 ± 3.6	-0.77	0.44
Scratch Left	6.56 ± 4.3	8.39 ± 5.4	-1.15	0.26
Scratch Right	6.74 ± 4.3	8.29 ± 6.2	-0.86	0.40
GUGT	7.72 ± 2.3	8.66 ± 2.6	-1.18	0.25
Power	216 ± 106	196 ± 86	0.64	0.53
BMI	26.67 ± 4.1	27.17 ± 4.5	-0.35	0.73
Falls Efficacy	120.8 ± 25.5	118.2 ± 21.4	0.35	0.73
Depression	17.72 ± 4.4	21.21 ± 6.4	-1.93	0.062
Nutritious Behavior	15.50 ± 3.6	14.84 ± 2.5	0.65	0.52
Locus of Control	6.44 ± 1.7	6.26 ± 1.4	0.36	0.72

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