Identification of falls risk factors in community-dwelling older adults: validation of the Comprehensive Falls Risk Screening Instrument

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IDENTIFICATION OF FALLS RISK FACTORS IN COMMUNITY-DWELLING OLDER ADULTS: VALIDATION OF THE COMPREHENSIVE FALLS RISK SCREENING INSTRUMENT

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy

in

The Department of Kinesiology

by

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May 2009
ACKNOWLEDGMENTS

For the unending support and patience, I would like to express my sincere appreciation to my Committee: Dr. Rebecca Ellis, chair; Dr. Maria Kosma, co-chair; Dr. Jan Hondzinski; Dr. Arnold Nelson; Dr. Dennis Landin; and Dr. Frank Greenway. I would also like to especially thank Dr. Robert H Wood of the Department of Physical Therapy at Husson College for providing me with the fundamentals needed to begin the doctoral program at Louisiana State University and the continued support throughout the process. To my journal co-authors and fellow researchers, I appreciate your trust, knowledge, and assistance in helping to promote and implement programs and community-wide education in efforts to combat health disparity issues faced amongst us.

My sincere gratitude is extended to the Southern Regional Education Board for providing myself and other colleagues with great networking opportunities, lectures that promoted independence and enthusiasm about the professoriate, and skill-building events to assist in preparing myself and others to be successful in the research and academic sector. A special thank you goes out to Graduate School Assistant Dean, Marie Hamilton, for all of her unending emotional support, encouragement, and assistance during the challenging feat of dissertation writing and defense preparation.

Most importantly, my special thanks are given to my loving husband Wayne C Wells, Jr., my world-class father and mother, Pierre and Kathy Fabre, and other members of my immediate and extended family. Without you, I would not have come this far. I also thank and am very grateful to have support from Dr. Martin Langston who has become a best friend and top cheerleader, the delightful Therapeutic By Design team of therapists and staff, my proficient fellow healthcare professionals, cherished friends, and current and former patients and clients who have provided me with the continued reason to thoroughly embrace my profession.
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ABSTRACT

Identifying risk factors and those at risk for falls is necessary. The first purpose of the dissertation was to validate the Comprehensive Falls Risk Screening Instrument (CFRSI) that weights falls risk factors and includes the subscale scores of history, physical, vision, medication, and environment, and a total falls risk score. The CFRSI total falls risk score was compared to subscale scores, physical activity, physical function, health-related quality of life (HRQL), and history of falls (Study 1). The second purpose of the dissertation was to determine associations between the CFRSI total falls risk score, race, education, and income (Study 2). Data were collected at falls risk screenings conducted at 10 community organizations with 286 older adults (M age=74.2 years, SD=10.0, 75.9% female, 52.9% White/Caucasian, 52.4% low-income status, and 43.1% low educational level).

The total falls risk score was associated with all risk subscale scores (r=.25, p<.01 to r=.69, p<.01), total physical activity score (r=-.30, p<.01), total physical function score (r=.30, p<.01), and total HRQL scores (r=-.44, p<.01 to r=-.24, p=.03). Fallers (n=90) had higher total falls risk scores (M=41.03, SD=9.38) than non-fallers (n=188; M=34.06, SD=10.05), t(276)=5.53, p<.001). Discriminant function analysis indicated the most important predictor of falling status (i.e., fallers and non-fallers) was the history risk score (r=.96).

A 2x2x2 factorial ANOVA only revealed a significant main effect for education (F[1,205]=10.19, p=.002), indicating that the total falls risk score was greater for participants with a lower educational level (M=41.1) than for those with a higher educational level (M=34.5). ANCOVA revealed that individuals with low-income reported higher falls risk scores (M=39.2) than individuals with high-income (M=34.5) when controlling for race (F[1,204]=10.4, p=.001, η²=.05). There were no significant differences between fallers and non-fallers by
education ($\chi^2[1,N=262]=.03$, $p=.86$) or income ($\chi^2[1,N=212]=.38$, $p=.54$), but there were differences by race ($\chi^2[1,N=267]=6.44$, $p=.0$). White/Caucasians (63.2%) were more likely to fall than African American/Black/Others (36.8%). Results provide evidence of the construct validity of the CFRSI and that sociodemographic factors such as education, income, and race are important when identifying older adults at risk for falls, determining applicability of falls risk screening instruments, and implementing falls reduction programs.
A fall is an event resulting in the person or a body part of the person unintentionally coming to rest on the ground or other surface lower than the body (Nevitt, Cummings, & Hudes, 1991). Over the last decade, the rates of falls and fall-related deaths in older adults has increased (Stevens, 2005). Currently, one out of every three older adults fall each year (Hausdorff et al., 2001; Hornbrook et al., 1994; Kannus et al., 1999) and of these, over half are by adults over the age of 80 (Centers for Disease Control [CDC], 2008b). About two-thirds of those who experience a fall will fall again within six months (Hausdorff et al., 2001; Hornbrook et al., 1994; Kannus et al., 1999).

Falls are the leading cause of non-fatal injuries and injurious death among older adults (Alexander, Rivara, & Wolf 1992; Rivara, Grossman, & Cummings, 1997). Injuries associated with falls increase with age such that adults over the age of 85 have a four to five times greater chance of having a fall-related injury as compared to those between the ages of 65 and 74 (Stevens, 2005). Twenty to 30% of older adults who fall suffer moderate to severe injuries (Alexander, et al., 1992) that can lead to mortality, significant disability, decreased independence, and early admission to nursing homes (Sterling, O'Connor, & Bonadies, 2001). Age adjusted fatal fall injury rates significantly increased between 1994 and 2003 among men and women aged 65 years and older. In 2000, 46% of fall-related fatalities were associated with traumatic brain injuries and of all fatalities, 42% involved a fracture (Stevens, Corso, Finkelstein, & Miller, 2006) of areas such as the hip, spine, forearm, leg, ankle, pelvis, upper arm, and hand (Scott, 1990). Other fall-related injuries included bruises and head traumas (see Table 1). Yet, in 2004 nearly 85% of deaths related to falls were by adults over the age of 75 and close to 16,000 older adults died because of unintentional falls in 2005 (CDC, 2008b).
Table 1. Region of Body Injured and Type of Injury Caused by Non-Fatal Falls in Older Adults, U.S. Data in 2000

<table>
<thead>
<tr>
<th>Body Region or Injury from Non-Fatal Falls</th>
<th>Incidence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body Region</strong></td>
<td></td>
</tr>
<tr>
<td>Lower extremity</td>
<td>27</td>
</tr>
<tr>
<td>Upper extremity</td>
<td>27</td>
</tr>
<tr>
<td>Torso</td>
<td>15</td>
</tr>
<tr>
<td>Other head/neck</td>
<td>19</td>
</tr>
<tr>
<td>Traumatic brain injury</td>
<td>4</td>
</tr>
<tr>
<td>Other region*</td>
<td>4</td>
</tr>
<tr>
<td>Unspecified</td>
<td>4</td>
</tr>
<tr>
<td><strong>Type of Injury</strong></td>
<td></td>
</tr>
<tr>
<td>Fracture</td>
<td>35</td>
</tr>
<tr>
<td>Superficial/contusion</td>
<td>31</td>
</tr>
<tr>
<td>Sprain/strain</td>
<td>15</td>
</tr>
<tr>
<td>Open wound</td>
<td>12</td>
</tr>
<tr>
<td>Internal organ</td>
<td>4</td>
</tr>
<tr>
<td>Dislocation</td>
<td>4</td>
</tr>
</tbody>
</table>

(CDC, 2008b)

*Other region includes upper extremity, vertebral column, spinal cord, and systemic/late effects

In addition to injury or fatality, the epidemic of falls in older adults can also cause financial burdens to the older adult, the family involved, and the healthcare community. Falls are the most costly category of injury among older persons (Rizzo, et al., 1998). The total costs of fall-related injuries increase with age (Stevens, et al., 2006) and the subsequent medical treatment and cost continues to rise each year (CDC, 2008b). In 2000, direct medical costs were over $179 million for fatal falls and over $19 billion for nonfatal fall injuries (Stevens, et al., 2006). Direct medical costs included all fees associated with medical care such as hospital and nursing home associated expenses, doctors and other professional fees, rehabilitation, medical equipment, community-based services, insurance costs, medications, and even home modifications; however, they did not include any consequential costs such as long-term disability, future dependent care, lost time and work, or reduced quality of life (Englander,
Hodson, & Terregrossa, 1996). These costs were two to three times higher for women than for men. This may be because women made up over 58% of the older adult fallers and older women appear to report more fall-related injuries than men (CDC, 2008a).

In addition to the economic burden, falls can also have a negative impact on emotional and psychological well-being. Many older adults who sustain a fall develop a fear of falling that decreases quality of life and causes them to limit their activities (Fletcher & Hirdes, 2004; Wilson et al., 2005; Zijlstra, van Haastregt, van Eijk, & Kempen, 2005). Two or more falls, instability or unsteadiness, and fair or poor health status were found to be independent risk factors for developing a fear of falling in a two-year longitudinal study of falls in community-dwelling older adults (Lach, 2005). In addition, fear of falling increased over a two-year period from 23% to 43% following a fall. Furthermore, the prevalence of post-fall anxiety syndrome and daily function-impairing fear of falling reaches upwards of 73% in those who have fallen within the last year (Maki, Holliday, & Topper, 1991; Nevitt, Cummings, Kidd, & Black, 1989; Tinetti, Speechley, & Ginter, 1988; Tinetti, Mendes de Leon, Doucette, & Baker, 1994; Walker & Howland, 1991), and is as high as 46% among individuals who do not report a recent fall (Maki, et al., 1991; Nevitt, et al., 1989; Tinetti, et al., 1988; Tinetti, et al., 1994; Walker & Howland, 1991).

A decrease in activity because of the impending fear of falling can lead to further reduced mobility, dependence in performing daily activities, and reduced quality of life. Thus, falls challenge the physical and psychological well-being of older adults and the stability of the healthcare system. Because of the high physical, emotional, and economic costs incurred by older adults and society because of fall-related injuries, the development of falls prevention programs is an important public health objective.
Demographics of Older Adult Fallers

Female older adults, on average, fall more often than males (De Rekeneire et al., 2003). Data show that the health impact from falls may be greater for female older adults compared to males because the annual rates of nonfatal injuries for women were, on average, 48.4% higher than the rates for men (CDC, 2008a). Older adult women have twice the chance of experiencing a fall-related fracture as compared to older adult men (Stevens & Sogolow, 2005) and in 2003, of the older adults admitted to the hospital with hip fractures, approximately three-fourths of them were women (CDC, 2008b). Although women appear to fall more often than men, the age-adjusted fatalities because of fall injuries for men are 49% higher than for women. This may be the result of men falling from greater heights or having poorer health at the time of the fall.

The 2006 U.S. census retrospective data showed that White Non-Hispanic older adults fell and sustained more fall-related injuries as compared to Black, Hispanic, and other Non-Hispanic older adults (see Table 2; CDC, 2008a, 2008b; Hanlon, Landerman, Fillenbaum, & Studenski, 2002). Similarly, White women also demonstrated significantly higher rates of fall-related hip fractures than women of other races (Stevens & Sogolow, 2005). Yet, evidence of sociodemographic factors as related to falls and falls risk is contradictory and only a few prospective studies have examined the relationship of falls and falls risk to race and other sociodemographic characteristics in older adults (Hanlon, et al., 2002). One of these prospective studies was performed by Hanlon and colleagues (2002) and they did find that African Americans had a 23% decreased chance of experiencing a fall within the preceding year as compared to White older adults, but they did not find race to be a significant predictor of multiple falls in a 10-year longitudinal study (Hanlon, et al., 2002). However, in contrast, Means, O’Sullivan, and Rodell (2000), and Studenski et al. (1994) reveal a similar reporting of falls between the two groups. Thus, the relationship between race and falls is not entirely understood.
Table 2. 2006 Unintentional Falls Non-Fatal Injuries Reported per 100,000, Ages 50+

<table>
<thead>
<tr>
<th>Sex</th>
<th>Race/Ethnicity</th>
<th>Injuries</th>
<th>Percent of Group Total (%)</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>2,854,195</td>
<td></td>
<td>89,327,640</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td>933,868</td>
<td>32.7</td>
<td>40,908,528</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>1,919,654</td>
<td>67.3</td>
<td>48,419,112</td>
</tr>
<tr>
<td></td>
<td>White</td>
<td>1,713,536</td>
<td></td>
<td>69,903,493</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td>554,002</td>
<td>32.3</td>
<td>32,243,990</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>1,159,399</td>
<td>67.7</td>
<td>37,659,503</td>
</tr>
<tr>
<td></td>
<td>Black</td>
<td>245,900</td>
<td></td>
<td>8,799,547</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td>80,950</td>
<td>32.9</td>
<td>3,757,123</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>164,950</td>
<td>67.1</td>
<td>5,042,424</td>
</tr>
<tr>
<td></td>
<td>Hispanic</td>
<td>82,364</td>
<td></td>
<td>6,632,634</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td>31,604</td>
<td>38.4</td>
<td>3,097,206</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>50,760</td>
<td>61.6</td>
<td>3,535,428</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>66,637</td>
<td></td>
<td>3,991,966</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td>21,193</td>
<td>31.8</td>
<td>1,810,209</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>45,321</td>
<td>68.0</td>
<td>2,181,757</td>
</tr>
</tbody>
</table>

(CDC, 2008b)

In attempt to identify other sociodemographic falls risk factors, educational level was identified as an independent risk factor for any and multiple falls (Hanlon, et al., 2002), and Gill, Taylor, and Pengelly (2005) found that greater education and greater income were both associated with a decreased falls risk. These findings suggest that falls risk may be influenced more by a social determinant (i.e. educational or income level) than a biological determinant (i.e., race). Although a direct relationship between falls and income has not been found, it is defined as another social determinant possibly indirectly linked to falls and falls injuries because of its known impact on health status (Speechley et al., 2005). The 2000 U.S. Census data indicated that adults classified as poor (below poverty level) or near poor were disadvantaged in terms of health status, healthcare utilization, and health behaviors. Comparatively, in a 2003
report, about one in four adults over the age of 55 years had poorer health (based on a 5 point self-rating scale of excellent, very good, good, fair, or poor; Schoenborn, Vickerie, & Powell-Griner, 2006). Furthermore, there was a two- to three-fold increase in the number of older adults between the ages of 55-64 years and 85 years and older experiencing chronic health conditions and difficulty executing physical and social activities, which mirrors the increasing prevalence of falls in older adults over the age of 80 years (CDC, 2008b). Because there appears to be a relationship between education, income, and chronic health conditions, a decreased overall health or access to healthcare or community resources may be contributing factors to fall prevalence in certain subgroups of older adults, such as those with lower income or lower educational levels. Therefore, demographic variables such as race, income status, and educational level are worthy of investigation to improve the understanding of the relationship of these variables with falls, which will aid the design of falls prevention programs for various cohorts of older adults.

Falls Risk Factors in Older Adults

Falls are multi-causal, and therefore there are numerous risk factors for falls among older adults. The American Geriatrics Society (AGS) compiled published evidence found in systematic reviews, randomized and controlled pre- and post-trials, meta-analyses, and cohort studies to identify and rank falls risk factors and the relative risk ratio (RR; relative risk for prospective studies) or odds ratio (OR; odds ratio for retrospective studies) associated with each risk factor (AGS, 2001; Rubenstein & Josephson, 2002). The identified falls risk factors found in the search included muscle weakness, history of falls, gait deficit, balance deficit, use of assistive device, visual deficit, arthritis, impaired activities of daily living, depression, cognitive impairment, and age over 80 (see Table 3). Among these risk factors, the RR or significant OR ranged from 4.4 to 1.7, respectively. The relative risk of falling increased linearly from 8% (older adults with no risk
factors) to 78% (older adults with four or more risk factors) suggesting interactions among risk factors (Tinetti et al., 1988). Thus, the risk of falling increased as the number of risk factors increased (Nevitt et al., 1989; Tinetti et al., 1988).

Table 3. Risk Factors for Falls: American Geriatrics Society

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Mean RR - OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle weakness</td>
<td>4.4</td>
</tr>
<tr>
<td>History of falls</td>
<td>3.0</td>
</tr>
<tr>
<td>Gait deficits</td>
<td>2.9</td>
</tr>
<tr>
<td>Balance deficits</td>
<td>2.9</td>
</tr>
<tr>
<td>Use of assistive device</td>
<td>2.6</td>
</tr>
<tr>
<td>Visual deficits</td>
<td>2.5</td>
</tr>
<tr>
<td>Arthritis</td>
<td>2.4</td>
</tr>
<tr>
<td>Impaired activities of daily living</td>
<td>2.3</td>
</tr>
<tr>
<td>Depression</td>
<td>2.2</td>
</tr>
<tr>
<td>Cognitive impairment</td>
<td>1.8</td>
</tr>
<tr>
<td>Age over 80</td>
<td>1.7</td>
</tr>
</tbody>
</table>

(AGS, 2001)

Falls risk factors are intrinsic or extrinsic. Health history and biological factors represent intrinsic risk factors. These include, but are not limited to age, health and medical conditions, physical fitness, mobility, function, history of falls, gender, race/ethnicity, and cognitive and psychological issues (Campbell, Borrie, & Spears, 1989; Tinetti et al., 1988). Although acute illnesses such as incontinence, influenza, and infections are not identified as independent risk factors for falls, they are associated with falls within the previous year (Dolinis, Harrison, & Andrews, 1997). On the other hand, chronic progressive diseases such as Parkinson’s disease (Wielinski, Erickson-Davis, Wichmann, Walde-Douglas, & Parashos, 2005), cerebrovascular accident, osteoarthritis, glaucoma (Dolinis et al., 1997), and cardiovascular disease (AGS, 2001)
are independent falls risk factors in older adults. Other intrinsic falls risk factors include sensory deficits (Poole, 1991) such as impairments in the somatosensory (Wolfson, 2001), vestibular (Bergstrom, 1973a, 1973b, 1973c; Rosenhall & Rubin, 1975), or visual systems (Fozard, Wolf, Bell, McFarland, & Podolsky, 1977). Physical impairments and function of vestibular end organs, progressive macular degeneration, and diminished sensory conduction can also contribute to maladaptive balance responses in older adults and make an older adult more prone to losing balance and experiencing a fall.

Much like sensory deficits, declines in physical fitness domains (Gehlsen & Whaley, 1990a, 1990b; Mecagni, Smith, Roberts, & O'Sullivan, 2000), which are often seen in older adults, are also intrinsic falls risk factors. Decreased cardiorespiratory function such as a diminished overall total lung capacity, lung resiliency, and decline in central cardiac function (Wynne, 1979; Zadai, 1986), musculoskeletal changes such as decreased muscle mass, force production, or altered tissue properties (AGS, 2001; Lord, Ward, Williams, & Anstey, 1994), or impaired physical function, gait, and mobility (Judge, King, Whipple, Clive, & Wolfson, 1995) can also contribute to older adult falls risk. For example, gait speed, single leg standing balance, and reported difficulty with ambulation, mobility, and instrumental activities of daily living were associated with loss of balance (Judge, King, Whipple, Clive, & Wolfson, 1995). A decline in many age-related factors can affect overall physical functioning ability and ultimately lead to an increased falls risk in older adults.

Considerable attention is also given to extrinsic risk factors (influences outside of health history or biological factors) such as substance or environmental factors and certain medication types, number of medications, side effects and adverse effects, and interactions among multiple medications as related to elevated falls risk in older adults (Cumming, 1998; Leipzig, Cumming, & Tinetti, 1999; Ray, Griffin, & Shorr, 1990; Tinetti et al., 1994). On average, older adults take
4.5 prescription and 2 over-the-counter medications per day (Kaiser Family Foundation, 2004). Medication usage increases in prevalence with advancing age and there is a significant increase in initial or recurrent falls if three or more medications (prescription or over-the-counter) are taken concurrently (Leipzig et al., 1999; Tinetti et al., 1994). Certain medications such as benzodiazepines, anti-depressants, anti-psychotics, anti-hypertensive medications, anticholinergics, cardiac medications, and analgesics have greater detrimental side effects that include, but are not limited to, dizziness, reduced alertness, sedation or fatigue, cognitive impairment, decline in neuromuscular function or weakness, or postural hypotension.

Other extrinsic risk factors such as drinking alcohol (Fink, Hays, Moore, & Beck, 1996) and performing other hazardous behaviors such as risk taking, wearing inappropriate footwear, using an assistive device inappropriately (Tinetti et al., 1988), or traversing home or environmental hazards are also related to falls in older adults. Connell (1996) found that environmental hazards create opportunities for falls among community-dwelling older adults who already had multiple intrinsic falls risk factors. According to data compiled from the 1997 and 1998 National Health Interview Surveys, the majority (55%) of falls injuries among older adults occurred inside the home (Kochera, 2002). The highest risk for falling in the home was among community-dwelling older adults who were mobile, but unsteady on their feet (Tinetti, Doucette, & Claus, 1995). Tripping or slipping while forward walking most commonly caused falls, followed by falling during transfers from one position/location to another, such as moving from a chair or bed, or while negotiating stairs or steps (Campbell et al., 1990; Ellis & Trent, 2001). Thus, falls can occur while performing routine activities in the home like dressing, bathing, toileting, or walking along a familiar route.

Falls are not a natural process of aging and therefore are preventable. Falls are a threat to safety, independence, and well-being of the older adult population. Many studies support the
associations between physical activity and falls prevention within community-dwelling older adults (Chan et al., 2007; Heesch, Byles, & Brown, 2008; Ory et al., 1993; Wolf et al., 1996), and physical activity is necessary to maintain and combat age-related declines in strength, neuromuscular function, and flexibility. The lack of physical activity is related to disabling conditions that limit physical mobility and activities of daily living, which further increases falls risk. But not only do falls have a tremendous impact on physical mobility and functional health, the impact on emotional and psychological well-being can significantly affect health-related quality of life (HRQL; Graafmans, Lips, Wijlhuizen, Pluijm, & Bouter, 2003). A decline in HRQL is associated with the presence of falls risk factors of poor balance, decreased muscle strength, greater fear of falling, and lower functional mobility (Ozcan, Donat, Gelecek, Ozdirenc, & Karadibak, 2005). The possibility of potential associations between HRQL and other age-, physical-, and socioeconomic-related variables and falls in older adults is worth investigation.

**Methods of Screening for Falls Risks in Older Adults**

There is a need to identify older adults who possess falls risk factors to aid clinicians and community organizations in targeting specific older adult groups and using appropriate intervention and prevention strategies that reduce falls risks and the occurrences of falls in older adults. Therefore, a variety of adequate reliable and valid quick screening tools, consisting of questions or simple tests, based on specific falls risk factors were developed and tested, and are available to predict and/or identify older adults with a significant falls risk (a comprehensive list is available in chapter 2):

- history of falls is a predictor for future falls in older women (Gerdhem, Ringsberg, Akesson, & Obrant, 2005);
- intake of psycho-active drugs is an independent predictor for future falls (Gerdhem, Ringsberg, Akesson, & Obrant, 2005);
• center of pressure/force platform to measure postural sway suggests that a poor outcome score is related to 2-4 fold increase in falls risk (Pajala et al., 2008);

• sensory organization test (SOT) significantly differentiates fallers vs. non-fallers (Wallman, 2001);

• tandem stance to measure static standing balance is an independent predictor of falls (Pajala et al., 2008);

• qualitative gait or balance abnormalities is a significant predictor of falls (Ganz, Bao, Shekelle, & Rubenstein, 2007; Whitney, Hudak, & Marchetti, 2000);

• step test for dynamic standing balance (Four-Square Step Test) is a positive predictor (86%) of identifying a faller (Dite & Temple, 2002);

• visual Screen for binocular visual field loss significant is a predictor of two or more falls (OR = 1.5; Coleman et al., 2007);

• functional mobility screen of timed up and go (TUG) is a significant predictor of near falls in older adults with hip osteoarthritis (Arnold & Faulkner, 2007); and

• disabling foot pain and decreased toe plantarflexion strength is a significant predictor of falls (Menz, Zammit, Munteanu, & Scott, 2006);

Many of the outcome measures from the abovementioned quick screening tools are positive predictors of falls in older adults or identify those at risk for future falls. These quick screening tools can be helpful in a fast-paced clinical environment, in a setting where it is essential to identify older adult fallers, or in a community facility where staff is limited in number or specialized training. Although the quick screen may identify an older adult at risk for falls, there still may not be identification of the actual falls risk or cause of fall. Thus, further focused intervention would be difficult to implement, and in this case, the older adult would then need to undergo more services at a more specialized facility or with a health-care professional for additional detailed assessments whereby cost and availability may be an issue.

In addition to not identifying the falls risk, the earlier identified screening tools are also not comprehensive in that they are not able to weigh falls risk factors. For example, some of these screens may identify that an older adult may have a risk for future falls. With outcomes
from a simple screen, one may assume that because of the type of screen used, the older adult may have a need for implementing treatment addressing the single risk factor for which the screening tool was developed (i.e., impaired vision, gait deficits or impaired functional mobility, foot pain, or diminished range of motion). The clinician may be correct in making this assumption of using a single risk factor, and the intervention targeting this risk factor may be helpful in decreasing the overall falls risk. Nevertheless, this would not address multiple or other risks that an older adult may be experiencing unknowingly. Therefore, it is necessary to devise a comprehensive falls risk screening instrument that would be able to not only identify single or multiple falls risk factors as identified by the AGS, but can also weight these falls risks to determine those that may be most influential (AGS, 2001).

**Development of the Comprehensive Falls Risk Screening Instrument (CFRSI)**

A comprehensive falls risk screening instrument would aid clinicians and community program leaders in identifying older adults who have multiple falls risks factors, identify those specific falls risks as defined by a weighted scoring tool, and initiate intervention by educating them on ways to reduce their specific risks for falling on an individualized basis. Motivated by the National Council on Aging Falls Free Initiative, the Comprehensive Falls Risk Screening Instrument (CFRSI) was developed according to those falls risks identified through collaborative effort of the AGS, the British Geriatrics Society, and the American Academy of Orthopaedic Surgeons in 2001 for the two dissertation studies (AGS, 2001).

The CFRSI includes five falls risk subscales (i.e., history, physical, medication, vision, and environment) as identified and weighted according to the AGS odds ratios. Asking the participants specialized questions and/or having them participate in certain screens made it possible to generate individual subscale scores for each subscale. For example, the history risk score of the CFRSI was calculated based upon answers about recent history of falls, assistive
device usage, diagnosis of arthritis, and self-reported age. To obtain the physical risk score, balance and mobility tests were performed and scored to assess functional mobility and standing balance. The participants gave information about high risk medication use, use of multiple pharmacists, and possible side effects to obtain the medication risk score, and the vision risk score was calculated using a visual acuity score and answers from questions about the date of the last vision screening and use of prescription lenses. A Home Assessment Checklist was completed for the calculation of the environment risk score. All five of the subscale scores were averaged to determine a total falls risk score for the CFRSI and the subscales and total falls risk scores were calculated on a 0-100 scale with a higher score indicating a higher falls risk.

Summary

Falls among older adults living in the community are common. Whether of intrinsic or extrinsic origin, identification of falls risk factors by appropriate screening instruments can prompt older adults and caregivers to modify or eliminate certain influences or activities and further aid in the development of a falls prevention program. Therefore, many public and private organizations (such as the Center for Healthy Aging as organized by the National Council on Aging) established the need for a reduction in falls and falls risk factors as an important public health objective. The AGS identifies and ranks falls risk factors and the relative risk associated with each risk factor (Rubenstein & Josephson, 2002). Although there are adequate falls risk screening tools available that may aid in identifying a specific risk factor of falls, clinicians and researchers would benefit by moving toward the validation of a single comprehensive screening instrument, such as the CFRSI, that identifies and weighs various falls risk factors, is applicable across the spectrum of older adult groups with variable demographic characteristics, and can determine specific risk factors to be addressed while implementing a falls risk reduction or prevention program.
Objectives and Purpose of the Dissertation

The specific objectives of this dissertation were to (a) review literature about the identification of older adult fallers, provide an overview of falls risk factors, and discuss strategies for falls risk screening and assessment, prevention, and treatment for community-dwelling older adults (chapter 2); (b) validate the CFRSI that includes multiple subscales of history, physical, medication, vision, and environment to provide a total falls risk score (chapter 3); and (c) determine relations of the sociodemographic factors of race, education, and income with falling status and falls risk (chapter 4).

More specifically, the purpose of study one (chapter 3) was to validate the newly developed CFRSI that included multiple falls risk factors weighted according to the AGS relative risk or odds ratios. By comparing the total falls risk score against falls risk subscale scores, self-reported physical activity levels, self-reported physical function, HRQL, and self-reported 1-year history of falls, construct validation of the CFRSI was expected. It was hypothesized that a higher total falls risk score would be significantly associated with (a) higher history, physical, medication, vision, and environment subscale scores; (b) lower self-reported physical activity levels; (c) lower self-reported physical function level; (d) lower HRQL; and (e) that those who fell within the year before the initial screening would exhibit higher total falls risk than non-fallers. A research question was also proposed to determine which of the falls risk subscale scores would predict whether an older adult would experience a fall.

The purpose of study two (chapter 4) was to determine if there were any associations between the total falls risk score and the sociodemographic characteristics of race, education, and income. It was hypothesized that (a) educational level would be negatively associated with the total falls risk score, (b) income level would be negatively associated with the total falls risk scores, and (c) the identified fallers would have lower average education and income levels than
those who were non-fallers. Two research questions were also proposed to determine (a) any pattern of relation between race and total falls risk score, and (b) if there is a pattern of relation between race and falling status (fallers vs. non-fallers). Finally, chapter 5 summarized the main findings of studies one and two, and provided a general discussion of strengths and limitations of the dissertation, implications of the research findings, and future directions of this area of study.
FALLS RISKS: IDENTIFICATION, ASSESSMENT, PREVENTION, AND TREATMENT STRATEGIES FOR FALLS IN THE COMMUNITY-DWELLING OLDER ADULT

Falls Risk Factors

Falls are multi-causal, and therefore numerous risk factors for falls among older adults have been identified. These factors are frequently classified as being intrinsic (individual-specific) or extrinsic (environmentally influenced). Intrinsic risk factors include, but are not limited to health history and biological factors such as age, gender, behavior or cognitive impairment, impaired physical and psychological status, acute and chronic illness, mobility, sensory deficits, falls history, and continence (Rawsky, 1998). Studies also reveal extrinsic factors, such as medication effects and home hazards as additional contributors to falls in older adults.

The American Geriatrics Society (AGS) recently published a review in which they identify and rank falls risk factors and the relative risk associated with each risk factor (Rubenstein & Josephson, 2002). Identified risk factors include muscle weakness, history of falls, gait deficit, balance deficit, use of assistive device, visual deficit, arthritis, impaired activities of daily living, depression, cognitive impairment, and age over 80. Among these risk factors, the relative risk ratio (or significant odds ratio) ranged from 4.4 to 1.7, respectively. In addition, it is important to note that there is potential for interaction among risk factors. Specifically, the risk of falling increases as the number of risk factors increases (Nevitt, Cummings, Kidd, & Black, 1989; Tinetti, Speechley, & Ginter, 1988); such that the relative risk of falling increases linearly from 8% with no risk factors to 78% with four or more risk factors (Tinetti et al., 1988).
Health History and Biological Falls Risk Factors

Age, Falls History, Gender, Race/Ethnicity

Studies reveal that an increase in age is associated with an increase in the number and severity of falls (Baker & Harvey, 1985). One in three community-dwelling older adults over the age of 65 falls at least once a year. For those over the age of 80, the annual falls rate increases to 50% (Blake et al., 1988; O'Loughlin, Robitaille, Boivin, & Suissa, 1993; Tinetti et al., 1988). Age-related physiological and biological changes can affect overall mobility resulting in a decline of overall physical fitness, increasing falls risk (Rawsky, 1998; Vellas, Wayne, Romero, Baumgartner, & Garry, 1997).

Older adults who have experienced one or more falls have three times the risk of falling again within a year compared to non-fallers (O'Loughlin et al., 1993; Rubenstein & Josephson, 2002). Furthermore, whether from functional limitations due to a falls-related injury or from an impending fear of future falls, older adults who have sustained a fall decrease their overall level of physical activity. This can induce a gradual decline in mobility and can encourage debility further interfering with the potential to obtain a full recovery and return to prior functional status. Consequently, an older adult is more likely to suffer one or more additional falls (Campbell, Borrie, & Spears, 1989; Cummings, Nevitt, & Kidd, 1988; Tinetti et al., 1988).

Muscle weakness and lower levels of physical activity observed in older women (Davis et al., 1994) may contribute to the tendency of women to fall more often than men. Female older adults sustain more non-fatal falls injuries as compared to males (National Center for Injury Prevention and Control [NCIPC], 2003). However, the fatality rate for males is higher than for females potentially because of the cause or severity of the fall (Centers for Disease Control [CDC], 2008a, 2008b; Stevens, 2005). This may be explained by the fact that males fall from greater heights and/or may be in poorer health at the time they fall (Stevens, 2005).
White Non-Hispanic older adults fall more often than Black, Hispanic, and Other Non-Hispanic older adults (CDC, 2008b). African Americans are less likely than Whites to have any fall (adjusted odds ratio [OR] 0.77, 95% confidence interval [CI] 0.62-0.94) (Hanlon, Landerman, Fillenbaum, & Studenski, 2002). In this same study, information about sociodemographic characteristics, health-related behaviors, health status, visual function, and drug use was determined. Multivariable analysis revealed that an increased age and education, arthritis, diabetes, and history of broken bones were significant independent risk factors ($p < .05$) for any fall and comparing those with two or more falls to those with none, again, increased age and education, arthritis, and diabetes were significant independent risk factors ($p < .05$) and race was not a significant predictor of multiple falls (adjusted OR 0.90, 95% CI 0.64-1.26). Similar sociodemographic characteristics and health problems as compared to a race difference appear to be important risk factors for any and multiple falls in community-dwelling African American and White older adults, with White older adults at greater risk of one-time falls (Hanlon et al., 2002).

Caucasian women are significantly more likely than African American women to fall outdoors versus indoors (odds ratio [OR] =1.6, 95% CI =1.0-2.7) and laterally versus forward (OR=2.0, 95% CI =1.1-3.4), but less likely to fall on the hand/wrist (OR=0.6, 95% CI =0.3-1.0). This indicates possible differences in fracture risk in older women of differing ethnicities. The differences in fracture risk may be due in part to the different ways in which older Caucasian and African American women fall, rather than how often they fall (Faulkner et al., 2005).

**Chronic and Acute Illness and Disease**

In addition to ordinary age-related changes, bowel and bladder incontinence, as well as short-term illnesses such as influenza and infections contribute to falls risk. Certain chronic disease processes more commonly observed in advanced age, such as Parkinson’s disease,
Parkinson’s disease (a progressive degenerative disease of the brain) is characterized by increased extremity rigidity, crouched posture, shuffling steps, poor initiation of movement, dementia, masking of expression, and tremor. Among patients with Parkinsonism, those that are older in age, have an atypical presentation, suffer an extended course of the disease, or have an increasing intellectual impairment are at higher risk for falls (Wielinski, Erickson-Davis, Wichmann, Walde-Douglas, & Parashos, 2005).

A cerebrovascular accident (stroke), like Parkinson’s disease, can also cause neuromuscular and musculoskeletal impairments. It is caused by an interruption of blood flow to the brain tissue resulting in ischemia and often death or damage to the brain cells in the affected area. Most cerebrovascular accidents occur in advanced age and 43% occur in adults over the age of 74 (Robins & Baum, 1981). Depending on the location of the brain injury, there may be substantial loss of motor or sensory function in either the right and/or left side of the body; deficits in speech, vision, and sensory interpretation; and frequently an increased or decreased muscular tone and postural imbalance. Research indicates that 40% of people who suffer a cerebrovascular accident suffer a fall within a year of the event (Lamb, Ferrucci, Volapto, Fried, & Guralnik, 2003). Causes of falls in this case commonly include balance dysfunction and reported dizziness during complex tasks such as dressing. In addition, individuals with visual neglect secondary to a stroke, and who are slow in performing tasks, are at high risk of multiple accidents (Diller & Weinberg, 1970) and of running into obstacles (Webster, Rapport, Godlewski, & Abadee, 1994). In addition behavioral impulsivity, older age, a history of
previous falls, and multiple transfers increase the falls risk in individuals with right hemispheric strokes (Rapport et al., 1993).

Osteoarthritis is another progressively debilitating disorder that is associated with over twice (RR = 2.4) the risk for falls in the older adult (American Geriatrics Society [AGS], 2001). Older adults with osteoarthritis demonstrate an increased chance of tripping over an obstacle and a decreased standing balance test score as compared to controls (Pandya, Draganich, Mauer, Piotrowski, & Pottenger, 2005). Osteoarthritis can lead to musculoskeletal pain and stiffness (mostly with weight-bearing activities), decreased range of motion, and joint degeneration and/or deformation. Joints most often affected by this disease process are cervical, lumbar, hips, knees, and hands. This disease affects over 50% of people aged 65, and 70% of people over the age of 75 (Verbrugge, Gates, & Ike, 1991; Verbrugge, Lepkowski, & Konkol, 1991). This is a progressively incapacitating disease with clinical manifestations that include a decreased ability to perform daily activities (Donatelli & Owens-Burkart, 1981; Verbrugge, Lepkowski, & Konkol, 1991) such as personal hygiene, household activities, walking, reaching, and stooping resulting in a decline of overall physical activity.

Other co-morbidities such as cardiovascular disease and blood pressure irregularities increase in prevalence with age and are associated with an increased risk for falls in older adults. Coincidentally, cardiovascular dysfunction attributed to the aging process has a similar clinical presentation to cardiovascular limitations due to inactivity (Lamb, Stevens, & Johnson, 1965; Miller, Johnson, & Lamb, 1964). In an aged, weakened, or pathological system, the heart is less effective in meeting homeostatic demands during physical activity, and functional limitations are more evident with worsening heart function. Moreover, hypertension (often accompanying other cardiovascular etiologies) worsens cardiac performance, renal function, and cerebral blood flow adding a greater threat for abnormal blood pressure regulation and cerebral perfusion. In
combination, these conditions can lead to postural and postprandial hypotension, carotid sinus hypersensitivity, cardiac arrhythmias (Lipsitz, 1985) or other syncopal events (Maire, 1992) which are all related to an increased incidence of falls in older adults.

**Sensory**

The somatosensory, vestibular, and visual systems are responsible for receiving sensory information and transmitting information via afferent nerves to the central nervous system. The integration of these systems is important in maintaining balance (Poole, 1991). In addition, the integration is imperative to defend against falls.

**Somatosensory.** Age is associated with an impaired response of the somatosensory system (Wolfson, 2001) and/or integration of external stimuli (Teasdale, Stelmach, & Breunig, 1991; Teasdale, Stelmach, Breunig, & Meeuwsen, 1991). There is an involvement of the aging sensory and/or central nervous systems in the increased prevalence of falls secondary to an age-related decrease in mechanical receptor responsiveness. This can cause diminished touch and texture sense (Axelrod & Cohen, 1961; Dyck, Schultz, & O'Brien, 1972; Kenshalo, 1977; Thornbury & Mistretta, 1981), decreased response to vibration (Beall & Goldstein, 1986; Era, Jokela, Suominen, & Heikkinen, 1986; Goff, Rosner, Detre, & Kennard, 1965; Verrillo, 1980; Whanger & Wang, 1974), and impaired joint position awareness (Kaplan, Nixon, Reitz, Rindfleish, & Tucker, 1985; Kenshalo, 1977; Kokmen, Bossemeyer, & Williams, 1978; Skinner, Barrack, & Cook, 1984), all of which are associated with an increase in postural sway (Brocklehurst, Robertson, & James-Groom, 1982), a strong indicator of standing balance. In fact, the following independent risk factors for falls are related to the somatosensory system: impaired ankle tactile sensitivity, knee vibration sense, and joint position (Lord, Clark, & Webster, 1991a; Lord, Ward, Williams, & Anstey, 1994).
There is also a strong association between distal limb neuropathy and falls (Richardson, Ching, & Hurvitz, 1992) in that those with electromyographically identified peripheral neuropathy have a far more likely chance of falling and repetitive falling. Therefore, function of the somatosensory system is important to evaluate when determining falls risk insofar as these deficits may negatively impact the older adult’s safety, body position awareness, and/or muscle reaction to a perturbation while in a balanced position (Duckrow, Abu-Hasaballah, Whipple, & Wolfson, 1999) during functional activities.

**Vestibular.** The vestibular system provides information about position in space and head movement with respect to gravity and inertial forces. The age-related deterioration in vestibular function can cause feelings of unsteadiness, lightheadedness, or dizziness, all commonly associated with falling in older adults. Much like the somatosensory and visual systems, age affects the vestibular system such that there is an increase in lipofuscin content, a 40% reduction in hair cells for those over the age of 70, a progressive loss of nerve fibers in the peripheral vestibular system (Bergstrom, 1973a, 1973c; Rosenhall & Rubin, 1975) and an overall decline in vestibular system function (van der Laan & Oosterveld, 1974). The incidence of falls for those aged 65 to 74 years of age with increased bilateral vestibular dysfunction is 26.1% greater than age-matched community-dwelling older adults with normal vestibular function (Herdman, Blatt, Schubert, & Tusa, 2000; Herdman, Blatt, & Schubert, 2000).

**Visual.** With respect to age-related visual system deficits, clinical manifestations include poor lens elasticity, lack of lens transparency, decreased peripheral field view (Fozard, Wolf, Bell, McFarland, & Podolsky, 1977), reduced acuity in near vision, and decreased accommodation during lighting changes. These impairments are common among older adults as they accompany cataracts, macular degeneration, and glaucoma. Older adults who have sustained a fall may rely more on visual cues to recognize and correct postural deviations during dynamic
activities as compared to non-fallers (Cromwell, Newton, & Forrest, 2002), possibly resulting from reduced age- and health-related proprioceptive and vestibular function (Lord & Webster, 1990). This suggests that visual input is an important factor in maintaining postural stability in older adults.

Hence, older adults with visual deficits are 2.5 times more likely to sustain a fall over those without visual deficits (AGS, 2001). An increase in sway (an indicator of balance control) during standing when visual input is altered or removed may account for this increased risk (Dornan, Fernie, & Holliday, 1978; Sheldon, 1963; Woollacott, Shumway-Cook, & Nashner, 1986). In a cross-sectional survey of eye disease with a retrospective collection of falls information, tests of visual function associated with two or more falls were contrast sensitivity (1-unit decrease at 6 cycles per degree), and visual acuity (worse than 20/30; Ivers, Cumming, Mitchell, & Attebo, 1998). In addition, adults over the age of 74 with moderate visual impairment had a nine times higher chance of sustaining a hip fracture secondary to a fall during the subsequent two years. Other visual factors associated with falls include decreased visual field, posterior subcapsular cataract, usage of nonmiotic glaucoma medication (AGS, 2001; Ivers et al., 1998), using bifocal and multifocal lenses, wearing ill-fitting glasses, or relying on an out-of-date lens prescription (Buckley, Heasley, Scally, & Elliott, 2005).

**Multisensory.** Humans use multiple sensory systems for balance control so that a deficit in one system may not always lead to instability, for information provided by the remaining systems may compensate for the problem. Older adults with aged or weakened systems, however, are forced to use different responses than younger individuals to remain standing during balance challenges (Wolfson, Whipple, Amerman, Kaplan, & Kleinberg, 1985). For example, among older adults, the visual system may compensate for a diminished proprioceptive input by identifying limb position using sight. This implies that older adults with impaired
somatosensory input rely heavily on the visual system not only for vision, but also for head and body stabilization (Brownlee et al., 1989; Cromwell et al., 2002; Manchester, Woollacott, Zederbauer-Hylton, & Marin, 1989). Unfortunately, older adults possessing deficits in multiple sensory systems may be unable to compensate adequately because the remaining sensory inputs may not be sufficient or working properly (i.e., too slow or weak to maintain stability) thus contributing to falls risk. Hence, the incidence of falling during challenging dynamic balance activities can greatly increase with multi-sensory system impairments.

**Physical Fitness and Physical Function**

**Physical Fitness.** Physical fitness is defined as a set of physical attributes that contribute to one’s ability to perform physical activities (American College of Sports Medicine [ACSM], 2000). Physical fitness includes components such as cardiorespiratory function, muscular strength and endurance, balance and coordination, flexibility, and body composition (Centers for Disease Control [CDC], 1996). Components of physical fitness decline with age and are inversely associated with the prevalence of falls in older adults. In particular there is considerable evidence indicating that loss of muscle strength and endurance, a decrease in range of motion or flexibility, and deterioration of balance and coordination are associated with falls (Gehlsen & Whaley, 1990b; Mecagni, Smith, Roberts, & O'Sullivan, 2000).

**Cardiorespiratory Function.** While little evidence exists, the well-known age-related deterioration in cardiorespiratory fitness may have some indirect impact on falls frequency in older adults. With age, there are decreases in total lung capacity, vital capacity, and lung resiliency, and an increase in residual volume (Zadai, 1986). There is also an age-related decrease in cardiac output at rest and response to stress, as well as an increase in systolic blood pressure and peripheral vascular resistance to blood flow (Weisfeldt, Gerstenblith, & Lakatta, 1985). The cardiovascular and cardiorespiratory systems work together following physical
activity to aid in recovery, which is often prolonged due to multi-system impairments in the older adult (Wynne, 1979; Zadai, 1986). An older adult’s prolonged recovery may also be a consequence of lower levels of physical fitness and the tendency toward a greater relative work rate during physical activities. This may lead to an increased reliance on anaerobic metabolism, as well as slower heat elimination. Furthermore, episodes of cardiovascular and cardiopulmonary deconditioning resulting from a decline of various components of physical fitness in the older adult often compound the effects of normal age-related changes in physiologic systems and can be indirectly related to falls.

**Musculoskeletal Changes.** In the musculoskeletal system, a common reaction to aging and disuse is a deterioration of muscular strength (Hakkinen & Hakkinen, 1991) accompanied by signs of atrophy. It is estimated that 20% to 40% of maximal strength is lost by the age of 65 in a non-exercising adult (Aniansson, Sperling, Rundgren, & Lehnberg, 1983). Strikingly, older adults with muscular weakness (Campbell et al., 1989; Davis, Ross, Nevitt, & Wasnich, 1999; Nevitt et al., 1989; Robbins et al., 1989) have over four times the risk (RR=4.4) of sustaining a fall (AGS, 2001). In a group of community-dwelling older women aged 65 and over, quadriceps strength was an identifying factor for those who experienced multiple falls versus those with no falls or one fall only (Lord et al., 1994). Other studies also reveal a decreased ankle dorsiflexion power (Moreland, Richardson, Goldsmith, & Clase, 2004; Whipple, Wolfson, & Amerman, 1987), hip strength (Robbins et al., 1989), and knee extension strength (Moreland et al., 2004) is associated with falls history in institutionalized and in community-dwelling older adults. The combined odds-ratio in the community-dwelling subset was 1.76 for any fall and 3.06 for recurrent falls (Moreland et al., 2004).

There are several other age-related changes in skeletal muscle properties and function that may be associated with falls, including the reduction in capillary density. A consequential
decrease in the delivery of essential nutrients to working muscles (Albert, Gale, & Taylor, 1967), age-related changes in chemical composition, an overall decrease in both type IIA and IIB (high and low oxidative, fast twitch) fibers, and a decrease in myosin ATP activity (Albert et al., 1967) in remaining muscle fibers can decrease overall muscular performance (Aniansson, Hedberg, Henning, & Grimby, 1986). In addition, conduction of nerve impulses to and from muscular tissue is also prolonged, affecting coordination and sensory integration during activities limiting balance reactions to an impending fall.

Another aspect of musculoskeletal function that appears to deteriorate with age is flexibility (Bell & Hoshizaki, 1981), which is frequently measured as the range of movement about a joint. As a person ages, muscle becomes less flexible because of a decrease in elastin and an increase in collagen of the muscle tissue (Alnaqeeb, Al Zaid, & Goldspink, 1984). No evidence exists directly relating a deterioration in flexibility to falls in older adults (Ozcan, Donat, Gelecek, Ozdirenc, & Karadibak, 2005), but changes in bone and connective tissue structure and function surrounding the joint in older adults can affect movements further limiting the ability to execute daily tasks and other areas of physical function. Further research is warranted in this area.

**Physical Function and Mobility.** Indeed, adequate or enhanced cardiovascular function, cardiorespiratory function, muscular strength, and flexibility are associated with enhanced mobility and independence, which can lead to higher levels of physical activity and functioning (ACSM, 1998; Warburton, Gledhill, & Quinney, 2001). Incidentally, it is believed that adequate physical fitness components may reduce the prevalence of falls and the associated injuries. However, the sum total of age-related changes in physical fitness and alterations in the musculoskeletal system often present as muscular weakness, a decrease in body stability during perturbations or unplanned movement patterns, and inadequate functional movements for daily
activities. These age-related changes carry with them significant consequences related to functional capacity (Bassey, Bendall, & Pearson, 1988) and appear to contribute to poor physical function outcomes that are also associated with falls.

Measures of physical function also infer mobility limitations. Functional outcomes that are of particular relevance in the falls literature include competency with basic and instrumental activities of daily living (BADL and IADL, respectively) and gait. BADLs (such as feeding oneself, dressing, bathing, getting out of bed, toileting, walking, and climbing steps and stairs) are associated with an increased falls risk and self-reported difficulties with IADLs (such as grocery shopping, performing housework, gardening, preparing meals, or using a telephone) are associated with a loss of balance (Judge, King, Whipple, Clive, & Wolfson, 1995).

Poor mobility or other physical disabilities that often accompany musculoskeletal or neurological impairments and diagnoses may contribute to gait abnormalities, postural control, and correlate with functional balance (Lin et al., 2004) and may not be just a matter of age. As related to gait dysfunction, conditions such as stroke, Parkinson’s disease, myelopathy (Elliott et al., 1995), cerebellar disorders, and hypothyroidism increase an older adult’s risk for falls. In addition, common gait deficits observed in older adults such as an increased stride width, a reduced walking speed and stride-to-stride variability are independent predictors of falling (Campbell et al., 1989; Hinman, Cunningham, Rechnitzer, & Paterson, 1988; Maki, 1997; Nevitt et al., 1989), and balance deficits often observed under these and other conditions can impose up to three times the risk (RR = 2.9) of falling (AGS, 2001). Cross-sectional studies indicated that gait velocity declines at a rate of 12% to 15% per decade after the age of 60 (Hinman et al., 1988). Furthermore, slower gait speeds have been reported in individuals who sustained multiple falls (Era & Heikkinen, 1985; Woolacott, 1993).
Other Conditions

Bladder dysfunction, incontinence, nocturia, and frequency are related to falls. These problems predispose the older adult to impending home hazards while ambulating to and from the toilet (Abrams, Mattiasson, Lose, & Robertson, 2002; Van Kerrebroeck et al., 2002). Furthermore, nocturia can produce daytime sleepiness secondary to the loss of sleep at night. This resultant loss of energy or attentiveness can render many older people prone to falls during the day (Eustice & Wragg, 2005).

Behavioral Falls Risk Factors

Medication Usage

The numbers of medications taken by older adults and the associated falls risk sparks attention of researchers and healthcare providers. With the general increase in prevalence and severity of health problems in older adults, medication use also increases with advancing age (Rosenberg & Moore, 1997). Older adults use approximately 30% of all prescription and over-the-counter medications sold in the U.S. Of these, older adults use on average 4.5 prescription medications and 2.0 over-the-counter medicines every day and take 26.0 different prescription drugs annually (Kaiser Family Foundation, 2004). This is significant because the risk of falling increases with the number of prescription and over-the-counter medications taken concurrently. Furthermore, taking three or more medications is shown to increase the risk of initial or recurrent falls (Leipzig, Cumming, & Tinetti, 1999; Tinetti et al., 1994).

In addition to the number of medications taken, certain classes of medications contribute to falls risk. This may be due to a heightened sensitivity to drugs (Ray, Griffin, & Shorr, 1990) that is known to occur in older adults. Some of the more common side effects of medications include blurred or impaired vision, sedation or decreased alertness, confusion and impaired
judgment, delirium, compromised neuromuscular function, anxiety, or hypotension leading to dizziness and lightheadedness.

Regardless of the specific cause, medications associated with elevated falls risks include antidepressants, antipsychotics, long and short acting benzodiazepines and other anticonvulsants, antihypertensives, cardiac medications, analgesics, antihistamines, and gastro-intestinal-histamine antagonists (Allain, Bentue-Ferrer, Polard, Akwa, & Patat, 2005; Cameron, 2005; Thapa, Gideon, Cost, Milam, & Ray, 1998). Cumming (1998) indicates that adults over the age of 65 taking psychotropic medications appear to have twice the risk of falls and fractures as compared to those not taking them. Antidepressants increase the risk of falling by 66% (Leipzig et al., 1999), and like antipsychotics (Cutson, Gray, Hughes, Carson, & Hanlon, 1997; Nakamura, Ishii, Niwa, Yamazaki, & Ito, 2005) they also contribute to the side effects of orthostatic hypotension and dizziness, sedation, decreased alertness, ataxia, and blurred vision. New users of antidepressants have higher rates of falls than nonusers, and higher doses are associated with higher rates of falls. In addition, older persons taking the new generation of antidepressants, known as selective serotonin reuptake inhibitors have a greater risk of falls over those not taking these medications (Thapa et al, 1998).

Benzodiazepines are commonly prescribed for up to 15% of older adults to treat anxiety, insomnia, and seizure disorders (Ray et al., 1990) with adverse effects commonly including sedation, dizziness, decrease in neuromuscular function, and cognitive impairment. Benzodiazepines are associated with up to 48% greater risk of experiencing falls and fractures in older adults (Leipzig et al., 1999) and the risk of falls-related fractures from benzodiazepine use is associated with the dose, but not the medication’s long or short acting characteristics (Herings, Stricker, de Boer, Bakker, & Sturmans, 1995). In addition, the greatest risk of falling occurs within 15 days of a new prescription (Neutel, Hirdes, Maxwell, & Patten, 1996).
Medications prescribed for the treatment of certain cardiac conditions may also contribute to falling. Cardiac arrhythmias can arise due to altered origin and/or conduction of electrical impulses within the heart. Some medications used to treat this condition (Class I: sodium channel blockers) have adverse effects of dizziness and visual disturbances (Podrid, 1991) and have an association with significant increases in the risk of one or more falls (Leipzig et al., 1999). Clinically, it is important to note that there may be episodes of increased arrhythmias or changes in the nature of arrhythmias with these medications as there may be cardiotoxic drug effects often signified as fainting or reported symptoms of dizziness (Podrid, 1984).

Antihypertensive medications used to treat other cardiopulmonary conditions of hypertension or congestive heart failure can also increase the risk of falls. These drugs include centrally acting antihypertensives, beta-blockers, ACE inhibitors, and diuretics. Centrally acting antihypertensive medications can cause side effects of orthostatic hypotension, dizziness, decreased mental alertness, fatigue, and sedation potentially leading to falls. However, diuretics are the only antihypertensive medications that appear to independently increase the risk of falling (Leipzig et al., 1999). This relationship may be enhanced because of the additional adverse effects of fluid depletion, electrolyte disturbances, and/or an urgency to rush to the bathroom. Also, older persons taking more than one type of antihypertensive drug have an increased risk of falling compared with those taking just one (Lord et al., 1994; Lord, Ward, Williams, & Anstey, 1993).

Narcotic pain relievers, as well as non-steroidal anti-inflammatory agents cause side effects such as decreased alertness, impaired neuromuscular function, dizziness, sedation, confusion, hearing problems and blurred vision. There is no direct link, but Ray et al. (1990) noted that non-steroidal anti-inflammatory agents might have a relationship with a disease state
(i.e. arthritis) that may influence falls risk. Medications with anticholinergic properties, such as those used for nausea and gastrointestinal disorders, dizziness, Parkinson’s disease, antihistamines, and muscle relaxants may cause side effects that contribute to falls (Cameron, 2005). These include blurred vision, drowsiness, tachycardia, confusion, dizziness, agitation or anxiety, weakness, and/or delirium. Use of topical eye medications, not including miotics, is associated with a greater than five-fold increase in falls risk due to pupil constriction (Cameron, 2005). The use of certain ocular and systemic medications emerged as the strongest risk factors for falls (Guralnik et al., 1994) because of the side effects of hypotension, bradycardia, and syncope.

In addition to the independent effects of certain medications on falls, many older adults take numerous medications concurrently. Few studies have assessed whether and to what extent various combinations of medications are associated with this risk. At least one study has revealed that patients taking combinations of non-steroidal anti-inflammatory agents, cardiac, and psychotropic drugs have an increased risk of falling compared with those not taking this combination (Tinetti et al., 1994). Most importantly, however, healthcare providers, patients, and caregivers should be aware of medications that may have an association with an increased falls risk and that taking these medications concurrently may heighten the risk. Furthermore, medication issuance/supervision should be a consideration when prescribing these types of medications. Older persons who take these classes of drugs identified to elevate falls risk should be observed for adverse effects to avoid, manage, or reverse problems.

**Hazardous Behaviors**

Hazardous behaviors cause approximately five percent of all falls (Tinetti et al., 1988). Older adults may attempt to perform activities without being aware of their strength, balance, or physical abilities. Behaviors that increase an older adult’s risk for falling include attempting to
perform activities or chores beyond one’s physical ability, not paying attention to surroundings, and using assistive devices improperly (Connell, 1996; Scott, Dukeshire, Gallagher, & Scanlan, 2001). For example, many falls occur while climbing ladders, trimming trees, or reaching for objects while standing on a stool (Scott, Dukeshire, Gallagher, & Scanlan, 2001). Inattention to one’s surroundings also increases the chance of falling particularly in a new environment or transition area such as a doorway entrance or an elevation change. Other hazardous behaviors associated with falls are frequent changing of shoe styles or wearing inappropriate footwear such as loose fitting shoes or slippers, shoes with slippery soles, high heeled shoes, or shoes with thick soles (Connell, 1996; Scott et al., 2001).

In general, the use of assistive devices more than doubles the risk (RR = 2.6) of falls in older adults (AGS, 2001). Data from one recent study reveal that the time to complete a functional mobility test (Timed Up and Go; TUG) by community-dwelling older adults with a history of falls (2 or more falls in the previous 6 months) was highly correlated ($r = .95$) with the type of assistive device (none, cane, and front-wheeled walker) used for ambulation (Shumway-Cook, Brauer, & Woollacott, 2000). Furthermore, participants using either a cane or front-wheeled walker compared to those not using an assistive device were at greater risk for falls as measured by performance on the TUG, respectively. In addition, walking without a mobility aid when one was needed or the inappropriate use of one can be harmful (Bateni & Maki, 2005), and not having a proper assessment to ensure a device is suited to an individual’s specific needs, abilities, and understanding can be problematic. For example, falls can occur if an individual using a device fails to set a brake on a walker or lock on a wheelchair. Used correctly and appropriately, however, assistive devices such as walkers, canes, scooters, and wheelchairs can reduce the risk of falling by allowing safe mobility while increasing independence and activity levels.
Alcohol

Another behavioral risk factor for falls in older adults is alcohol consumption (Fink, Hays, Moore, & Beck, 1996). Because of altered pharmacokinetics in older persons, blood alcohol levels tend to be higher than the levels in younger persons who consume the same amounts of alcohol (Reid & Anderson, 1997). Long-term alcohol abuse also influences postural instability, increasing the likelihood of falls (Mukamal et al., 2004). A recent study reveals an association between self-reported alcohol consumption of 14 or more drinks per week with a 24% greater risk of frequent falls (Mukamal et al., 2004). Therefore, seniors who drink alcohol, especially those who drink to intoxication, can have a greater risk of falling. In addition, for those older adults who take medications, alcohol can increase the sedative and negative neuromuscular side effects of many prescription or over-the-counter medications.

Psychological Issues

Low levels of physical activity can predispose an older adult to muscular weakness and falls. The avoidance of physical activity may be due to physical, psychological, or environmental factors. Physical factors include musculoskeletal limitations, injury, or pathology whereby psychological factors may include fear of falling, anxiety, depression, etc. Moreover, the physical and psychological state of the older adult may interact with the built or physical environment in such a manner as to reduce physical activity levels (Campbell et al., 1989; Cummings et al., 1988; Tinetti et al., 1988). Psychological states common in older adults, such as dementia, delirium, anxiety, Alzheimer’s disease (Alexander et al., 1995), and depression (RR = 2.2) may also diminish alertness or cognitive functioning (RR = 1.8) and thereby increase the risk of falls (AGS, 2001).

Although older adults may be able to execute certain activities, a fear of falling may lead to avoidance of performing chores or participating in various forms of physical activity. Self-
rated health status and experience of previous falls are significantly associated with fear of falling (Howland et al., 1993). As a reaction to a previous fall, the fear of falling again can lead to inactivity. The consequential degeneration of postural control (Bloem, Steijns, & Smits-Engelsman, 2003) then places the older adult at an increased risk of future falls. Furthermore, fear of falling is an independent risk factor for decreased mobility and loss of quality of life, which may affect social interaction (Howland et al., 1993) and possibly health-related quality of life. The marked deficits in strength and health status (Brouwer, Musselman, & Culham, 2004) observed among independent community-dwelling older adults who report a fear of falling underscores the seriousness of it being a potential health and falls risk factor.

**Environmental (Home, Community) Falls Risk Factors**

Connell (1996) found that environmental hazards could create opportunities for falls among community-dwelling older adults who may already have multiple intrinsic falls risk factors. Data compiled from the 1997 and 1998 National Health Interview Surveys indicated that the majority (55%) of falls injuries among older adults occurred inside the home (Kochera, 2002). Over 20% of falls injuries occurred outside, but near the home and the remaining occurred away from the home. It is important to note that the highest risk for falling in the home was among community-dwelling older adults who were mobile, but unsteady on their feet (Tinetti, Doucette, & Claus, 1995). Tripping or slipping while forward walking most commonly caused falls, followed by falling during transfers from one position/location to another or while negotiating stairs or steps (Campbell et al., 1990; Ellis & Trent, 2001). Falls during transfers often resulted while moving from a chair or bed (Ellis & Trent, 2001). Hence, falls can occur while performing routine activities in the home like dressing, bathing, and toileting or walking along a familiar route.
It is estimated that 80% of homes have at least 1 hazard and that nearly 40% have 5 or more hazards that are associated with falls (Carter, Campbell, Sanson-Fisher, & Gillespie, 2000). Many falls that occur in the home are caused by hazards and are, therefore, preventable. Some of the most common home hazards include clutter, electrical cords that cross pathways, slippery throw rugs and loose carpets (Carter et al., 2000; Norton, Campbell, Lee-Joe, Robinson, & Butler, 1997), poor or inadequate lighting, changes in floor surfaces or slippery surfaces (wet or polished floors, and non-slip-resistant bathtub surfaces), problems associated with stairs (lack of handrails), inappropriate chair or cabinet heights, and pets and pet-related objects (Dickinson, Shroyer, Elias, Curry, & Cook, 2004; Leslie & Pierre, 1999; Norton et al., 1997; Tideiksaar, 2001). In addition, many homes present potential environmental obstacles or barriers to safely executing activities of daily living such as outside steps to the entrance, inside stairs to a second floor, and unsafe bathrooms.

With respect to community hazards, poor sidewalk and pavement maintenance such as pavement cracks, tree roots, inadequate street markings, slippery footing, and obstacles (bike racks, flower boxes and garbage cans) in walkways are common causes of falls for older adults within the community (Braun, 1998). Hence, falls among older adults living in the community are common. Whether an intrinsic or extrinsic origin, identification of falls risk factors by appropriate screening and assessment instruments can prompt older adults and caregivers to modify or eliminate certain risk factors and further aid in the development of a falls prevention program.

**Screening and Assessment Instruments**

Because of the high costs incurred by older adults and society as a result of falls-related injuries, considerable energy has been devoted to the development of falls prevention programs. While there are, at present, seemingly countless interventions proposed for falls prevention, the
initial step in virtually all of these intervention programs is initial identification of persons at risk for falling. The use of quick, reliable, and valid screening and assessment tools to identify those with an elevated falls risk will aid in determining the need for further falls-related interventions in the older adult population. Thus, utilizing these outcome measurement tools are a crucial first step in implementing and evaluating falls prevention programs.

In choosing a proper screening or assessment tool, Perell et al. (2001) recommend the following criteria: high sensitivity, specificity, and inter-rater reliability; similarity of population to that in which the tool was developed or studied; standardized written procedures explicitly outlining the appropriate use of the tool; reasonable time required to administer the tool; and established thresholds identifying when to initiate interventions. These criteria are important to identify for each tool prior to usage and apply regardless of the setting. The specific instrument chosen might vary depending on the setting and professionals responsible for obtaining the information.

Identification of older adults at risk for falls can be as easy as asking the individual simple questions. Time to administer a tool is of utmost importance in some busy settings. However, as part of routine care, older adults should at the minimum be asked about previous falls at least once a year (AGS, 2001) and use of medications (prescription and over-the-counter medications) and herbal/alternative therapies. Gerdhem, Ringsberg, Akesson, and Obrant (2005) determined that a recalled fall was the most important predictor for future falls in older women, and that recalled falls and intake of psychoactive drugs can independently predict future falls. In addition, the inability to stand on one leg, and a subjective estimate of biologic age is important in determining falls risk (Gerdhem et al., 2005). Persons who have notable limitations during even a simple screening such as these indicated should be prompted for further detailed assessments.
Falls risk assessments with greater detail are believed to be beneficial for older adults who have had one or more falls, have identifiable abnormalities of gait and/or balance, who report recurrent falls (AGS, 2001), or who are found to have a high falls risk as determined from a screening. An extensive assessment should be performed by a clinician with appropriate skills and expertise (as indicated by the specific outcome measure standards), which may then necessitate a referral to a specialist. Due to the wide array of conditions and circumstances that may lead to falls in an older adult, a detailed assessment may include questions and examinations to identify specific risk factors for falls such as: a history of falls circumstances, medications, acute or chronic medical problems, and mobility levels; an examination of vision, gait and balance, and lower extremity joint function; examination of basic neurological function, including mental status, muscle strength, lower extremity peripheral nerves, proprioception, reflexes, tests of cortical, extrapyramidal, and cerebellar function; and assessment of basic cardiovascular status including heart rate and rhythm, postural pulse and blood pressure and, if appropriate, heart rate and blood pressure responses to carotid sinus stimulation. In most cases, identification of specific risk factors in an individual can often be revealed with a thorough assessment.

Numerous assessment tools available can provide related outcome measures and aid in determining specific limitations within the areas determined to be indicative of an elevated falls risk in the older adult. Although assessment tools have not been standardized within or across settings (Perell et al., 2001), it is necessary to note that in addition to within the community-dwelling older adult population, a number of assessment tools have been used to identify older adults at risk for falling among residents of nursing homes or within a frail subset of the older adult population. It is important for the tester to select appropriate tools when examining a community-dwelling older adult, for tests validated for a less functional subset would be less
predictive of falls in older adults who have fewer health problems, live independently, and are more active (Bogle, Thorbahn, & Newton, 1996; O'Brien, Pickles, & Culham, 1998).

For example, the Berg Balance Scale (BBS; Berg, Wood-Dauphinee, & Williams, 1995; Berg, Wood-Dauphinee, Williams, & Maki, 1992), the Tinetti Performance-Oriented Mobility Assessment (POMA; Tinetti, Williams, & Mayewski, 1986), the Tinetti Balance Subscales (Tinetti et al., 1986), and the TUG (Podsiadlo & Richardson, 1991) were developed for, and validated primarily on residents of nursing homes. Nevertheless, the usefulness of a test in predicting falls may vary depending on the health status and level of function of the older adults being tested.

In a study of older community-dwelling older adults who were in good health, O’Brien et al. (1998) found the BBS was less sensitive in predicting falls than did Berg et al. (1992) who studied residents of a nursing home. Other researchers (Shumway-Cook, Baldwin, Polissar, & Gruber, 1997), however, studying community-dwelling older adults found BBS scores to be predictive of falls. The fallers, however, were only those who had a history of recurrent falls, which indicates those at greater risk for falling. Thus, the BBS may better identify older adults who have greater impairments and who are at risk for falls than older adults who are in good health and more active, but who also may be at risk for falls.

Table 4 provides an extensive list of available falls risk screening and assessment tools most commonly used. The table lists the various instruments according to falls risk domain, and includes a brief description of each measure. These tests are appropriate for community-dwelling older adults and can easily be incorporated and performed in emergency wards, doctors’ offices and clinics, or during community events. They can provide useful outcome measures that can aid in implementing targeted interventions in efforts to reduce medical, physical, behavioral, or environmental falls risk factors.
Evidence for Prevention of Falls in Older Adults

It is evident that dysfunction in balance and decline in other physical fitness components are precipitating factors of falls in older adults. Therefore, researchers have developed interventions that are designed to decrease falls risks and falls in community-dwelling older adults. A number of systematic reviews evaluate intervention strategies intending to promote a decrease in falls risk or incidence of falls (Gillespie et al., 2001; Hill et al., 2004; RAND, 2003; Scott et al., 2001). The RAND Report concluded that, in general, falls prevention programs effectively reduce the risk of falling by 11% and the monthly rate of falling by 23% (RAND, 2003). Interventions that focus on high-risk individuals (those who have fallen and are at increased risk of falling again) are more likely to be effective than those that target an unselected group of seniors.

Additional detail regarding effectiveness of intervention type is provided in the Guidelines for the Prevention of Falls in Older Persons, a position stand published by the American Geriatric Society, British Geriatrics Society, and the American Academy of Orthopaedic Surgeons (AGS, 2001). These guidelines indicate that interventions promoting falls prevention should attempt to address multiple falls risk factors. As an example, the guidelines suggest that an intervention might include the following: gait training and education on assistive device usage; review and medication modification (especially psychotropic medications); exercise programs (specifically including balance training); treatment of postural hypotension; environmental modifications; and treatment of cardiovascular disorders. The review concludes that the comprehensive falls risk assessment when followed by individualized multifactorial interventions and proper patient follow-up reduces falls in older adults, particularly in cases when the interventions address specific identified risks (RAND, 2003).
**Exercise and Physical Activity for Falls Prevention**

In general, physical activity is an important component of a healthy lifestyle, including a preventive effect on the risk of falls in older adults. Physical activity is a prerequisite to maintain neuromuscular functioning, necessary to keep balance and to react to a fall, but a higher level of physical activity also implies a greater exposure to environmental threats, possibly leading to a fall (Graafmans, Lips, Wijlhuizen, Pluijm, & Bouter, 2003). There is an abundance of evidence positively supporting the effects of various physical activity or exercise intervention strategies targeted towards prevention of falls among community-dwelling older adults. Recent research has focused on examining the effectiveness of exercise on preventing age-related loss of strength, endurance, flexibility, and balance in relation to falls risk. For example, in the early 1990s, the U.S. National Institute on Aging launched an initiative to improve physical functioning in older adults. In efforts to address this concern, the Frailty and Injuries: Cooperative Studies of Intervention Techniques (FICSIT) project (Ory et al., 1993) that consisted of multi-center randomized controlled trials, represented the first systematic and large-scale attempt to investigate the efficacy of exercise (Wolf et al., 1996) on a number of different performance measures related to falls incidence rates, as well as frailty among older adults. In this project, five sites provided exercise interventions focusing on physical fitness areas of strength, endurance, flexibility, and balance within community-dwelling older adults.

Although the interventions in the FICSIT trials varied with respect to the type of exercise used (i.e. tai chi; Wolf et al., 1996), moderate weight lifting, balance training (Campbell, Robertson, Gardner, Devlin, McGee, & Campbell, 2001; Campbell et al., 1997; Judge, Lindsey, Underwood, & Winsemius, 1993; Lord et al., 1993; Robertson, Devlin, Gardner, & Campbell, 2001) and the intensity, frequency, and duration of the intervention, the combined multi-site
<table>
<thead>
<tr>
<th>Domain</th>
<th>Outcome Measure</th>
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<tbody>
<tr>
<td>Health History: (obtained by interview)</td>
<td>Age/Date of Birth&lt;br&gt;Gender&lt;br&gt;Race&lt;br&gt;Anthropometric&lt;br&gt;Weight&lt;br&gt;Height (to establish body mass index)&lt;br&gt;Waist&lt;br&gt;Hip (to establish waist-to-hip ratio)&lt;br&gt;Assistive Device Usage&lt;br&gt;Alcohol use&lt;br&gt;Health problems&lt;br&gt;Acute illness (i.e. influenza, infection)&lt;br&gt;Disease (i.e. osteoarthritis, Parkinson’s disease)&lt;br&gt;Bowel/bladder incontinence&lt;br&gt;Blood pressure: lying, sitting, standing&lt;br/Cardiovascular pathologies&lt;br/Other musculoskeletal or neurological pathologies&lt;br/History of syncope&lt;br/Other&lt;br&gt;History of falls&lt;br&gt;1 year; cause&lt;br&gt;3 year; cause&lt;br&gt;History of fractures from a fall&lt;br&gt;Health Information&lt;br&gt;Primary Care Physician&lt;br&gt;Date of last eye exam&lt;br&gt;Proper use of prescription lenses (if applicable)&lt;br&gt;/Medications&lt;br&gt;Type/Class&lt;br&gt;Number of medications&lt;br&gt;Adverse/Side effects&lt;br&gt;Pharmacy information&lt;br&gt;Sensory Deficits&lt;br&gt;Somatosensory&lt;br&gt;Semmes-Weinstein Monofilament Testing&lt;br&gt;Description&lt;br&gt;Administered;&lt;br&gt;Assess tactile sensitivity;&lt;br&gt;Time: Several minutes to complete Training: Basic Equipment: Monofilament set&lt;br&gt;Cost: Moderate to Maximal ($300+)&lt;br&gt;References&lt;br&gt;(Conner-Kerr &amp; Templeton, 2002</td>
</tr>
</tbody>
</table>
The inter-rater reliability in individuals with peripheral nerve injury, as well as control subjects without disability, as measured by the ICC is .965 (Jerosch-Herold, 2005; Novak, Mackinnon, Williams, & Kelly, 1993).

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
<th>Time Required</th>
<th>Training Required</th>
<th>Equipment Required</th>
<th>Cost Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vibration/Kinesthetic awareness</strong></td>
<td>Administered; Assess vibration sense; Training: Basic; Equipment: Large 128Hz tuning fork</td>
<td>Several minutes to complete</td>
<td>Basic</td>
<td>Large 128Hz tuning fork</td>
<td>Minimal to Moderate ($50+)</td>
</tr>
<tr>
<td><strong>Visual</strong></td>
<td>Hermann Snellen, MD (Snellen, 1862)</td>
<td>Administered/Scored; Assess visual acuity; Training: Basic; Equipment: Eye chart</td>
<td>Minimal (~$10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Melbourne Edge Test (MET)</strong></td>
<td>Administered; Assess contrast sensitivity; Training: Basic; Equipment: Eye chart</td>
<td>Several minutes to complete</td>
<td>Basic</td>
<td>Eye chart</td>
<td>Unknown</td>
</tr>
<tr>
<td><strong>Mars Letter Contrast Sensitivity Test</strong></td>
<td>Administered; Assess contrast sensitivity; Training: Basic; Equipment: Test kit</td>
<td>Several minutes to complete</td>
<td>Basic</td>
<td>Test kit</td>
<td>Moderate to Maximal ($350+)</td>
</tr>
</tbody>
</table>

This test is simple to perform and is sensitive to the most common sources of visual impairment (i.e. uncorrected refractive error, cataracts, macular degeneration, and amblyopia). Some factors reducing the Snellen chart's reliability include failure to test visual acuity at the right distance and decreased levels of illumination (Pandit, 1994).

This test uses a dual contrast visual acuity chart presenting 20 circular patches containing edges with reducing contrast. The proper identification of the edge orientation determines a measure of contrast sensitivity. Moderate to high correlations were obtained between contrast sensitivity tests, thus providing evidence of validity (Haymes & Chen, 2004).
The Spearman correlation between the Mars and Pelli-Robson test (standard) was 0.83 at $p < .001$ indicating test-retest reliability equal to or better than the standard contrast sensitivity test and comparable responsiveness. In addition, a strong correlation between the two tests provides evidence of validity (Haymes et al., 2006).

Vestibular

Dix-Hallpike maneuver

Administered; Assess benign paroxysmal positional nystagmus
Time: Several minutes to complete
Training: Skilled
Equipment: Mat/bed or table
Cost: None

(Dix & Hallpike, 1952; Fife et al., 2000)

Persons with dizziness should be examined for nystagmus after rapid positioning (Fife et al., 2000).

Perceptual dysfunction

Albert’s test

Administered; Assess perceptual neglect dysfunction/unilateral spatial neglect in persons with a stroke
Time: Several minutes to complete
Training: Basic
Equipment: Test chart
Cost: Minimal to none

(Fullerton, McSherry, & Stout, 1986)

Test-retest reliability ($r=.79$) (Chen Sea, Henderson, & Cermak, 1993); Construct validity: excellent correlation with the Line Bisection test ($r=.85$), adequate with star cancellation test ($r=.63$) (Agrell, Dehlin, & Dahlgren, 1997), good correlation with Wundt-Jasatrow Area Illusion test ($r=.64$; Massironi, Antonucci, Pizzamiglio, Vitale, & Zoccolotti, 1988).

Behavioral Inattention test (BIT)

15-item; Administered; Assess unilateral visual neglect
Time: ~40 minutes to administer
Training: Skilled
Equipment: Test Kit
Cost: Moderate to Maximal ($500+)


In a study to explore the relationship between unilateral spatial neglect and levels of sensorimotor and cognitive impairment and functional ability in patients with right hemisphere lesions, the BIT score was a predictor of functional outcome, as measured by FIM and IADL, at 6 month follow-up (Katz et al. 1999). Interrater reliability ($r=.99$) and test-retest reliability ($r=.99$) of the BIT scores also have been examined (Wilson et al., 1987) showing a strong correlation between the conventional and behavioral test scores ($r=.92$).

Arnardottir Occupational Therapy Neurobehavioral Evaluation (A-ONE)

Administered; Assess ADL performance with neurological disorders
Training: Skilled/Certification

(Gardarsdottir & Kaplan, 2002)

This is a standardized assessment that links ADL performance to neurobehavioral impairments. There is minimal support for construct validity. However, results regarding the ability of the A-ONE to detect and lateralize impairments agreed with research regarding specific lesion sites for the impairments (Gardarsdottir & Kaplan, 2002).
Multi-sensory
Modified Clinical Test of Sensory Interaction for Balance (mCTSIB)

Administered/Scored:
Test of sensory integration impairment
Time: Several minutes to complete
Training: Skilled
Equipment: Foam pad; stopwatch
Cost: Minimal

(Shumway-Cook & Horak, 1986)

This test allows for assessment of how well an individual can integrate various senses with respect to balance and compensate when one or more of those senses are compromised under four conditions. In a study of 12 subjects from 24 to 68 years of age (\(M = 42.2\)), test-retest reliability for the mCTSIB using only firm surface eyes open and firm surface with eyes closed conditions was high (ICC = .91) for firm surface with eyes open, (ICC = .97) for firm surface with eyes closed (Hageman, Leibowitz, & Blanke, 1995). It should be noted, however, that the sample studied was much younger than the proposed older adult population.

Sensory Organization Test (SOT)

Administered/Scored:
Test of sensory integration impairment
Time: Approximately 30-45 minutes to complete
Training: Skilled
Equipment: Computer/Software/dynamic force-plate platform and full visual field surround
Cost: Maximal

(Cohen, Heaton, Congdon, & Jenkins, 1996; Cohen, Kimball, & Adams, 2000; Ford-Smith, Wyman, Elswick, Fernandez, & Newton, 1995)

This test measures postural stability under 6 different sensory conditions. The individual has to rely on particular sensory information and the response in sway is used to compare to normative values for each condition.

Physical Fitness and Physical Function

Strength
Timed sit to stand

Administered:
Assess lower extremity strength
Time: Several minutes to complete
Training: Basic
Equipment: Stopwatch, Chair
Cost: Minimal to none

(Carr, Shepherd, Nordholm, & Lynne, 1985; Jones, Rikli, & Beam, 1999; Jones, Rikli, Max, & Noffal, 1998)

The score is the total number of stands executed correctly within 30 seconds. If the older adult is more than half way up at the end of 30 seconds, it is counted as a full stand. Normal ranges of scores are defined for each age group and gender between ages 60 to 94 (Rikli & Jones, 2001).

Hand Held Dynamometer

Administered:
Assess lower/upper extremity strength
Time: Several minutes to complete
Training: Basic
Equipment: Dynamometer
Cost: Moderate to Maximal ($250+)

(Wang, Olson, & Protas, 2002)

Researchers have used the hand-held dynamometer to obtain reliable lower-extremity strength values in community-dwelling older adult fallers. Test-retest intraclass correlation coefficients (ICCs) were high, generally ranging from .95 to .99 for 1 trial and from .97 to 1.00 for the mean of 2 trials (Wang et al., 2002).
(Table 4 continued)

<table>
<thead>
<tr>
<th>Test</th>
<th>Administered;</th>
<th>Cost: Minimal to none</th>
<th>American Thoracic Society (ATS, 2002)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Endurance</strong></td>
<td><strong>6 minute walk</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Administered</strong></td>
<td><strong>Assess aerobic capacity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Time:</strong></td>
<td><strong>Approximately 6 minutes to complete</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Training:</strong></td>
<td><strong>Basic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Equipment:</strong></td>
<td><strong>Stopwatch</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cost:</strong></td>
<td><strong>Minimal to none</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test-retest reliability and construct validity has been demonstrated in pathological conditions (Cahalin, Pappagianopoulos, Prevost, Wain, & Ginns, 1995; Cahalin, Mathier, Semigran, Dec, & DiSalvo, 1996; Kadikar, Maurer, & Kesten, 1997; Lipkin, Scriven, Crake, & Poole-Wilson, 1986; Montgomery & Gardner, 1998) reported a mean distance of 683 m based on only 10 subjects without known pathology, aged 36 to 62 years. In a study of subjects aged 40 to 80 years, Enright and Sherrill (1998) recorded a median distance of 576 m for men (n=117, median age=59.5 years) and a median distance of 494 m for women (n=173, median age=62.0 years).

**Graded Exercise Test**

Administered; Assess heart function during exercise activity

Time: 15-60 minutes to complete

Training: Skilled

Equipment: Treadmill/Stationary bike; ECG; BP

Cost: Maximal

(ACSM, 2000)

**Range of Motion/Flexibility**

**Goniometric Measurement**

Administered; Assess joint range of motion;

Time: Depending on joints measured

Training: Skilled

Equipment: Goniometer

Cost: Minimal ($10-20)

(Gajdosik & Bohannon, 1987)

**Chair Sit and Reach**

Administered; Assess hamstring/lower back flexibility

Time: Several minutes to complete

Training: Basic

Equipment: Chair; Ruler/tape measure

Cost: Minimal to none

(Jones et al., 1998)

Chair sit-and-reach measures hamstring flexibility (Jones et al., 1998). Studies indicate that the test has good intraclass test-retest reliability (r = .92 for men; r = .96 for women), and has a moderate-to-good relationship with the criterion measure (standard sit and reach; r = .76 for men; r = .81 for women). Results indicate that the test produces reasonably accurate and stable measures of hamstring flexibility and it is a safe and socially acceptable alternative to traditional floor sit-and-reach tests as a measure of hamstring flexibility in older adults.
<table>
<thead>
<tr>
<th>Test Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apley Back Scratch</td>
<td>Administered; Assess shoulder range of motion/upper body flexibility; Time: Several minutes to complete; Training: Basic; Equipment: Ruler/tape measure; Cost: Minimal to none.</td>
</tr>
<tr>
<td>Balance 180 degree turn</td>
<td>Administered/Rated; Assess ability to turn 180 degrees; Time: Several minutes to complete; Training: Basic; Equipment: Chair or handholds; Cost: Minimal to none.</td>
</tr>
<tr>
<td>Berg Balance Scale (BBS)</td>
<td>14-item; Administered; Time: 10-15 minutes to complete; Training: Basic; Equipment: Stool; Stopwatch; Ruler; Cost: Minimal to none.</td>
</tr>
<tr>
<td>Functional Reach Test (FRT)</td>
<td>Administered; Assess dynamic balance impairment; Time: Several minutes to complete; Training: Basic; Equipment: Yardstick / Tape measure, Tape/Platform showing foot position; Cost: Minimal to none.</td>
</tr>
</tbody>
</table>

Assessment to measure individual’s ability to maintain balance, either statically or while performing functional activities of increasing difficulty and increasingly narrow base of support. Each task is graded on a scale of 0 to 4 and a total score of 56 can be achieved. In a clinical setting, the cutoff score to separate fallers from people who are not at risk for falling is usually 45 points. Reliability of data obtained with the BBS has been established in a previous study of 35 residents of nursing homes and 35 patients with stroke (ICC = .97-.98; Berg et al., 1995). Criterion validity was established in a study of 31 subjects with a mean age of 83 years. The BBS scores were correlated to the Tinetti Balance Subscale and the TUG (r=.76 -.91; Berg et al., 1992).

Functional reach test can be evaluated using the functional reach test by measuring the maximal distance an individual can reach forward beyond arm’s length while maintaining a fixed base of support in the standing position.
### Limits of Stability Test (LOS)

**Administered:**
- Assess dynamic balance

**Time:** Approximately 20-45 minutes

**Training:** Skilled

**Equipment:** Computer/Software/dynamic force-plate platform

**Cost:** Maximal

(Clarke & Rose, 2001; Wallman, 2001)

This test is used to determine the maximum distance a person can lean in a given direction without stepping, losing balance, or reaching for assistance. A decrease in limits of stability increases the risk for an individual to fall. In a study of community-dwelling older adults without histories of falling, test-retest reliability estimates of the 100% LOS were moderately high to high for movement speed, maximum excursion, and end-point excursion (Clark, Rose, & Fujimoto, 1997).

### Single leg stance

**Administered:**
- Assess static single leg balance

**Time:** Several minutes to complete

**Training:** Basic

**Equipment:** Stopwatch

**Cost:** Minimal to none

(Vellas et al., 1997)

### Computerized Dynamic Posturography

**Administered:**

**Time:** Approximately 20-45 minutes

**Training:** Skilled

**Equipment:** Computer/Software/dynamic force-plate platform

**Cost:** Maximal

(Balohe et al., 1994; Lichtenstein, Shields, Shiavi, & Burger, 1988)

Computerized dynamic posturography measures body sway under different visual and postural conditions by use of a force plate or platform. Increased postural sway, in both amplitude and speed, is associated with increased postural instability and may be associated with a greater risk for falling.

### Dynamic Gait Index (DGI)

8-item;

**Administered/Scored:**

**Time:** 10 minutes to complete

**Training:** Basic

**Equipment:** Staircase, Shoebox, 2 Cones, Tape measure, Tape

**Cost:** Minimal

(Shumway-Cook & Woollacott, 1995)

Research demonstrates that scores on the DGI discriminate community-dwelling older adults who report falls from those who do not report a falls history. It has been shown to have excellent inter-rater reliability (.96) and test-retest reliability (.98) in community-dwelling older adults (Shumway-Cook et al., 1997) and in those with vestibular disorders (Whitney, Hudak, & Marchetti, 2000). This test uses 8 test items to measure a person’s ability to accommodate to changes in environment, speed, and head position during gait. Tasks are rated on a 3-point scale from 0 (unable) to 3 (normal). The highest possible score is 24 and those scoring 19 or lower are considered to be at risk for falling.
Table 4 continued

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Description</th>
<th>Time</th>
<th>Training</th>
<th>Equipment</th>
<th>Cost</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-Directional Reach Test</td>
<td>This test measures how far an individual is able to lean away from a stable base of support in multiple directions. Interclass correlation (ICC 2,1) for multiple reaches were greater than .92. Reliability analysis (Cronbach’s Alpha, .842) demonstrated that directional reaches measured similar but unique aspects of the test. There was significant correlation with the Berg Balance Test total and a significant inverse relationship with scores on the Timed Up and Go (Newton, 2001).</td>
<td>Several minutes to complete</td>
<td>Basic</td>
<td>Tape measure/Yard stick</td>
<td>Minimal to none</td>
<td>(Newton, 1997; Newton, 2001)</td>
</tr>
<tr>
<td>ADL/Gait/Mobility Barthe Index</td>
<td>Values assigned to each item based on time and amount of physical assistance required to perform the activity.</td>
<td>5 minutes to complete</td>
<td>Basic</td>
<td>Testing Protocol</td>
<td>Minimal to none</td>
<td>(Mahoney &amp; Barthel, 1965)</td>
</tr>
<tr>
<td>Assessment of Motor and Processing Skill (AMPS)</td>
<td>16 motor and 20 process skill items administered; Tests motor and process skills and their effect on ability of an individual to perform instrumental or basic activities of daily living of those suffering neurological disorders. Time: 30 – 40 minutes to complete Training: Skilled/Certification Equipment: Testing Protocol/Daily activity</td>
<td>30 – 40 minutes to complete</td>
<td>Skilled/Certification</td>
<td>Testing Protocol/Daily activity</td>
<td>Minimal (Certification required)</td>
<td>(Fisher, 2003a, 2003b)</td>
</tr>
<tr>
<td>Rivermead Mobility Index</td>
<td>A number of studies have supported the validity of the test as a cross-cultural measure (Fisher, Liu, Velozo, &amp; Pan, 1992; Stauffer, Fisher, &amp; Duran, 2000) and high inter-rater reliability (Goto, Fisher, &amp; Mayberry, 1996).</td>
<td>10 minutes to complete</td>
<td>Basic</td>
<td>Testing protocol</td>
<td>Minimal to none</td>
<td>(Forlander &amp; Bohannon, 1999)</td>
</tr>
</tbody>
</table>
This test assesses mobility disability after a head injury and/or stroke. Activities scored range from turning over in bed to running and one direct observation of standing for 10 seconds.

**CS-PFP/CS-PFP10**
- 10-items; Administered; Assess physical function performance
- Time: Approximately 60 minutes
- Training: Basic
- Equipment: Testing dialogue/protocol and data reduction forms; ADL equipment as per protocol
- Cost: Minimal to Maximal ($0 to 2000 depending on current availability of daily task equipment)

(Cress et al., 1996)

The CS-PFP10 requires the adult to perform a series of activity of daily living-based activities measuring the time to complete the task, distance covered, and/or weight carried. Physical function domain scores include upper body strength, lower body strength, upper body flexibility, balance and coordination, endurance, and a total physical function score. The test has been validated in the older adult community-dwelling population and the reproducibility of the CS-PFP10 scores and subscales have demonstrated intraclass correlation coefficients in the range of r=.79 to .94 (Cress et al., 1996).

**Tinetti Balance and Gait Assessment**
- Administered; Assess gait, balance, and mobility
- Time: Approximately 10 – 15 minutes to complete
- Training: Skilled
- Equipment: Testing forms/protocol; Chair
- Cost: Minimal to none

(Tinetti, 1986; Tinetti et al., 1986)

This test includes items that address transitional skills such as sitting to standing and standing to sitting, static balance activities, and balance in response to external perturbations. The assessment also addresses gait initiation, step length and height, symmetry, continuity, and other gait variables. Each of the nine items receives a score of 0 to 2, and the final gait and balance score is summed. Interrater reliability is r=.85, SD = 10 (Whitney, Poole, & Cass, 1998). Tinetti scores are correlated with Berg Balance Test scores (r=.91), with stride length (r=.62-.68), and with single leg stance (r=.59-.64; Whitney et al., 1998).

**Performance Oriented Assessment of Mobility (POMA)**
- 13-item; Administered; Assess for balance and gait;
- Time: 15 minutes
- Training: Basic
- Equipment: Chair; Testing Protocol
- Cost: Minimal to none

(Tinetti, 1986; Tinetti et al., 1986)
In older adults, interrater and test-retest reliability for the POMA total score and balance scores ranged from R=.74 to .93 whereas POMA gait score ranged from R=.72 to .89. Spearman correlations with reference performance tests indicated satisfactory concurrent validity for the POMA total and balance scores (R=.64-.68) as compared to POMA gait scores (R=.52-.56). Results indicate that the POMA total and balance scores provide adequate reliability and validity for assessing mobility in older adults, but the accuracy of the POMA total score to predict falls is poor (Faber, Bosscher, & van Wieringen, 2006).

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
<th>Reliability/Validity</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timed up and go (TUG)</td>
<td>8-item; Administered/Rated; Assess balance and gait with task demands; Time: Dependent on patient speed Training: Basic Equipment: Chair, Measuring tape, Stopwatch Cost: Minimal to none</td>
<td>Excellent inter-rater and intra-rater reliability of data (ICC=.99 for both) in a study of 60 older adults who were frail and 10 older adults who were in good health (Podsiadlo &amp; Richardson, 1991). The TUG was a sensitive (sensitivity = 87%) and specific (specificity=87%) measure for identifying community-dwelling older adults who are prone to falls taking 14 seconds or longer to complete the task (Shumway-Cook et al., 2000). Trueblood, Hodson-Chennault, McCubbin, and Youngclarke (2001) indicated that a cutoff time of 10 to 12 seconds separated fallers from nonfallers in community-dwelling older adults (Trueblood et al., 2001), whereby 20 seconds was used for frail older adults. The results suggest that the TUG is a sensitive and specific measure for identifying community-dwelling adults who are at risk for falls.</td>
<td>(Mathias, Nayak, &amp; Isaacs, 1986; Podsiadlo &amp; Richardson, 1991)</td>
</tr>
<tr>
<td>Modified Gait Abnormality Rating Scale (GARS-M)</td>
<td>7-item; Administered/Rated; Assess gait Time: Several minutes to complete Training: Skilled Equipment: Testing protocol Cost: Minimal to none</td>
<td>Intrarater reliability ranged from .493 to .676 and interrater reliability ranged from .577 to .603. The mean GARS-M score for participants with a history of falling is 9.0, higher than the mean GARS-M score of participants without a falls history (3.8; t=4.538; df=2.50, p &lt; .001). As compared to the GARS-M test, participants with falls history took shorter strides and walked slower as compared to non-fallers, r=-.754 and r=-.679 (VanSwearingen et al., 1996).</td>
<td>(VanSwearingen, Paschal, Bonino, &amp; Yang, 1996)</td>
</tr>
<tr>
<td>Senior Fitness Test</td>
<td>Administered; Assess functional fitness in older adults Time: 10 – 20 minutes to complete Training: Basic Equipment: Fitness test manual; chair; hand weights (5 and 8 pounds); ruler/tape measure; cone; stopwatch Cost: Minimal to Moderate</td>
<td>(DiBrezzo, Shadden, Raybon, &amp; Powers, 2005; Rikli, 2000)</td>
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</table>
The Senior Fitness Test has not been validated for predicting falls in older adults. However, one study (DiBrezzo et al., 2005) reveals that the Senior Fitness Test is useful in predicting change in measures of functional strength, aerobic endurance, dynamic balance and agility, and flexibility following stretching, strengthening, and balance-training exercises. Significant improvements were noted in dynamic balance and agility, lower and upper extremity strength, and upper extremity flexibility potentially influencing falling risk among older adults (Rikli & Jones, 2001).

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Administered/Scored</th>
<th>Equipment/Testing Protocol</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Physical Performance Battery (SPPB)</td>
<td>Administered/Scored; Assess lower extremity functioning in older adults</td>
<td></td>
<td>(Guralnik et al., 1994)</td>
</tr>
<tr>
<td>Mental Status</td>
<td>Abbreviated mental test (AMT)</td>
<td>10-item; Administered; Test of orientation and memory; Time: 10-minutes to complete; Training: Basic; Equipment: Testing Protocol; Cost: Minimal to none</td>
<td>(Hodkinson, 1972)</td>
</tr>
<tr>
<td>Folstein Mini-Mental State Examination (MMSE)</td>
<td>11-item; Administered; Assess mental status; Time: 5-10 minutes to complete; Training: Basic; Equipment: Testing Protocol; Cost: None</td>
<td>(Folstein, Folstein, &amp; McHugh, 1975)</td>
<td></td>
</tr>
<tr>
<td>Psychological or Behavioral Influence</td>
<td>Falls Efficacy Scale (FES)</td>
<td>10-item; Administered; Assess confidence in completing activities without falling; Time: Approximately 10 minutes to complete; Training: Basic; Equipment: Testing Protocol; Cost: Minimal to none</td>
<td>(Tinetti, Richman, &amp; Powell, 1990)</td>
</tr>
</tbody>
</table>
(Table 4 continued)

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Questions/Components</th>
<th>Training/Equipment/Notes</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity-specific Balance Confidence (ABC) Scale</td>
<td>16-item; Participant completed; Assess confidence in perceived need for mobility assistance; Time: Approximately 5 minutes to complete; Training: Basic Equipment: Testing Protocol Cost: None</td>
<td>(Powell &amp; Myers, 1995; Whitney, Hudak, &amp; Marchetti, 1999)</td>
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<tr>
<td></td>
<td>This is a test to measure confidence of perceived need for a walking aid and personal assistance to ambulate indoors / outdoors. Participants with falls history within the previous year had lower scores compared to non-fallers. ABC total scores and Falls Efficacy Scale scores correlated at r=.84 (p=.001). ABC Scale discriminates better than FES of high versus low mobility older adults (Powell &amp; Myers, 1995).</td>
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<tr>
<td></td>
<td>Unlike the original Falls Efficacy Scale (Tinetti et al., 1990), this scale includes a broader range of indoor and outdoor activities with questions aimed to determine how confidently seniors feel they are able to undertake each activity on a scale of 0 (not confident at all) to 10 (completely confident; Hill et al., 1996). Average score of 9.8 (range 9.2 – 10) for sample of healthy women (M age 74.1 years, SD = 4.0; Hill, Schwarz, Flicker, &amp; Carroll, 1999). High retest reliability in older sample of fallers and non-fallers (ICC=.95; Hill et al., 1996).</td>
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<td></td>
<td>The GDS is a test whereby participants answer yes or no in reference to how they felt on the day of administration. Scores of 0 - 9 are considered normal, 10 - 19 indicate mild depression and 20 - 30 indicate severe depression. This test can be used with healthy, medically ill and mild to moderately cognitively impaired older adults. It has been extensively used in community, acute and long-term care settings. The GDS was found to have 92% sensitivity and 89% specificity when evaluated against diagnostic criteria. The validity and reliability of the tool have been supported through both clinical practice and research (Kurlowicz, 1999).</td>
<td></td>
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</tr>
<tr>
<td>SF-36</td>
<td>Administered; Assess health-related quality of life Time: 5 – 10 minutes Training: Basic Equipment: Testing Form/Protocol Cost: None</td>
<td>(Enloe &amp; Shields, 1997; Ware, 2000; Ware &amp; Kosinski, 1996)</td>
<td></td>
</tr>
</tbody>
</table>
Table 4 continued

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<tr>
<th>Instrument</th>
<th>Description</th>
<th>Source</th>
</tr>
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<tbody>
<tr>
<td>Among older adults, evidence for a high degree of internal consistency was good with Cronbach’s alpha statistic exceeding .8 for each parameter: physical functioning, role physical, role emotional, energy/vitality, mental health/emotional well-being, social functioning, bodily pain, general health (Ware, 2000).</td>
<td></td>
<td>(Jacobson &amp; Newman, 1990; Jacobson, Newman, Hunter, &amp; Balzer, 1991)</td>
</tr>
</tbody>
</table>
| Dizziness Handicap Inventory (DHI)               | Administered; 25-item Questionnaire  
Time: Several minutes to complete  
Training: Basic  
Equipment: Testing Form  
Cost: None | (Cohen & Kimball, 2000) |
| Assess the level of impairment felt by an older adult with dizziness incorporating measurements of emotional functional and physical impacts of dizziness in daily activities. |                                                                                |                                                                      |
| Vestibular Disorders Activities of Daily Living Scale (VADL) | 31-item; Administered;  
Assess self-perceived level of independence during activities of daily living  
Time: Several minutes to complete  
Training: Basic  
Equipment: Testing Form  
Cost: None | (Cohen & Kimball, 2000) |
| Good face validity, high internal consistency (a> .90) and high test-retest reliability (r> .87) (Cohen & Kimball, 2000). |                                                                                |                                                                      |
| Environmental Hazard                            | Home Falls and Accident Screening Tool (Home Fast)  
25-item; Administered;  
Screening tool of safety in home for older population urban and rural setting;  
Training: Skilled  
Equipment: Testing Protocol  
Cost: Minimal to none | (Mackenzie, Byles, & Higginbotham, 2000) |
| Westmead Home Safety Assessment                  | Administered;  
Identify home hazards;  
Training: Basic  
Equipment: Testing Protocol  
Cost: Minimal to none | (Clemson, Fitzgerald, & Heard, 1999) |
| Six domains (external/internal trafficways, seating, bedroom, footwear, and medication management) include 72 potential hazards for the tester to identify. |                                                                                |                                                                      |
outcomes demonstrated a significant reduction in the risk of falling, in terms of one time falls incidence and falls rate. Overall, whether using a group-based or individualized exercise intervention, there was a reduction in the risk of falls by 12% and the number of falls by 19% in the older adults tested (RAND, 2003). The risk of falling was further reduced (24%) in cases when the exercise intervention included specific balance and gait activities (Province et al., 1995).

Hence, exercise is effective in reducing falls when used alone or when included as part of a multi-component intervention (Shumway-Cook, Gruber, Baldwin, & Liao, 1997). Research supports not only endurance activities and specific exercise regimens that are geared towards balance, strength (Carter et al., 2002) or flexibility as important in falls risk reduction and successful aging, but also the incorporation of general physical activity, such as walking, cycling, or mild aerobic movements in preserving muscle performance, promoting mobility, and reducing falls risk (Buchner, 1997). For many older adults with risk factors of muscle weakness, balance impairments, or loss of functional mobility, physical activity alone is likely to reduce the risk of falls (Sherrington, Lord, & Finch, 2004). There is also clear evidence that a targeted supervised home exercise program and community exercise programs of strength and balance exercise and walking, issued by a skilled healthcare professional, can prevent falls among community-dwelling older adults (Campbell et al., 1997; Robertson et al., 2001; Robertson, Gardner, Devlin, McGee, & Campbell, 2001; Salkeld et al., 2000). Table 5 lists additional studies relevant in supporting exercise programming in reduction of falls and falls risks in community-dwelling older adults.

In addition, an Eastern form of exercise known as Tai Chi emerged as a stand-alone exercise intervention that also provides various health benefits, such as improvements in functional balance, physical performance, and reduced fear of falling (Li et al., 2005), and it also
appears effective in lowering risk of multiple falls and falls incidence rates among certain groups of older adults (Li et al., 2005; Wolf et al., 1996). Tai Chi programming in community-based falls prevention initiatives has a number of advantages in that it costs little and requires no equipment, little space, and it can be performed in groups or individually in the home. Despite the ease of use and promise for falls reduction in older adults, not all styles of Tai Chi may be appropriate for use in the older adult population. For reasons of safety, functional limitations, and ease of learning, instructors who are well experienced in the aging process may need to manipulate the number and type of movement forms selected. Tai Chi appears to be a promising type of balance exercise, however, it requires further evaluation before it can be recommended as a stand-alone falls prevention strategy or as the preferred exercise technique of choice for prevention of falls in the older adult population (AGS, 2001; Klein & Adams, 2004; Wolf et al., 2003).

Few studies have determined limitations in physical activity or exercise programs in reduction of falls rates and falls risk factors in community-dwelling older adults. For example, in one study whereby older adults participated in a 20-week exercise program with one group performing walking and daily activity exercises, one not altering their daily routine (control), and another group performing balance exercises, findings indicated that falls incidence rate was higher in the walking/daily activity exercise group (3.3 falls per year) compared to the balance exercise group (2.4 falls per year) and control (2.5 falls per year). This indicates that mode of physical activity is important in reduction of falls incidence rate.

In another study, forty women (randomized classification into exercise and control groups) aged 65 to 89 years, whereby the exercise group performed a 15-week general exercise program, were tested using outcome measures of BBS, Get-up and Go, Functional Reach test, and Wall-Sit tests. The exercise subjects showed significant improvement on five of 14 items
and total score in the BBS and in leg strength as measured by the Wall-Sit test. Although control subjects reported six falls and exercise subjects reported no falls in the 1-year follow-up interviews, there was no significant difference in falls rates \((p = .106)\). This suggests that the prescribed exercise program indeed resulted in increases in balance and leg strength (both falls risk factors), but did not result in a significant difference in falls during the follow-up period. A limitation of the study may be the limited size of the study sample (Ballard, McFarland, Wallace, Holiday, & Roberson, 2004).

Although exercise and physical activity clearly have many proven benefits (Buchner, 1997; Buchner et al., 1997a, 1997b; Buchner et al., 1993; Buchner, Larson, Wagner, Koepsell, & de Lateur, 1996), there are no specific recommendations regarding principles of exercise prescription, the optimal type, duration, intensity, or frequency of the intervention. To combat this dilemma, Rose (2005) recommends several topics to consider when matching the intervention to the specific needs of older adults at different levels of falls risk. She notes the importance of identifying the type of activity, level of falls risk for the individual, type of intervention strategy prescribed, compliance of the individual, effectiveness of the intervention, and influence of ethnicity, socioeconomic status, and geographical location. Exercise interventions must be developed and adopted with careful consideration of these factors (Rose, 2005) and the individual’s abilities because optimal levels of different exercise regimens are unclear and some programs may actually increase the risk of falls (Rizzo et al., 1998; Tinetti et al., 1994).

In addition, exercise interventions should be considered inadequately intense if they do not lead to significant improvements in intermediate variables such as balance, strength, or endurance because these variables contribute most to reduced falls risk and/or falls incidence rates (Reinsch, MacRae, Lachenbruch, & Tobis, 1992). Evidence further suggests that to
appreciably lower risks for falls in those older adults who are at a low to moderate risk for falls, exercise interventions should promote at least moderate intensity efforts. However, additional research is needed to clarify principles of physical activity and exercise prescription in relation to falls prevention in older adults.

For those in a higher functioning (pre-frail) category, falls risk significantly decreased and those performing walking, daily activity exercise, or balance exercises demonstrated improvement in physical performance (as measured by the Tinetti POMA and GARS tests). Higher functioning older adults participating in any program of walking, daily activity exercise, or balance exercises showed a small, but significant improvement in POMA and physical performance scores suggesting moderate intensity group exercise programs have positive effects on falling and physical performance in higher functioning older adults (Faber et al., 2006). Research suggests that the risk of becoming a faller in exercise groups increases significantly in older adults considered as frail (Faber et al., 2006). There is further indication that those older adults who are at high risk for falls and who are severely deconditioned (frail), should participate in exercise programs progressing from low to moderate intensity effort (Day et al., 2002; Reinsch et al., 1992).

Therapy

Many falls can be attributed to muscle weakness, loss of balance, fatigue with exertion and declines in physical function associated with aging. As mentioned in the previous section, it is widely accepted that exercise programs might delay or reverse physical decline and therefore prevent falls. However, progressive age-related limitations such as range of motion deficits or other musculoskeletal or neurological impairments may indicate the need for assistance of a trained healthcare professional (i.e. physical or occupational therapist) to provide individualized progressive muscle stretching, mobilization exercises, therapeutic activities, gait training, or
Table 5. Exercise Programs for Community-dwelling Older Adults: Current Research

<table>
<thead>
<tr>
<th>Project</th>
<th>Objective / Outcome Measures</th>
<th>Participants</th>
<th>Interventions / Outcomes</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Carter et al., 2002)</td>
<td>Objective: Cross-sectional study to describe the associations among knee extension strength, medication history, medical history, physical activity and both static and dynamic balance in women diagnosed with osteoporosis</td>
<td>97 females with osteoporosis; M age 69 years; SD = 3.2</td>
<td>Pre-knee extension strength intervention</td>
<td>Knee extension strength significantly determines performance on static and dynamic balance tests in older females.</td>
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<tr>
<td></td>
<td><strong>Outcome Measures/Means:</strong></td>
<td><strong>Interventions / Outcomes</strong></td>
<td><strong>Findings</strong></td>
<td></td>
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<tr>
<td></td>
<td>* Health history, current medications, and quality of life: Questionnaires*</td>
<td>* Significant predictors of dynamic balance: knee extension strength (26%, ( p &lt; .001 )), medications (6%, ( p &lt; .05 )), age (4%, ( p &lt; .05 )), height (4%, ( p &lt; .001 )), as well as years of estrogen use (2%), tobacco use (2%) and weight (2%).*</td>
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<td></td>
<td>* Static balance: CDP (Equitest)*</td>
<td>* Knee extension strength associated with quality of life (( r(2) = .12, \ p &lt; .001 )).*</td>
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<td></td>
<td>* Dynamic balance: Figure-eight run*</td>
<td>* A 3% increase in mean knee extension strength was associated with 1.2, 2.4 and 3.4% greater static balance, dynamic balance and quality of life, respectively.*</td>
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<tr>
<td></td>
<td>* Knee extension strength:*</td>
<td></td>
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<tr>
<td></td>
<td>* Dynamometry*</td>
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<tr>
<td>(Carter et al., 2002)</td>
<td>Objective: RCT to examine exercise programs for women with osteoporosis to improve balance, strength, and agility.</td>
<td>93 females 65-75 years of age; Osteoporosis; Not participating in moderate or hard exercise</td>
<td>Random assign to one of two groups: 2x/wk exercise / no program for 20 wks</td>
<td>Participants in the exercise program demonstrated improvements in dynamic balance and strength in older females.</td>
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<td></td>
<td><strong>Outcome Measures/Means:</strong></td>
<td><strong>Interventions / Outcomes</strong></td>
<td><strong>Findings</strong></td>
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<tr>
<td></td>
<td>* Pre/post program measures*</td>
<td></td>
<td>In exercise group, 4.9% improvement noted in dynamic balance (( p = .044 )) and 12.8% in knee extension strength (( p = .047 )).</td>
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<tr>
<td></td>
<td>* Static balance: CDP*</td>
<td></td>
<td>A home exercise program prescribed by a nurse in the home setting was effective in reducing falls, serious injuries, and hospital admissions.</td>
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<tr>
<td></td>
<td>* Dynamic balance: Figure-eight run*</td>
<td></td>
<td>The program was also cost effective only in those over 80 years of age.</td>
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<tr>
<td></td>
<td>* Knee extension strength:*</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>* Dynamometry*</td>
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<tr>
<td>(Robertson, Devlin, Gardner, &amp; Campbell, 2001)</td>
<td>Objective: RCT to assess effectiveness of home health nurse prescribed home exercise program to decrease falls and injuries in older adults.</td>
<td>240 males and females &gt;74 years of age</td>
<td>Random assign to one of two groups: Nurse prescribed home exercise program / usual care (control)</td>
<td>A home exercise program prescribed by a nurse in the home setting was effective in reducing falls, serious injuries, and hospital admissions.</td>
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<tr>
<td></td>
<td><strong>Outcome Measures:</strong></td>
<td><strong>Interventions / Outcomes</strong></td>
<td><strong>Findings</strong></td>
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<tr>
<td></td>
<td>* Number of falls*</td>
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<td>In home exercise group, there was a 46% decrease in falls.</td>
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<tr>
<td></td>
<td>* Number of injuries from falls*</td>
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<tr>
<td></td>
<td>* Costs of implementing program*</td>
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</tr>
<tr>
<td></td>
<td>* Costs of hospital care*</td>
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</tbody>
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58
| Table 5 continued |
|-------------------|--------------------------|-----------------|---------------------------------|
| **(Campbell et al., 1997)** | Objective: RCT to assess effectiveness of physical therapy issued home exercise program of strength and balance exercises in decreasing falls and injuries. | 133 females >79 years of age | Random assign to one of two groups: Physical therapist prescribed home exercise program / social visits (control) |
| Outcome Measures: | Number of falls | Mean rate (SD) of falls in exercise group lower (0.87 (1.29) compared to 1.34 (1.93) falls per year, respectively, with the difference of 0.47. | A physical therapy home exercise program of strength and balance exercises improved physical function and was effective in reducing falls and falls-related injuries in women over 79 yo. |
| | Number of falls-related injuries | | |
| | Time between falls (in 1 year) | | The relative hazard for a first fall with injury in the exercise group compared to the control was 0.61. |
| | Muscle strength (pre/post 6 mo) | | After six months, balance had improved in the exercise group with a difference between changes in balance scores of 0.43. |
| | Balance measures (pre/post 6 mo) | | |
| **(Shumway-Cook et al., 1997)** | Objective: Prospective investigation to examine effectiveness of multi-dimensional exercise program on balance, mobility, and falls risk for those with a history of falling. | 105 older adults > 64 years of age; Falls history (2 or more in previous 6 mo) | Classification groups: control with no intervention, fully adherent exercise group, partially adherent exercise group. |
| Outcome Measures/Means: | Balance / Mobility: Tinetti Mobility Assessment | | Intervention group received individualized exercise program specific to defined impairments and functional disabilities. |
| | Number of falls risks | | Both exercise groups scored better than control group on all measures of balance and mobility, fully adherent more than partially adherent. |
| **(Li et al., 2005)** | Objective: RCT to evaluate the efficacy of a 6-month Tai Chi exercise program to decrease the number of falls and risk for falling. | 256 males and females M age = 77.48; SD = 4.95; Physically inactive | Random assignment into one of two groups: 3x/wk Tai Chi group / stretching group (control) for 6 months |
| Outcome Measure/Means: | All measured at baseline, 3 mo, 6 mo, and 6 mo post intervention | Significant reduction in number of falls at the end of 6 mo in intervention group (p = .007), lower proportion of fallers (p = .01), fewer injurious falls (p = .03). | Tai Chi program 3x/wk for 6 months is effective in decreasing number of falls, fear of falling, and risk for falling, and it improves functional balance and physical performance in physically inactive older adults. |
| | Number of falls | Risk for falls 55% lower in Tai Chi group as compared to stretching group (RR = 0.45). | |
| | Functional Balance: | Tai Chi group participants showed significant improvements in all measures of functional balance, physical performance, and reduced fear of falling (p < .001). | |
| | o Berg Balance Scale | | |
| | o Dynamic Gait Index | | |
| | o Functional Reach Test | | |
| | o Single leg stand | | |
| | Physical Performance: | | |
| | o 50-ft speed walk | | |
| | o Up and Go | | |
| | o Fear of falling | | |
neuromuscular re-education in combination with other falls risk focused interventions. Studies demonstrate that personalized exercise programs targeting specific physical impairments identified during an initial assessment produce significantly lower falls incidence rates (Campbell et al., 1999; Campbell et al., 1997). For instance, Campbell et al. (1999) indicates improvements in physical function and a significant reduction in the rate of falling in a group of women over the age of 80 who were identified as being at high risk for falling following participation in individualized exercise interventions administered by physical therapists.

For those older adults with vestibular dysfunction, functional improvements are possible. Balance and vestibular physical therapy can decrease detriments in areas of balance, visual acuity, and gait stability (Badke, Shea, Miedaner, & Grove, 2004). These improvements are evident following individualized vestibular rehabilitation including gaze stabilization, balance and gait training, and habituation exercises, and they are generally effective against vestibular disorders with persistent symptoms.

There are no experimental studies that examine footwear and incidence of falls. However, some evidence suggests improvement in intermediate outcomes, such as balance and postural sway from specific footwear intervention (AGS, 2001). For example, in women, results of functional reach and timed mobility tests were better when subjects wore walking shoes than when they were barefoot, and wearing shoes with high collars versus wearing shoes with low collars (Lord, Bashford, Howland, & Munroe, 1999). This indicates that walking shoes, and those with higher collars, may provide additional balance and support for mobility. Furthermore, there were also improvements in static and dynamic balance while participants wore low-heeled rather than high-heeled shoes, potentially due to larger base of support; and static balance is best in hard-soled (low resistance) shoes (Robbins & Waked, 1997). Other physical therapy interventions involving footwear include addressing proper fit of shoes to accommodate any
bunions or toe deformities, or provide orthotics/shoe modifications or necessary debridement to decrease instability from skin thickening or poor sensation.

Assistive devices and hip protectors can be issued by physical or occupational therapists for prevention of falls and hip fractures in at-risk individuals. However, it is important to educate the individual on the correct use of walkers, canes, scooters and other devices (Bateni & Maki, 2005). Although there is no direct evidence that the use of assistive devices alone will prevent falls, studies of multifactorial interventions that have included assistive devices (including bed alarms, canes, walkers, and hip protectors) have demonstrated benefit (AGS, 2001). Therefore, while assistive devices may be effective elements of a multifactorial intervention program, their isolated use without attention to other risk factors cannot be recommended at this time.

Physical therapists can also assist those with cognition-related falls risks with BADL and IADL retraining by repetition and habituation, caregiver education on falls risks and prevention strategies, issuance of assistive devices, and distraction removal with task awareness/selective attention training (Woolley, Czaja, & Drury, 1997). For those older adults with specific impairments such as perceptual dysfunction, neglect, or inattention, there are available modifications that can reduce falls risk in the home. For example, remedial training (i.e. locating scattered objects) and environmental adaptations are treatment approaches to aid in decreasing falls risks for those with perceptual dysfunction (Antonucci et al., 1995; Katz et al., 1999; Paolucci et al., 1996; Rossetti et al., 1998). Older adults with visual neglect, inattention or hemianopia, can also demonstrate a reduction in falls risks following rearranging the environment or properly cueing the individual to his or her living environment. Furthermore, patients with deficits in spatial relations or depth perception can be guided to practice object retrieval or to feel depth and distance before movement to avoid slipping or tripping over obstacles in the home.
Home Adaptation

Research shows that environmental risk factors play a part in about half of all home falls (Nevitt, Cummings, & Hudes, 1991). The Canadian Best Practices Guide (2001) concludes that home modification can be an effective strategy for reducing falls among seniors and that this effect is enhanced by education and counseling about comprehensive falls-risk reduction (Scott et al., 2001). Although studies have not demonstrated that home modification alone will reduce falls (CDC, 2004; RAND, 2003; Roberts, 2003; Stevens, Holman, & Bennett, 2001; Stevens, Holman, Bennett, & de Klerk, 2001; van Haastregt et al., 2000), home modification is important in falls risk reduction as it converts or adapts the living environment to one that is safer for an individual. Modifications are typically made with the intended purpose of re-establishing an equilibrium between a person whose capabilities have declined and the demands of the environment (Lawton & Nahemow, 1973). This aids an older adult by making it easier to execute tasks with less challenge, reduces accidents, and supports independent living.

With respect to falls risk in older adults, home modification may include removing hazards (Koepsell et al., 1994), adding special adaptive features or assistive devices, rearranging furnishings, changing activity areas, or performing renovations to better accommodate the older adult for daily living. Removing environmental hazards from the home was the focus of at least four randomized controlled studies designed to decrease falls risk in the environment (Carter et al., 2000; Day et al., 2002; Gillespie et al., 2001; Salkeld et al., 2000; Stevens, Holman, & Bennett, 2001; Stevens, Holman, Bennett, & de Klerk, 2001). Hazards targeted included removing clutter, securing rugs and electrical cords, improving illumination, and installing handrails, grab bars (Pynoos & Overton, 2003) and non-skid strips, and painting pavement cracks and street obstacles in bright colors. Stevens et al. (2001) randomly assigned community-dwelling older adults into either an intervention or a control group whereby the intervention group
received home environment interventions such as home visits, home hazard assessments, home hazard reduction education, and installation of safety devices and the control group received only a home visit (Stevens et al., 2001). In this study, there was no significant reduction in either group in the incidence rate of falls involving home hazards, no reduction in the rate of all falls, nor was there a significant reduction in the rate of injurious falls in intervention subjects at 1-year follow-up (Stevens et al., 2001). This study, like others, suggests that a one-time or multiple-visit (van Haastregt et al., 2000) intervention program of medical screening, education, hazard assessment, behavioral and home modification is not by itself an effective strategy for falls prevention in older adults, which indicates that alternative strategies for falls prevention are warranted. Thus, there is no available evidence to conclude that home modifications alone will reduce falls risk.

The lack of evidence to support home modification interventions may be attributed to lack of follow-up to ensure that all home modifications are implemented and/or maintained. Programs that provide on-site home inspections in addition to performing necessary repairs or modifications appear to be more successful in falls risk reduction than programs that simply identify hazards and leave it to the older adults to make the necessary modifications on their own (Scott & Popovich, 2001). Older adults may also be limited by manual or financial help. In other instances, occupational therapy facilitation of home modification and intervention is also found to prevent falls and may promote changes in behavior for the older adult to live more safely (Leipzig et al., 1999), in addition to reducing home health costs and delaying institutionalization for community-dwelling older adults (Mann, Ottenbacher, Fraas, Tomita, & Granger, 1999).

**Medication Modification**

Physicians, pharmacists and other healthcare providers should be aware of certain medications and medication classes that have associations with an increased risk of falling. Some
initiatives that may aid in reducing medication-driven causes of falls include providing drug profiles for individuals and reviewing medications for interactions with each other. Reducing the number and types of medications used, particularly those elevating falls risk such as tranquilizers, sleeping pills, and anti-anxiety drugs, appears to be an effective falls prevention strategy when used alone or as part of a multi-component intervention (Campbell et al., 1999; Ray et al., 1990).

With respect to certain high risk drugs, it is important for physicians to prescribe the lowest therapeutic dose possible (Sorock & Shimkin, 1988) and for healthcare providers to educate and alert patients and caregivers about the risk of falling and fracture within the early days of use (Neutel et al., 1996). In addition, particular attention to medication reduction should be given to older persons taking four or more medications and to those taking psychotropic medications (AGS, 2001). Eliminating a medication, changing the dosage or switching to an alternative medication that does not compromise therapeutic effect may reduce the chance that a fall will occur or recur in an at-risk older person. Interventions aimed at reducing the potential increased risk posed by medication use are outlined in Table 6.

In general, recommendations include an initial review of the medication regimen, paying particular attention to new medications and any side effects, adverse effects, and toxic effects that may increase the risk of falling. Furthermore, recommendations should include changes in medication therapy (i.e. dose reduction, elimination of a medication or medications, and switch to a medication that poses less risk). Education is also important for older adults and caregivers regarding medication side effects that might increase the risk of falling, guidance about when to report those side effects, and follow-up with older adults to assess falls, recurrence of falls, and the impact of medication adjustment.
Table 6. Guidelines to Reduce Medication-Induced Falls

<table>
<thead>
<tr>
<th>Guideline</th>
<th>Medications: Falls-Reduction Recommendations</th>
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<tbody>
<tr>
<td>American Medical Directors Association (AMDA, 2003)</td>
<td>Potential fallers:</td>
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<tr>
<td></td>
<td>- Review high-risk medications (diuretics, cardiovascular medications, anti-hypertensive medications, anti-psychotics, anti-anxiety agents, sleeping medications, anti-depressants)</td>
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<td>- Reduce dosages or eliminate high-risk medications</td>
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<td>Post-fall:</td>
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<td>- Review for presence of medications that could predispose to falls and adjust dosage or stop medication as indicated</td>
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<td></td>
<td>- Review for recent changes in medication regimen</td>
</tr>
<tr>
<td>American Geriatrics Society, British Geriatrics Society, American Academy of Orthopedic Surgeons Panel on Falls Prevention (AGS, 2001)</td>
<td>- Those with falls history should have their medications reviewed and altered/stopped to prevent future falls.</td>
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<tr>
<td></td>
<td>- Attempt medication reduction for older persons taking four or more medications and those taking psychotropic medications.</td>
</tr>
<tr>
<td>Quality Indicators for Assessing Care of the Vulnerable Elders (ACOVE; Rubenstein, Powers, &amp; MacLean, 2001)</td>
<td>- Annual review of medications</td>
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<td>- Clearly define indications for prescribed medications</td>
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<td></td>
<td>- Avoid tricyclic antidepressants</td>
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<td></td>
<td>- Monitor diuretic and warfarin therapy</td>
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<td></td>
<td>- Clearly define indications for new medications</td>
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<td></td>
<td>- Educate individuals about side effects for new medications</td>
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<td></td>
<td>- Avoid medications with anticholinergic properties</td>
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<td>- Individuals should have updated medication list</td>
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**Other Clinical Interventions**

There is emerging evidence that some falls have a cardiovascular cause that may be amenable to intervention strategies often directed to syncope (Kenny & Traynor, 1991), such as medication change or cardiac pacing. It is believed that treatment for syncope should be directed to the underlying cause. However, the role of these cardiac investigations and treatments is not yet clear and cannot be recommended at this time (AGS, 2001).
With respect to visual sensory deficits, older adults should be asked about their vision and if they report problems, their vision should be formally assessed annually (Evans & Rowlands, 2004), and any remediable visual abnormalities should be treated. Although there are no randomized controlled studies of interventions for individual visual problems despite a significant relationship between falls, fractures, and visual acuity as discussed (AGS, 2001), presbyopia and refractive error can be managed with spectacles and ophthalmic surgery or laser can provide vital relief for certain eye diseases. Non-surgical approaches to enhancing visual acuity include enhanced color contrast décor and adjusting for adequate illumination.

Older adults with peripheral neuropathy impairment can benefit from conventional interventions such as learning visual compensation techniques, obtaining proper walking aids, and receiving treatment for underlying medical conditions. Other clinical interventions can be performed for conditions such as urge incontinence. This condition should be medically treated and these older adults should be educated to perform regular and/or scheduled toileting, perform pelvic floor exercises, or receive electrical stimulation to the pelvic floor muscles as indicated. These individuals should also be educated on the proper use of laxatives and diuretics.

**Multifactorial Interventions and Education**

As indicated throughout this literature review, falls are often the result of a complex, interdependent constellation of factors in which multiple causes interact together to produce a fall. For that reason, interventions that address a number of factors at once not only make sense, but are the most effective at decreasing falls frequency in community-dwelling older adults (Chang et al., 2004; Day et al., 2002). The AGS Panel has recommended intervention approaches based on the various falls risk needs of various populations. For people living in the community, the AGS Panel and Tinetti et al. (1994) further suggest that prevention strategies include multiple components of gait training, exercise and balance training, reviewing, reducing and/or modifying
medications, treating postural hypotension, reducing home hazards, treating cardiovascular
disorders including cardiac arrhythmias (AGS, 2001), behavioral modification, educating and
issuing assistive device use as needed, and clinical assessment and treatment (Tinetti et al.,
1994).

Although a multifactorial intervention strategy is more resource intensive and generally
requires a multidisciplinary team of providers, once risk factors are identified, the individual can
then be referred to the appropriate services for specific treatment and follow-up. A landmark
study of a multifactorial intervention conducted by Tinetti and colleagues (1994) reveals within
one year, only 35% of older adults in a multifactorial falls-risk reduction intervention program
experienced falls versus 47% in the control group ($p = .04$) and the incidence-rate ratio for
falling in the intervention group compared to the control group was 0.69 (Tinetti et al., 1994).
The study also found a significantly increased time to the first fall for the intervention group.

Education is also an important component of most successful falls prevention strategies.
Safety promotion and education, which should be the first step in the continuum of injury
prevention activities, involves raising awareness about the importance of preventing specific
injuries such as falls. It also involves changing public values so that people no longer see falls
among older adults as an ‘accident’ that cannot be prevented, and instead understand that falls
are highly predictable events that can be minimized by taking specific preventive actions. A
senior who has had a recent fall is more likely to be receptive to learning about prevention than
someone who has never fallen. Therefore, timing is also an important aspect of effective
education programs. However, when used as an isolated intervention, health or behavioral
education does not reduce falls and therefore education should be a part of a multifactorial falls
risk reduction intervention program.
The strongest, evidence-based interventions have found that through the use of thorough, focused clinical assessments identifying risks for falls followed up by targeted multifactorial interventions is critical because falls are frequently caused by an interaction between personal and environmental factors (Tinetti et al., 1994). In addition, informing seniors and healthcare providers about falls risks through information campaigns and health promotion activities is key to prevention. Falls risk reduction education can be in the form of printed materials such as handouts, discussion groups, or the use of the media. Another option is the use of trained peer volunteers, for they are well received by other seniors as reliable sources of information for promoting falls prevention.
CHAPTER 3
VALIDATION OF THE COMPREHENSIVE FALLS RISK SCREENING INSTRUMENT

Falls are the leading cause of non-fatal injuries and injurious death among older adults (Alexander, Rivara, & Wolf, 1992; Rivara, Grossman, & Cummings, 1997). It is estimated that one in three persons over the age of 65 will fall each year (Hausdorff et al., 2001; Hornbrook et al., 1994; Kannus et al., 1999) with over half of these falls occurring among adults over 80 years of age. Older adults who experience a fall have three times the risk of falling again within the year following the initial fall (O'Loughlin, Robitaille, Boivin, & Suissa, 1993; Rubenstein & Josephson, 2002). Data from the National Center for Injury Prevention and Control reveal that older women fall more often than older men and sustain more non-fatal falls (Davis et al., 1994; National Center for Injury Prevention and Control [NCIPC], 2003). In addition, Non-Hispanic Caucasian older adults fall more often than those of other races/ethnicities (Centers for Disease Control [CDC], 2008b; Hanlon, Landerman, Fillenbaum, & Studenski, 2002).

Older adults can experience falls because of a variety of health diagnoses and age-related issues such as diabetes (Schwartz et al., 2008; Tilling, Darawil, & Britton, 2006; Volpato, Leveille, Blaun, Fried, & Guralnik, 2005), hemodialysis treatment (Cook et al., 2006; Desmet, Beguin, Swine, & Jadoul, 2005; Roberts, Jeffrey, Carlisle, & Brierley, 2007), cancer (Overcash, 2007), osteoarthritis (Alencar et al., 2007), osteoporosis (Masoni, Morosano, Tomat, Pezzotto, & Sanchez, 2007), peripheral neuropathy (DeMott, Richardson, Thies, & Ashton-Miller, 2007; Kim & Robinson, 2006), visual loss (Coleman et al., 2007; Lamoreux et al., 2008), hearing loss (Purchase-Helzner et al., 2004), progressive muscular weakness (Moreland et al., 2004), chronic pain (Blyth et al., 2007; Martin et al., 2005), or orthostatic hypotension (Shibao, Grijalva, Raj, Biaggioni, & Griffin, 2007). Many older adults experience these progressive and chronic
debilitating health conditions, and therefore, the identification of impairments associated with them is imperative because they can lead to loss of mobility and balance causing a future fall. Falls in older adults has increased over the years (Stevens, Corso, Finkelstein, & Miller, 2006) leading healthcare providers and governmental organizations to identify specific impairments or causes of falls in older adults and determine means to decrease falls risk and prevent falls in this population.

In collaboration with the American Academy of Orthopaedic Surgeons and the British Geriatrics Society, the American Geriatrics Society (AGS) formed a panel for assisting healthcare professionals with the assessment of falls risk and falls risk management of older adults. To identify quality of care indicators for mobility issues and falls, the panel gathered data collected in meta-analyses and systematic literature reviews, articles with epidemiological or introductory information, randomized controlled and nonrandomized clinical trials, case control studies, cohort studies, bibliographies, and they consulted with experts in the field. Researchers extracted data from each article and they identified references from articles to review for further searches. Information included falls risk factors identified through assessments, outcomes such as number of fallers and fall frequency or time to first fall event, means of prediction of falls outcomes, and responsiveness of risk factors to interventions.

In general, participants represented in the studies that were reviewed by the panel included older adults with good fitness levels, those without fall history, those considered at risk for falls, and those who had one or multiple falls. Environmental locations included community settings (majority), long-term care facilities, and acute-care hospitals. Recommendations were formed by the panel following identification and compilation of relevant published evidence using evidence grading criteria (Class I, Class II, Class III, Class IV with the lower class indicated as the stronger research-base) and a distinguished strength of recommendation (levels
A, B, C, or D with the latter level having a lower recommendation; see Table 7). For example, Class I evidence indicated highly sound research, but the importance of panel comments and strength of recommendation was critical in ruling research characteristics of clinical relevance and practical importance. These recommendations were used to formulate a guideline for falls prevention in older adults (American Geriatrics Society [AGS], 2001).

Table 7. Evidence Categories and Strength of Recommendation.

<table>
<thead>
<tr>
<th>Evidence Categories: Evidence found from the following</th>
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<tbody>
<tr>
<td><strong>Class I</strong></td>
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<tr>
<td>At least one randomized controlled trial (RCT) or a meta-analysis of RCT</td>
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<tr>
<td><strong>Class II</strong></td>
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<tr>
<td>At least one controlled study without randomization; or At least one type of quasi-experimental study</td>
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<tr>
<td><strong>Class III</strong></td>
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<tr>
<td>Nonexperimental studies (comparative, correlational, or case-control)</td>
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<tr>
<td><strong>Class IV</strong></td>
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<tr>
<td>Expert committee reports or opinions and/or clinical experience of such</td>
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<tr>
<th>Strength of Recommendation by the Panel: Directly based on the Class Categories</th>
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<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
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<tr>
<td>D</td>
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</table>

(AGS, 2001)

Central to the guidelines for falls prevention was the identification of intrinsic and extrinsic falls risk factors common to older adults. Factors such as age, gender, race/ethnicity, cognitive or psychological issues, health or medical conditions, mobility, function, or fitness level are all considered intrinsic falls risk factors (Campbell, Borrie, & Spears, 1989; Tinetti, Speechley, & Ginter, 1988). Other falls risk factors, of non-biological, environmental, or other imposed influence, are extrinsic and include medication-related complications or side effects, home hazards, assistive device usage, wearing inappropriate footwear, or performing hazardous behaviors. For falls risk factors identified as being most influential by the AGS panel, relative risk ratios (RR) were calculated for reviewed prospective studies and odds ratios (OR) were
calculated for retrospective studies. The following falls risk factors were identified: muscle weakness (RR/OR = 4.4), falls history (RR/OR = 3.0), gait deficits (RR/OR = 2.9), balance deficits (RR/OR = 2.9), usage of an assistive device (RR/OR = 2.6), visual deficits (RR/OR = 2.5), arthritis (RR/OR = 2.4), impaired activities of daily living (RR/OR = 2.3), depression (RR/OR = 2.2), cognitive impairment (RR/OR = 1.8), and age over 80 years (RR/OR = 1.7; Rubenstein & Josephson, 2002). While each identified falls risk factor has its own relative risk, overall falls risk increases as the number of risk factors increases (Nevitt, Cummings, Kidd, & Black, 1989; Tinetti et al., 1988). Potentially from an interaction of risk factors, the relative risk of falling increases from 8% in those without any falls risk factors to 78% in those older adults who have four or more identified falls risk factors. Therefore, it is important for researchers and healthcare professionals to assess older adults for a variety of risk factors to achieve a more comprehensive understanding of their overall risk for falling (Tinetti et al., 1988). However, it is initially necessary to identify older adults who may demonstrate any of these risks.

Various assessment tools can indicate whether an older adult demonstrates an impairment that is a known risk factor for falls. The AGS recommends an assessment of an individual’s falls risks and specific mobility deficits to determine and deliver targeted and appropriate interventions. Screening for specific impairments that may lead to a fall can be simple. For example, a clinician can assess visual acuity deficits with a Snellen eye chart (Pandit, 1994) to indicate whether an older adult may have visual field deficits. Similarly, a Dix-Hallpike maneuver (Fife et al., 2000) can be performed to determine any vestibular deficits; the Functional Reach Test (FRT) can assess functional standing balance (Duncan, Weiner, Chandler, & Studenski, 1990); the Expanded Timed Get up and Go (ETGUG; Botolfsen, Helbostad, & Wall, 2006) can determine functional mobility; and the Tinetti Gait and Balance Assessment can detect any dynamic gait or balance impairments (Tinetti, 1986; Tinetti, Williams, & Mayewski,
1986). Each of these basic single domain screening tools can be helpful in identifying single impairments that can ultimately be responsible for causing a fall. However, because an older adult may possess more than one risk factor, these instruments are not capable of detecting the interaction of or the specific weight of multiple falls risk factors, and therefore, the overall falls risk is not captured.

Implementing multiple assessments in an attempt to capture the overall falls risk by revealing various falls risk factors may be difficult for a clinician or community leader because of the cost associated with the instrumentation or administration of multiple assessments, staff limitations, or the inability to devote the necessary time required to perform each of the tests individually. Therefore, the purpose of developing the Comprehensive Falls Risk Screening Instrument (CFRSI) was to quickly and cost-effectively examine multiple risk factors, and determine specific falls risk subscale scores for each individual impairment-influenced falls risk (as described by the AGS guideline) and a total falls risk score based on and weighted by the AGS falls risk ratios. The identification of weighted falls risk factors in older adults using the CFRSI will further allow clinicians to suggest appropriate intervention programs for the reduction of the specific identified risks.

The newly developed CFRSI includes five falls risk subscales and encompasses the identified and weighted falls risk factors according to the RR and OR as determined by the AGS. The history risk subscale includes the AGS identified falls risk factors of history of falls, assistive device usage, diagnosis of arthritis, and self-reported age. The physical risk subscale includes measures of balance and mobility, and the medication subscale includes information regarding high risk medication use, use of multiple pharmacists, and medication side effects. The vision subscale encompasses visual acuity, optometry visits, and use of prescription lens compliance; and the environment subscale is calculated using information regarding hazards in
the home. The RR or ORs are used to weight and calculate falls risk subscale scores and all five of the subscale scores are averaged for a total falls risk score. Because research shows that causes of falls are multifactorial, the generation of a total falls risk score from multiple impairment-influenced falls risk subscales is imperative. These scores will give older adults a total falls risk score to better define their falls risk as compared to similar cohorts and will aid older adults in identifying those risks that are most influential in predicting a future fall.

In developing a new instrument, validity of a tool is necessary to determine the extent to which a measurement is useful for making an accurate decision relevant to a given purpose or the appropriateness of inferences based on a particular measurement (American Psychological Association [APA], 1974). One measure of validity, construct validity, is “the degree to which a test measures a hypothetical construct and is usually established by relating the test results to some behavior” (Thomas & Nelson, 2001). In other words, it measures the validity of an instrument in terms of whether the instrument measures what it claims to measure. For example, to determine the construct validity of the Physical Activity Scale for the Elderly (PASE; Washburn, Smith, Jette, & Janney, 1993) PASE scores were correlated with physiologic and performance measures (e.g., peak oxygen uptake, systolic blood pressure, and balance). Results showed that older adults who were less active (i.e., lower PASE score) had poorer physiologic function and performance scores as compared to those who were more active (higher PASE score). This was evidence that the PASE is a valid measure of physical activity in older adults (Washburn, McAuley, Katula, Mihalko, & Boileau, 1999). The construct validation of the CFRSI can include a comparison of the total falls risk score against other known factors that are associated with falls in older adults such as physical activity, physical function, health-related quality of life (HRQL), and history of falls (Chan et al., 2007; Graafmans, Lips, Wijlhuizen, Pluijm, & Bouter, 2003; Heesch, Byles, & Brown, 2008; Ory et al., 1993; Ozcan, Donat,
Gelecek, Ozdirenc, & Karadibak, 2005; Wolf et al., 1996). Thus, the construct validation of the CFRSI was established by comparing the total falls risk score against (a) falls risk subscale scores of history, physical, medication, vision, and environment; (b) self-reported physical activity levels, (c) self-reported physical function, (d) HRQL, and (e) self-reported 1-year history of falls. Therefore, the overall purpose of the study was to validate the CFRSI that includes falls risk subscales of history, physical, medication, vision, and environment, and provides a total falls risk score. It was hypothesized that the total falls risk score, as derived from the comprehensive weighting of falls risk factors according to the AGS odds and relative risk ratios, would be (a) positively associated with the falls risk subscale scores, (b) negatively associated with self-reported physical activity levels, (c) positively associated with limited self-reported physical function, (d) negatively associated with HRQL scores; and (e) those who fell within the year prior to the initial screening would exhibit higher baseline total falls risk scores than non-fallers. These associations would be at least of moderate strength. A research question was also proposed to determine which baseline falls risk subscale scores would predict falling status within the year prior to the initial screening. The analysis for predicting falling status using the subscales was exploratory, and therefore, no hypotheses were formulated for the research question.

Methods

Participants

Participants were 303 older adults from ten local community centers, Councils on Aging, YMCAs, and retirement communities who volunteered for a falls risk screening. Falls risk screenings were advertised by newsletters, flyers and posters, and newspaper displays. A representative sample of participants was sought that was reflective of the demographic
composition with regards to race, sex, and age in the four surrounding Louisiana parishes where falls risk screenings were conducted (i.e., East Baton Rouge, West Baton Rouge, Washington, and Ascension parishes; see Table 8). All participants signed an informed consent document that was approved by the Louisiana State University Institutional Review Board. However, non-ambulatory wheelchair users, those under 50 years of age, those living outside of a 100-mile radius of East Baton Rouge Parish, those unable to participate in proper administration of the tests, and those who demonstrated dementia through an inability to comprehend instructions and the informed consent were excluded from the study.

Table 8. CFRSI Validation Study: Target Demographic Profile Based on Census 2000

<table>
<thead>
<tr>
<th>Variable</th>
<th>US (%)</th>
<th>Louisiana (%)</th>
<th>Local Parishes* (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (50 years and over)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>56</td>
<td>57</td>
<td>56</td>
</tr>
<tr>
<td>Male</td>
<td>44</td>
<td>43</td>
<td>44</td>
</tr>
<tr>
<td>Race/Ethnicity (50 years and over)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>82</td>
<td>73</td>
<td>71</td>
</tr>
<tr>
<td>Black/African American/*Other</td>
<td>9</td>
<td>32</td>
<td>27</td>
</tr>
<tr>
<td>Educational Level (65 years and over)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low (High School Graduate/GED or less)</td>
<td>83</td>
<td>87</td>
<td>Information not available</td>
</tr>
<tr>
<td>High (Some College or above)</td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

*2000 LA Census Data Local Parishes includes: East Baton Rouge, West Baton Rouge, Washington, and Ascension Parishes

**Procedure**

Over a 2-year period, falls risk screenings were scheduled and performed at ten community organizations and each community screening lasted for about 3 hours. Current active facility or community members signed up for a 20-minute testing block during the screening period one to two weeks before the screening date. Each participant was asked to bring to the screening a completed Home Assessment Checklist and a completed Medication List Form that were issued to the facility coordinator when the screening was scheduled. During the 20-minute
screening block of time, each participant visited the following four stations that each had trained testers: (a) informed consent, demographics, and home safety; (b) medical history and medications; (c) mobility and balance; and (d) vision.

Following the completion of the four falls risk screening stations, the total falls risk score was calculated using the information collected about falls and medical history, medications, home safety, mobility and balance, and vision. This required about 15 minutes. While the participants waited for their falls risk scores to be calculated, they responded to the physical activity questionnaire in an interview format administered by trained testers. Once the physical activity questionnaire was completed and the screening score results were available, one tester provided the participant with a copy of his or her screening results, reviewed the report with the participant, and explained some brief educational points regarding reduction of his or her identified falls risks.

Within 14 days of the screening, the physical function and HRQL surveys were administered over the telephone. The average time in days these data were collected following the screening was 6.5 days ($SD = 4.0; n = 90$). These data were collected over the telephone because they were too time consuming to collect at the falls risk screening. The phone calls took about 20 minutes to complete.

**Measures**

**Demographic Information**

Information about each participant’s age, gender, race, sex, education level, household income level, and history of diabetes and hypertension was collected using a questionnaire developed for this project.
The Comprehensive Falls Risk Screening Instrument (CFRSI)

The CFRSI identified and scored (weighted using RR and OR) several of the most common falls risks in older adults as reported by the AGS (2001). The falls risk subscales that were examined included history, medication, environment, physical, and vision. The individual subscale scores were averaged to produce a total falls risk score. Individual subscale and total falls risk scores were converted to scales ranging from 0 to 100 with a higher score indicating a higher falls risk.

**History Subscale.** Self-reported age (RR/OR = 1.7), history of falls (RR/OR = 3.0; number of falls within the past 12 months and within the past 3 years), use of an assistive device for mobility (RR/OR = 2.6), and a diagnosis of arthritis (RR/OR = 2.4) made up the history risk score. These risk factors were scored on an ordinal scale with numerical values assigned for a ‘yes’ or ‘no’ response. The history risk score was weighted according to the AGS relative risk or odds ratio of each of these falls risk factors and therefore, falls risk was higher for participants who reported an age over 80 years, a history of falls, use of an assistive device, and/or reported a diagnosis of arthritis.

**Medication Subscale.** Participants were asked to bring to the screening a completed Medication List Form and they were questioned about any side effects they may have experienced while taking the listed medications. The participants were also interviewed about their use of multiple pharmacists and frequency of pharmacy consults. High risk medication use and use of more than four medications were classified and scored according to the following AGS relative risk scores: psychotropics (OR = 1.7), class 1a anti-arrhythmics (OR = 1.6), digoxin (OR = 1.2), and diuretics (OR = 1.1). Side effects and use of multiple pharmacists values were calculated on an ordinal scale with numerical values assigned for a ‘yes’ or ‘no’ response. Falls risk was higher for participants who reported taking any of the defined high risk
medications or more than four prescription medications, experienced side effects relative to their medications, did not fill all prescriptions at the same pharmacy, and/or did not have a pharmacist consult about their current medication usage.

Environment Subscale. Participants were asked to complete a Home Assessment Checklist that included twelve questions about potential falls risks in the home, which was adapted from the National Center for Injury Prevention and Control (NCIPC) and Home Safety Council checklist (Home Safety Council, 2004). Sample questions include “are stairways lit with lights at the top and bottom of the stairs” (yes/no); “are your steps, landings, and floors clear of clutter” (yes/no); and “do you have nightlights to help light your bathrooms, bedrooms, and hallways during evening hours” (yes/no). The environment risk score was based on the number of ‘no’ responses recorded on the Home Assessment Checklist and therefore, more ‘no’ responses indicated a higher falls risk.

Physical Subscale. The physical subscale included scores from a mobility test and a standing balance test. The ETGUG (Botolfsen et al., 2006; Dite & Temple, 2002; Mathias, Nayak, & Isaacs, 1986; Podsiadlo & Richardson, 1991; Trueblood, Hodson-Chennault, McCubbin, & Yougclarke, 2001; Wall, Bell, Campbell, & Davis, 2000) is a measure of functional mobility and is a reliable and valid predictor of falls risk among adults. It required the participant to rise from a seated position in a chair without arms, walk 10 meters, turn around and return to the original seated position in the chair from which they started. The score for the test was calculated as the total time (in seconds) taken to complete the task. A higher falls risk was associated with a longer duration to complete the task.

The FRT (Duncan et al., 1990) was used to measure standing balance and is a valid and reliable predictor of falls risk. This test required the participant to stand with his or her feet together, with the dominant arm flexed at a 90-degree angle to the frontal plane (i.e., reaching
forward), in a position that was horizontal to the floor, and with the palm facing down. From this position, the participant was asked to reach as far forward as possible without stepping forward. The test was performed such that the participant was reaching along a measurement tape that was fixed to a wall. The distance between the starting position and final position of the middle finger tip of the extended arm (in inches) was recorded. A higher falls risk was associated with a shorter distance of reach.

**Vision Subscale.** The vision risk score was calculated from questions about having a prescription for corrective lenses (‘yes’ or ‘no’), if the participant wore lenses as prescribed (as applicable; ‘yes’ or ‘no’), and if the participant had a vision test within 12 months before the screening (‘yes’ or ‘no’). A simple test of visual acuity using a Snellen eye chart read from 20 feet was also used in calculation of the vision risk score. When reading the Snellen eye chart, the participants were asked to read the chart using prescriptive lenses, if appropriate. A higher denominator score on the Snellen eye chart indicated a lower visual acuity (i.e., scores greater than 20/20). Therefore, falls risk was higher for participants who did not wear lenses as prescribed, had not participated in a vision test within the previous 12 months, and demonstrated a lower visual acuity.

**Physical Activity**

The PASE was used to provide information about the participant’s self-reported physical activity within the past seven days as related to the frequency (days x week) and duration (hours) of strength and endurance activities, sport activities ranging from light to vigorous, occupational activity, and family care, household, yardwork, and gardening activities (Washburn et al., 1993). The PASE is a reliable (Hagiwara, Ito, Sawai, & Kazuma, 2008) and valid measure of physical activity for use in the older adult population against strength (hand grip; \( r = .37 \)), static balance (\( r = .33 \)), leg strength (\( r = .25 \)), resting heart rate (\( r = -.13 \)), age (\( r = -.034 \)), and perceived health
status \( r = -.34 \); Washburn et al., 1993), and it is a validated measure of physical activity for independent-living, diverse older adults (Moore et al., 2008). The PASE produced a unitless total physical activity score ranging from 0 to 400 or more (Washburn et al., 1993; Washburn et al., 1999) with higher scores indicating higher physical activity levels.

**Physical Function**

The Functional Status Index (FSI) short form was used to assess three aspects of self-reported physical function including the need for assistance, the amount of pain, and the degree of difficulty experienced when completing specific basic or instrumental activities of daily living (ADL). The FSI is a valid and reliable measure of self-reported physical function in older adults (Jette, 1980, 1987). ADL were scored in the areas of gross mobility, hand activities, personal care, home chores, and interpersonal activities. This questionnaire has 18 items for each function domain (i.e., assistance, pain, difficulty) and scores were summed for a total domain score. Need for assistance was rated on a 5-point Likert scale \( 1 = \text{independent}, 5 = \text{unable or unsafe to do the activity} \) and amount of pain and degree of difficulty are rated on a 4-point Likert scale \( 1 = \text{no pain/no difficulty}, 4 = \text{severe pain/severe difficulty} \). The domain scores were then summed for a total physical function score that can range from 54 (complete independence, no pain, and no difficulty with any ADL) to 234 (unable or unsafe, severe pain, or severe difficulty restrictions with performing all ADL). Individuals with a higher score had a lower self-reported functional status.

**Health-related Quality of Life**

The MOS 36-Item Short Form Health Survey (SF-36 v2) is a reliable and validated measure of HRQL in adults (Ware, 2000). The SF-36 contains eight subscales including physical function (PF), role physical (RP), bodily pain (BP), general health (GH), vitality (VT), social function (SF), mental health (MH), and role emotional (RE), as well as physical (PCS) and
mental (MCS) health summary scores. The test provides scores for each domain from 0 to 100, with the highest score indicating better HRQL. The SF-36 v2 is a copyrighted instrument. To obtain a copy or more information about the scale, please visit www.qualitymetric.com.

**Statistical Analyses**

Based on an alpha level of $\leq 0.05$ and a medium power (80%), the target $N$ for the multivariate analysis (direct discriminant function analysis) was 134 (Cohen, 1992). Considering a 50% attrition rate (Marcus & Telesky, 1983) to account for participant non-responses to data collection by phone and unusable data (such as a participant having a fall or other event that could potentially affect HRQL between time of screening and phone interview), the target sample size for study recruitment was $N = 134/0.5 = 268$. Before conducting the analyses to test the hypotheses of the study, tests for normality and univariate and multivariate outliers were conducted. Descriptive statistics (frequencies) were conducted to determine sample characteristics such as gender, race, income, education, falls history within the past 12 months, history of diabetes, hypertension, osteoarthritis, and usage of an assistive device. Ranges, means, and standard deviations were also calculated to describe age, scores on the falls risk subscales, the total falls risk score, total FSI score, SF-36 scores, and total PASE score. Five MANOVAs were performed to identify differences in the total falls risk scores, FSI scores, SF-36 component summary scores, and total PASE scores based on the demographic dichotomous variables of age (50-69 and 70 and over), gender (male and female), race/ethnicity (White/Caucasian and Black/African American/Other), education level (low = less than or equal to 9th grade/high school graduate or equivalent; high = some college or above), and income status (low = less than $1572/month; high = greater than $1571/month).

Pearson product moment correlations were used to detect relationships between the total falls risk score and the falls risk subscale scores (hypothesis a), the total PASE score (hypothesis...
b), total FSI score (hypothesis c), and the SF-36 PCS and MCS scores (hypothesis d). The quantitative thresholds for the Pearson correlation were > .5 = large, .5-.3 = moderate, .3-.1 = small, and < .1 = insubstantial (Cohen, 1988). An independent-sample t-test was performed to identify group differences in total falls risk scores between fallers and non-fallers (hypothesis e). Finally, to test the research question, a direct discriminant function analysis was performed to identify the most important falls risk subscale predictors of falling status (fallers vs. non-fallers). SPSS 16.0 was used to analyze all data.

**Results**

Participants were 303 older adults from ten community organizations who volunteered to participate in a falls risk screening over a 2 year period. Four of these participants were excluded because they did not meet the eligibility requirements of the study (n = 2 were non-ambulatory wheelchair users, n = 1 was deaf and was not able to complete the screening as per protocol, and n = 1 had a cognitive impairment). Therefore, 299 participants met all inclusion criteria. In addition, 13 participants were excluded from the analyses because they were identified as univariate or multivariate outliers. Thus, the final sample included 286 independent-living older adults, providing sufficient power for the data analyses. The participants had a mean age of 74.2 years (SD = 10.0), 75.9% were female, and 52.9% were White/Caucasian (n = 14 did not report race; see tables 9 and 10).

Of the 286 participants in the final sample, only 90 participants completed the FSI and SF-36 because these data were not collected during the first year of data collection (n = 121). Other reasons for missing FSI and SF-36 data (n = 75) are identified in Table 11. Falls risk subscale scores ranged from 0 to 98.9 (out of a possible range of 0 to 100). The participant mean subscale scores ranged from 27.3 (environment subscale) to 45.6 (medication subscale), and the average total falls risk score was 36.3 (SD = 10.4). Means and standard deviations of all falls risk
subscale scores are provided in Table 12; and the ranges, means, and standard deviations of the FSI score, SF-36 scores, and total PASE score are provided in Table 13.

Table 9. CFRSI Validation Study: Participant Profile

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
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<tbody>
<tr>
<td>Gender n = 286</td>
<td></td>
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</tr>
<tr>
<td>Female</td>
<td>217</td>
<td>75.9</td>
</tr>
<tr>
<td>Male</td>
<td>69</td>
<td>24.1</td>
</tr>
<tr>
<td>Race/Ethnicity n = 272</td>
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<tr>
<td>White/Caucasian</td>
<td>144</td>
<td>52.9</td>
</tr>
<tr>
<td>Black/African American/*Other</td>
<td>128</td>
<td>47.1</td>
</tr>
<tr>
<td>Income n = 212</td>
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<td></td>
</tr>
<tr>
<td>Low ($1571 or less monthly)</td>
<td>111</td>
<td>52.4</td>
</tr>
<tr>
<td>High (Greater than $1571 monthly)</td>
<td>101</td>
<td>47.6</td>
</tr>
<tr>
<td>Highest Educational Level n = 262</td>
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<td></td>
</tr>
<tr>
<td>Low (High School Graduate/GED or less)</td>
<td>113</td>
<td>43.1</td>
</tr>
<tr>
<td>High (Some College or above)</td>
<td>149</td>
<td>56.9</td>
</tr>
</tbody>
</table>

*Other descents include those of American Indian/Alaskan Native (n=2), Hispanic or Latino (Mexican, Puerto Rican, Cuban, Other; n=1), Asian (Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese; n=2), Other than defined (n=2)

Table 10. CFRSI Validation Study: Descriptive Statistics for Participants

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall in the past 12 months</td>
<td>94</td>
<td>32.9</td>
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<tr>
<td>Diabetes</td>
<td>48</td>
<td>17.3</td>
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<tr>
<td>Hypertension</td>
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<td>40.4</td>
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<td>Osteoarthritis</td>
<td>175</td>
<td>63.2</td>
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<tr>
<td>Use of Assistive Device</td>
<td>59</td>
<td>21.3</td>
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Table 11. Reasons for Missing Phone Interview Data

<table>
<thead>
<tr>
<th>Reason</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Could not be reached by phone/unavailable</td>
<td>54</td>
<td>72.0</td>
</tr>
<tr>
<td>No phone number given for contact</td>
<td>4</td>
<td>5.3</td>
</tr>
<tr>
<td>Refused to participate in phone interview</td>
<td>6</td>
<td>8.0</td>
</tr>
<tr>
<td>Too busy to participate in phone interview</td>
<td>2</td>
<td>2.7</td>
</tr>
<tr>
<td>Deaf or hearing problems</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td>Did not consent to phone interview</td>
<td>4</td>
<td>5.3</td>
</tr>
<tr>
<td>Hung up on interviewer more than one time</td>
<td>3</td>
<td>4.0</td>
</tr>
<tr>
<td>Fell after the screening, before phone interview</td>
<td>1</td>
<td>1.3</td>
</tr>
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</table>

Table 12. Means and SD of Falls Risk Subscales and Total Falls Risk Scores

<table>
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<th>Risk Scores</th>
<th>Range</th>
<th>M</th>
<th>SD</th>
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<tbody>
<tr>
<td>History</td>
<td>0-92.5</td>
<td>41.4</td>
<td>23.8</td>
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<tr>
<td>Physical</td>
<td>0-97.4</td>
<td>40.4</td>
<td>17.4</td>
</tr>
<tr>
<td>Medication</td>
<td>11.6-98.9</td>
<td>45.6</td>
<td>26.3</td>
</tr>
<tr>
<td>Vision</td>
<td>7.9-86.4</td>
<td>28.3</td>
<td>17.0</td>
</tr>
<tr>
<td>Environment</td>
<td>1.5-82.0</td>
<td>27.3</td>
<td>19.0</td>
</tr>
<tr>
<td><strong>Total Falls Risk</strong></td>
<td>10.5-69.0</td>
<td>36.3</td>
<td>10.4</td>
</tr>
</tbody>
</table>

Table 13. Means and SD of FSI, SF-36 (PCS and MCS), and PASE Total Scores

<table>
<thead>
<tr>
<th>Total Scores</th>
<th>Range</th>
<th>M</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>FSI</td>
<td>54-115</td>
<td>62.4</td>
<td>11.3</td>
</tr>
<tr>
<td>SF-36 PCS</td>
<td>22.9-58.9</td>
<td>46.7</td>
<td>8.6</td>
</tr>
<tr>
<td>SF-36 MCS</td>
<td>36.1-68.9</td>
<td>56.8</td>
<td>6.4</td>
</tr>
<tr>
<td>PASE</td>
<td>0-340.8</td>
<td>109.3</td>
<td>64.4</td>
</tr>
</tbody>
</table>
The five MANOVAs with the Bonferroni correction (α = .05/5 = .01) did not reveal significant group differences for the total falls risk scores, FSI scores, SF-36 component summary scores, and total PASE scores based on age ($F[5, 83] = 1.47, p = .21$), gender ($F[5, 79] = 2.12, p = .07$), race/ethnicity ($F[5, 79] = .39, p = .86$), education level ($F[5, 79] = .69, p = .64$), and income status ($F[5, 63] = 1.21, p = .32$). Analyses also revealed that the total falls risk score was significantly associated with all falls risk subscale scores ($r = .25, p < .01$ to $r = .69, p < .01$; hypothesis a; see Table 14). The total falls risk score was also significantly associated with the total PASE score ($r = -.30, p < .01$; hypothesis b; see Table 15), the total FSI score ($r = .30, p < .01$; hypothesis c; see Table 15), the total SF-36 PCS score ($r = -.44, p < .01$; hypothesis d; see Table 16), and the SF-36 MCS score ($r = -.24, p = .03$; hypothesis d; see Table 16).

Table 14. Correlational Matrix for the Subscale and Total Falls Risk Scores

<table>
<thead>
<tr>
<th></th>
<th>History</th>
<th>Physical</th>
<th>Medicine</th>
<th>Vision</th>
<th>Environment</th>
<th>Total Falls Risk Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>.39**</td>
<td>.27**</td>
<td>.06</td>
<td>-.12</td>
<td>.69**</td>
<td></td>
</tr>
<tr>
<td>Physical</td>
<td></td>
<td>.12*</td>
<td>.10</td>
<td>-.21**</td>
<td>.51**</td>
<td></td>
</tr>
<tr>
<td>Medication</td>
<td></td>
<td></td>
<td>-.12</td>
<td>.001</td>
<td>.63**</td>
<td></td>
</tr>
<tr>
<td>Vision</td>
<td></td>
<td></td>
<td></td>
<td>-.01</td>
<td>.31**</td>
<td></td>
</tr>
<tr>
<td>Environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.25**</td>
<td></td>
</tr>
</tbody>
</table>

**Correlation significant at the .01 level  *Correlation significant at the .05 level

Table 15. Correlational Matrix for FSI Subscale Scores (FSI-A, FSI-P, FSI-D), FSI Total Score, Total PASE Score, and Total Falls Risk Score

<table>
<thead>
<tr>
<th></th>
<th>FSI – A</th>
<th>FSI - P</th>
<th>FSI - D</th>
<th>FSI - Total</th>
<th>Total PASE</th>
<th>Total Falls Risk Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSI – A</td>
<td>.53**</td>
<td>.76*</td>
<td>.91**</td>
<td>-.17</td>
<td>.30**</td>
<td></td>
</tr>
<tr>
<td>FSI – P</td>
<td></td>
<td>.69**</td>
<td>.76**</td>
<td>-.08</td>
<td>.21</td>
<td></td>
</tr>
<tr>
<td>FSI – D</td>
<td></td>
<td></td>
<td>.94**</td>
<td>-.13</td>
<td>.28**</td>
<td></td>
</tr>
<tr>
<td>FSI – Total</td>
<td></td>
<td></td>
<td></td>
<td>-.15</td>
<td>.30**</td>
<td></td>
</tr>
<tr>
<td>Total PASE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.30**</td>
<td></td>
</tr>
</tbody>
</table>

**Correlation significant at the .01 level  *Correlation significant at the .05 level
Table 16. Correlational Matrix for SF-36 Subscale Scores (PF, RP, BP, GH, VH, SF, RE, MH), Total SF-36 Scores (PCS, MCS), and Total Falls Risk Score

<table>
<thead>
<tr>
<th></th>
<th>PF</th>
<th>RP</th>
<th>BP</th>
<th>GH</th>
<th>VH</th>
<th>SF</th>
<th>RE</th>
<th>MH</th>
<th>PCS</th>
<th>MCS</th>
<th>Total Falls Risk Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF</td>
<td>.42**</td>
<td>.37**</td>
<td>.57**</td>
<td>.41**</td>
<td>.37**</td>
<td>.38**</td>
<td>.21*</td>
<td>.83**</td>
<td>.03</td>
<td>-.37**</td>
<td></td>
</tr>
<tr>
<td>RP</td>
<td>.47**</td>
<td>.44**</td>
<td>.46**</td>
<td>.53**</td>
<td>.51**</td>
<td>.36**</td>
<td>.66**</td>
<td>.35**</td>
<td>-.41**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP</td>
<td>.37**</td>
<td>.42**</td>
<td>.14</td>
<td>.24*</td>
<td>.13</td>
<td>.69**</td>
<td>.01</td>
<td>-.34**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GH</td>
<td></td>
<td>.44**</td>
<td>.28**</td>
<td>.33**</td>
<td>.26*</td>
<td>.75**</td>
<td>.16</td>
<td>-.39**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VH</td>
<td></td>
<td></td>
<td>.41**</td>
<td>.27*</td>
<td>.36**</td>
<td>.53**</td>
<td>.44**</td>
<td>-.43**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF</td>
<td></td>
<td></td>
<td></td>
<td>.55**</td>
<td>.50**</td>
<td>.31**</td>
<td>.69**</td>
<td>-.17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.41**</td>
<td>.29**</td>
<td>.68**</td>
<td>-.29**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.11</td>
<td>.81**</td>
<td>-.32**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.06</td>
<td>-.44**</td>
<td></td>
</tr>
<tr>
<td>MCS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.24*</td>
<td></td>
</tr>
</tbody>
</table>

**Correlation significant at the .01 level  *Correlation significant at the .05 level

According to the $t$-test, those who reported a fall (fallers; $n = 90$) exhibited significantly higher total falls risk scores ($M = 41.03; SD = 9.38$) than those who did not report a fall (non-fallers; $n = 188; M = 34.06; SD = 10.05$), $t\ (276) = 5.53, \ p < .001$; hypothesis e). Finally, for the research question, the direct discriminant function analysis revealed one significant discriminant function (composite score of the predictors; Wilks $\Lambda = 0.78, X^2\ (5, N = 277) = 69.22, \ p < .001$). A canonical correlation of $R = .47$ showed a moderate association between the groups (fallers vs. non-fallers) and the discriminant function, and the most important predictor of falling status was only the history risk score ($r = .96$). The predictors accurately classified 72.6% of the fallers and non-fallers.

**Discussion**

The overall purpose of the study was to validate the total falls risk score of the CFRSI against the falls risk subscale scores (hypothesis a), physical activity (hypothesis b), physical function (hypothesis c), HRQL (hypothesis d), and 1-year falls history (hypothesis e). Another objective of the study was to determine risk factor predictors of falls in older adults. Using the
CFRSI, five falls risk subscales were addressed (i.e., history, physical, medication, vision, and environment) and were weighted according to the RR and ORs as determined by the AGS (2001) to obtain a total falls risk score. In general, construct validation of the CFRSI was provided by the significant associations between the total falls risk score of the CFRSI and the falls risk subscale scores, as well as the selected constructs of physical activity, physical function, HRQL, and falls history; and because fallers exhibited higher baseline total falls risk scores compared to non-fallers.

The study sample included 286 independent-living older adults residing within a 100-mile radius of Baton Rouge, LA. The sociodemographics of the study sample did not identically correspond to the Census 2000 target demographic profile information taken from the surrounding parishes outside of East Baton Rouge parish, the state of Louisiana, and the United States in terms of race, education, and income. Within this study, there were fewer White/Caucasian older adults than expected as compared to the target profile such that national, state, and surrounding parish data revealed a distribution range of 71% to 82% of White/Caucasian instead of the 52% distribution of White/Caucasian in this sample. This finding suggests a more racially diverse group of older adults as compared to the target profile.

Also, older adults in the present study indicated a higher educational level (57%; some college or above) as compared to state (13%) and national data (17%) suggesting a higher educated study sample; and the median household income for the current sample was below that found within Louisiana and the United States as a whole. For example, low-income status was reported by 52% of this study sample, and in comparison, the median household income in 1999 for the United States and Louisiana (ages 55 to 74 years) and for United States (ages 75+ years) on average was in the high-income category. This suggests that older adults within the study sample are in the lower income category in relation to other older adults. It is difficult to report
sample comparison to other falls risk and prevention studies due to lack of reported information in the literature. For those studies that performed falls risk screenings for community-dwelling older adults and also report sociodemographic information, this study is the only identified falls risk screening study that reports sociodemographic variable comparisons other than age and gender.

To summarize the sample profile characteristics, this study sample as compared to local, state, and national sociodemographic data, was slightly more racially diverse, achieved a higher educational status, and grossed a lower income. Thus, the diversity achieved in the study sample according to race, education, and income may be considered a unique aspect of this research. However, the current findings did suggest a comparable rate of falls to that reported in previous research (1 out of 3 older adults fall each year; Hausdorff et al., 2001; Hornbrook et al., 1994). In this sample 32.9% of the older adult participants reported a fall within 12 months of the initial screening, and the current study sample closely resembles other sample groups with regards to sample characteristics such as community-dwelling status and average age and age range (Boulgarides, McGinty, Willett, & Barnes, 2003; Muir, Berg, Chesworth, & Speechley, 2008; Raiche, Hebert, Prince, & Corriveau, 2000).

The falls risk subscale and total falls risk scores were all based on a 0 to 100 scale. Higher scores indicate a higher falls risk within each of the subscales and overall (average of the five subscales). The mean subscale scores ranged from 27.3 to 45.6, and the average CFRSI total falls risk score was 36.3. As expected, the CFRSI total falls risk score was significantly associated with all CFRSI falls risk subscale scores (history, physical, medication, vision, and environment), helping to establish the construct validity of the CFRSI ($p < .01$; hypothesis a). The relationships among the falls risk subscales were, for the most part, also in the expected direction. However, an unexpected finding emerged that revealed that those with a higher
environmental risk (more home hazards) had a significantly lower physical falls risk score indicating that those who have better balance and mobility scores appear to have greater influential falls risk hazards in their home as opposed to those who have poorer balance and mobility scores. The Home Assessment Checklist Form asks questions as related to stairways, shower grab bars and safety decals, and ADL/storage specifics. Thus, those who are more mobile and have greater balance may traverse stairways more often, possibly shower as opposed to tub-bench bathe, and may be more prone to and active in performing ADL. Furthermore, older adults who have better balance and mobility may not be inclined to adapt their home in such a way to prevent falls because they have yet to experience any signs of danger or risk of falling in their home. It is also possible that the home safety checklist is not sensitive enough to capture environmental risks for falls among individuals with less balance and mobility. Therefore, additional research is needed by using different home safety instruments to determine if the relation between the environment falls risk subscale score and the physical falls risk subscale score is negative. Regardless, older adults can benefit from home assessments, home safety or hazardous behavior education, or modifications to remove environmental hazards or obstacles that can be associated with a fall in the home. They can also benefit from assessment for appropriateness (need and safety) of assistive or equipment device usage in their homes.

The study sample reported total PASE scores comparable to the findings of other studies. Similar PASE scores have been found in validation studies using rural, community-dwelling older adults (Dinger, Oman, Taylor, Vesely, & Able, 2004; Washburn et al., 1993), healthy, well-educated, Caucasian older adults (Washburn, 2000), a convenience sample of older adult participants of community centers (Harada, Chiu, King, & Stewart, 2001), and community-dwelling older adults (Chad et al., 2005; Hagiwara et al., 2008; Moore et al., 2008). Other validation studies also report comparable PASE scores in similar cohorts while determining
associations between physical activity and criterion measures such as the SF-36, body mass index, the Mini-Logger activity monitor (Harada et al., 2001), Actigraph Monitor data (Dinger et al., 2004), and doubly labeled water (Schuit, Schouten, Westerterp, Saris, 1997). Thus, in support of hypothesis b, the results indicate that the total falls risk score was moderately associated with the total PASE score such that less active older adults had a higher overall falls risk, which provides further evidence of the construct validity of the CFRSI. Longitudinal studies using retrospective (Shephard & Montelpare, 1988) and prospective data (Morey et al., 1991a, 1991b) support the notion that adults who are less physically active in later middle age have a greater chance of developing physical disabilities in later life because of muscular weakness, balance impairments, and decline in functional mobility and independence with daily activities (Shephard, 1997), which increases falls risk (Heesch et al., 2008). Thus, regular physical activity can combat the loss of function in older adults and help decrease falls risk.

Similar to physical activity, physical function is predictive of falls among older adults (Dite & Temple, 2002; Mathias et al., 1986; Podsiadlo & Richardson, 1991; Trueblood et al., 2001; Wall et al., 2000). The current study FSI values are within range of values found in the instrument’s validation study (Jette, 1987) and in a study using a convenience sample of community-dwelling older adults to determine sex differences in physical function and HRQL (Wood et al., 2005). Thus, as hypothesized (hypothesis c), the total falls risk score of the CFRSI was significantly associated with physical function as measured by the total FSI score such that a lower physical function level was associated with a higher falls risk in older adults. This association also provides evidence of the construct validity of the screening instrument. Taking the results of hypothesis b and c together, health promoters are encouraged to implement physical activity programs such as group or individualized exercise, therapy, or multi-factorial interventions (Cryer & Patel, 2001; Feder, Cryer, Donovan, & Carter, 2000) directed towards
improving muscular strength, functional independence, balance, and overall physical function and mobility for older adults in efforts to reduce falls risk and prevent falls.

A fall is a major event that can also significantly reduce the quality of life of older adults (Engin, Ozturk, Engin, & Kulaksizoglu, 2007; Parry, 2001). The HRQL outcome scores of the current study sample are within the expected normative range (Hopman et al., 2004; Hopman et al., 2000; McHorney, Kosinski, & Ware, 1994; Ware & Kosinski, 1996). As predicted (hypothesis d), the total falls risk score from the CFRSI was significantly correlated with HRQL (PCS and MCS) such that a higher total falls risk was associated with lower physical and mental HRQL. In fact, all of the subscales of the SF-36 except for social functioning were significantly correlated with the total falls risk score, providing further evidence of the construct validity of the CFRSI.

The negative impact on HRQL brought on by falls can hinder functional activities and social networking, and may lead to self-imposed activity restriction, loss of independence, and may increase the risk of future falls (Fletcher & Hirdes, 2004; Kosorok, Omenn, Diehr, Koepsell, & Patrick, 1992; Wilson et al., 2005; Zijlstra, van Haastregt, van Eijk, & Kempen, 2005). However, the benefits of physical activity that include maintaining muscular strength, balance, functional mobility, and functional independence that can aid in the prevention of falls can also counter depression and anxiety, improve mental and overall physical health, and improve HRQL (Hawkins & Duncan, 1991). Therefore, the assessment of barriers to physical activity and screenings to determine readiness to participate in activities may be helpful for improving HRQL (Seefeldt, Malina, & Clark, 2002; Stutts, 2002) and also decreasing falls risk. In addition, physical activity and other falls prevention programs that target older adults at elevated risk for falls can also promote mental health and social involvement to aid in countering depression and alleviation of fall-related anxiety (Stewart et al., 2001). Not only can these programs be
beneficial in falls reduction, but they can also assist in battling the associated decline in well-being.

Non-fallers had, on average, a total falls risk score of 34.1 and fallers had a score of 41.0. Although a threshold of falls risk has not yet been defined for the CFRSI, findings suggest that on average, those older adults who have a total falls risk score near the mean average of 41 ($SD = 9.4$) or greater are likely to experience a fall within the year. Further, the percentage of the sample who reported a fall in the 12-months before the initial screening (32.9%) is comparable to that reported in previous research (Hausdorff et al., 2001; Hornbrook et al., 1994). Thus, as hypothesized (hypothesis e), the participants in the current study who reported a fall within 12-months prior to the screening had a significantly higher CFRSI total falls risk score than those who did not report a fall during the same time period. The CFRSI’s ability to distinguish between fallers and non-fallers is additional evidence of the construct validity of the screening instrument. Due to the likelihood of an older adult experiencing a fall, it is imperative to identify those older adults who score at or around a total falls risk score of 41 on the CFRSI and implement a targeted falls risk reduction intervention based on the identified falls risks of the screening instrument. Determination of threshold scores for low, medium, and high total falls risk to identify fallers and those at elevated risk for falls is also worthy of further investigation. These threshold scores would assist health-care professionals in identifying those older adults who are in most need of further assessment and intervention to reduce falls risk and prevent falls.

The CFRSI generates a total falls risk score and allows identification of specific risk factors to possibly aid in future targeted intervention. However, it was necessary to determine the best falls risk factor predictor of falling status (fallers vs. non-fallers). In doing so, the discriminant function analysis only revealed one main predictor of falling status in older adults; the history risk score. The history risk score (comprised of identified AGS falls risk factors of
age, history of falls, assistive device usage, and diagnosis of osteoarthritis) emerged as an important component of the instrument for the prediction of older adult fallers within the study sample. Although separated and identified according to each specific OR/RR in the AGS list of examined risk factors, these risk factor components, which were combined using the RR/ORs to calculate the history risk score as measured by the CFRSI, exhibited strong influence on total falls risk. Therefore, it is critical to identify those older adults who have elevated score components of the history risk subscale (such as advanced age, 1-year or 3-year history of falls, assistive device usage, and presence of osteoarthritis) because these components in themselves are strong influential factors of falls risk and are predictors of falls within 1-year of the screening. These risk factors are primarily non-modifiable through medical treatment, but efforts can be made by healthcare providers and community liaisons to improve access to medical screenings for those of advanced age. Organizations can also allow more frequent screenings and assessments for those of advanced age or those with a falls history, perform assessments on assistive device usage (safety and appropriateness), and promote programs to alleviate consequential joint pain, decreased mobility, stiffness and range of motion associated with osteoarthritis. Further investigation of the subscales of the CFRSI is necessary to determine if all of the items and/or subscales are necessary to predict total falls risk and falling status. Through factor analysis, the instrument may be reduced to fewer items to allow quicker and easier administration while maintaining the comprehensive nature of the falls risk information.

There were not any significant differences between genders on the outcome variables and there were comparable cohort outcome findings to other studies. However, the oversampling of females could possibly limit generalization of the findings to older adult males. Identification of barriers to participation in screening and/or intervention programs among males and older adults not participating in community programs is warranted for additional studies. In addition,
identification of possible barriers such as functional limitations, lack of access to programs, decreased confidence in performance, or lack of knowledge about benefits can be beneficial for continuation of care of identified older adult fallers and those at risk for falling.

There were limitations in the current research study. First, self-report bias and recall limitations cannot be ruled out because of the reliance on self-report instrumentation used throughout the study and particularly with older adults who were not screened for cognitive impairments. Future researchers using the CFRSI are encouraged to include verification procedures for documenting age and medical history, as well as a quick screening of cognitive functioning.

Second, there was possible selection bias due to the voluntary nature of recruitment and the availability of the participants in question who were already members and/or participants of the community centers where the screenings were performed. This may suggest that the older adults who participated in the screenings may be more involved in community activity programs, and therefore, may be more physically active as opposed to older adults who do not participate in the community center programs. This selection bias may have possibly limited the number of older adults who are at a higher risk of falling and consequently reduced the range of CFRSI total falls risk scores. Future researchers should determine whether there is a significant difference in total falls risk between the cohort sampled as compared to community-dwelling older adults who are not members or participants of community centers.

However, despite these limitations, the research does have some unique characteristics. First, the findings do support the construct validity of the CFRSI, a comprehensive screening instrument that uses weighted falls risk factors to provide risk factor subscale scores and a total falls risk score. Many other validated falls risk screening instruments and falls prevention programs have been developed in efforts to help older adults in combating falls, but much of the
published research does not factor in all underlying variables, weighted components, and effects associated with falls and falls risk in older adults.

Second, the validation of the instrument occurred in a diverse population of older adults that included racial minorities and people of low-income levels. To date, few falls risk screening and falls prevention studies have included underserved populations or have failed to report sociodemographic information such as race and income status. The diversity of the validation study sample does increase the generalization of the CFRSI results and helps translate the usage of the CFRSI into community settings.

In summary, the CFRSI adds to the current falls risk screening tools in that it provides a valid measure of falls risk and generates a composite falls risk score based on multiple weighted falls risk factors as identified by the AGS, unlike any other screening tool. Specifically, the construct validation of the CFRSI included significant associations between the total falls risk score and the falls risk subscale scores, self-reported physical activity, self-reported physical function, and HRQL (physical and mental). In addition, identified fallers exhibited higher baseline total falls risk scores as compared to non-fallers, and the history score (1-year falls history, advanced age, assistive device usage, and presence of osteoarthritis combined) was a significant predictor of falling status. The newly developed CFRSI is not only able to capture overall falls risk, it is cost-effective, easy to administer, and time-efficient. This will assist clinicians, healthcare providers, and community liaisons in weighting multiple falls risk factors and identifying older adults at risk for falls to implement more appropriate and targeted interventions according to those risks in hopes of reducing falls risk and preventing future falls in the older adult population. In lieu of the AGS call to action (2001), the development and validation of the CFRSI was necessary to quickly and effectively identify falls risks in
community-dwelling older adults, those at risk for falling, and to rank identified falls risk factors most influential or predictive of causing a fall.
CHAPTER 4
RELATIONSHIPS BETWEEN SOCIODEMOGRAPHIC FACTORS AND FALLS IN OLDER ADULTS

The epidemic of falls in older adults is becoming an emergent problem for the healthcare industry, community organizations, and older adults and their families with one out of every three older adults experiencing a fall each year (Hausdorff, Rios, & Edelberg, 2001; Hornbrook et al., 1994), and of those who experience a fall, two-thirds will fall again within six months. Falls are the leading cause of fractures, loss of independence, and injurious death in older adults (Center for Disease Control [CDC], 2008b). Close to 16,000 older adults in the United States died from falls-related injuries in 2005 (CDC, 2008b) and in 2004, 85% of those were by adults over the age of 75.

Not only can falls have severe physical consequences, but falls can also impact older adults and their families financially (Vellas, Wayne, Romero, Baumgartner, & Garry, 1997). Falls can cause non-fatal injuries, which may increase the need for dependent care (Alexander, Rivara, & Wolf, 1992; Sterling, O'Connor, & Bonadies, 2001). Non-fatal fall injuries cost healthcare systems about $19 billion in the year 2000 (Stevens, Corso, Finkelstein, & Miller, 2006) and the cost is expected to increase upwards to $44 billion by the year 2020.

In addition to financial burdens, falls challenge the physical and psychological well-being of older adults through a voluntary decrease in functional activity secondary to a fear of falling that promotes a decreased health-related quality of life (HRQL; Ozcan, Donat, Gelecek, Ozdirenc, & Karadibak, 2005). The activity restriction as a result of fear of falling will ultimately impair functional strength, which can further increase the risk for falling. Due to the consequences of falls from injury, economic burden, or reduction in quality of life and physical
function, the identification of falls risk factors to assist in the implementation of falls reduction and prevention programs is an important objective of many public and private organizations.

To assist with falls risk factor identification in older adults, a review published by the American Geriatrics Society (American Geriatrics Society [AGS]; 2001) identified and ranked falls risk factors and their associated relative risk or odds ratios ranging from 1.7 to 4.4. These falls risk factors included muscle weakness, history of falls, gait and balance deficits, assistive device usage, visual deficits, history of arthritis, impaired activities of daily living, depression, cognitive impairment, and age over 80 years. Although falls are common in older adults and the risk of a fall increases with age, falls can be prevented. Some examples of preventable underlying risk factors for falls include gait instability or frequent loss of balance, muscular weakness, visual problems and other sensory deficits, high risk medication usage or medication side effects, environmental hazards, chronic or debilitating medical conditions, or hazardous behaviors.

There is also evidence that suggests that certain sociodemographic variables may be risk factors for falls. For example, the AGS (2001) identified that females have a higher risk of falling compared to males. Muscle weakness and lower levels of physical activity observed in older women (Davis et al., 1994) may contribute to the tendency of women to be 67% more likely to experience a fall-related injury (CDC, 2008b). As compared to men, women also have twice the chance of having a fracture secondary to a fall as opposed to men (Stevens, 2005). However, men are more likely to die from a fall while performing hazardous behaviors with the fatality rate 49% higher than for women in 2004 (CDC, 2008b).

Racial or ethnic differences also appear to contribute to falls risk, but the relationship is not entirely understood. According to the CDC, there is a relationship between race and falls using retrospective data such that White older adults fall more often than older adults of other
races, but there is little difference in fatal fall rates between races aged 65 to 74 years (CDC, 2008b). Only a few published studies have reported a relationship of falls to race and other sociodemographic factors within older adults (Gill, Taylor, & Pengelly, 2005; Hanlon, Landerman, Fillenbaum, & Studenski, 2002; Nevitt, Cummings, Kidd, & Black, 1989; Tinetti, Speechley & Ginter, 1988) and the results are contradictory. Hanlon and colleagues (2002) provide further support of the CDC findings suggesting that African Americans were 23% less likely than Whites to have any fall within a 1-year period. They did not find race to be a significant predictor of multiple falls, nor did they find race to have any significant interactions with other sociodemographic factors (Hanlon et al., 2002). In contrast, a prospective population-based study suggested that there were higher age-adjusted fall rates in Caucasians as opposed to African Americans, but the findings were not significant (Faulkner et al., 2005). Means, O’Sullivan, and Rodell (2000) also performed a study using 298 female older adults (60% White and 40% African American) and found that the number of self-reported 1-year history of falls was similar between the two groups, and Studenski et al. (1994) indicated that Blacks and Whites had a similar reporting of self-reported falls (Studenski, et al., 1994).

Although the relationship between falls and race is unclear, significant relationships appear to be more evident for other sociodemographic characteristics such as education and income (Gill et al., 2005; Hanlon et al., 2002). For example, Hanlon and colleagues found that education level was an independent risk factor for any and multiple falls, and Gill et al. (2005) found that greater education and greater income were associated with a decreased risk for falls. Hence, similar sociodemographic characteristics and health problems may be important risk factors for any and multiple falls in community-dwelling African American and White older adults.
To implement an intervention program to prevent falls, it is essential to understand the relationship between total falls risk and falling status according to the sociodemographic factors of race, education, and income to better determine falls risk factor influences on community-dwelling older adult subgroups. Therefore, the overall purpose of the study was to determine associations between the sociodemographic characteristics of race, education, and income and a total falls risk score calculated by the Comprehensive Falls Risk Screening Instrument (CFRSI; development and validation of the instrument is described in chapter 3), as determined by weighted AGS falls risk factors, in community-dwelling older adults. It was hypothesized that (a) educational level would be negatively associated with the total falls risk score (Gill et al., 2005; Hanlon et al., 2002), (b) income level would be negatively associated with the total falls risk scores (Gill et al., 2005; Hanlon et al., 2002), and (c) participants having reported a fall (fallers) within the year prior to the screening will have lower average education and income levels than those who reported no falls (non-fallers; Gill et al., 2005; Hanlon et al., 2002). Two research questions were proposed to determine (a) if there is a pattern of relation between race and total falls risk score, and (b) if there is a pattern of relation between race and falling status (fallers vs. non-fallers). These research questions were exploratory because of the contradictory evidence that exists regarding the relationship between falls and race (Faulkner et al., 2005; Hanlon et al., 2002; Means et al., 2000; Studenski et al., 1994), and therefore, no hypotheses were developed.

Methods

Participants

Participants were 303 older adults who were recruited through local community organizations such as Councils on Aging, YMCAs, retirement communities, and local community centers in four surrounding Louisiana parishes by way of advertisements such as
flyers, posters, newsletters, and the newspaper (see Table 17). Attempts were made to obtain a representative sample of participants that were reflective of the demographic composition of the area and included those who were 50 years of age or older, who were ambulatory, those living within a 100-mile radius of Baton Rouge, LA, and those who did not demonstrate severe dementia (through an inability to comprehend instructions and the informed consent). The participants ultimately excluded were those community members that did not meet the eligibility requirements of the study ($n = 4$), and informed consent was received from the recruited participants. Of the remaining, 299 older adults participated in the screenings. Univariate and multivariate outliers were also excluded ($n = 13$) leaving 286 participants for data analysis.

Table 17. Sociodemographic Factors and Falls: Target Demographic Profile (Census 2000)

<table>
<thead>
<tr>
<th>Sociodemographic Variable</th>
<th>US (%)</th>
<th>Louisiana (%)</th>
<th>Local Parishes*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (Age: 50+)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>56</td>
<td>57</td>
<td>56</td>
</tr>
<tr>
<td>Male</td>
<td>44</td>
<td>43</td>
<td>44</td>
</tr>
<tr>
<td>Race/Ethnicity (Age: 50+)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>82</td>
<td>73</td>
<td>EBR 71</td>
</tr>
<tr>
<td>Black/African American/*Other</td>
<td>9</td>
<td>32</td>
<td>51</td>
</tr>
<tr>
<td>Educational Level (Age: 65+)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low (High School Graduate/GED or less)</td>
<td>83</td>
<td>87</td>
<td>Information not available</td>
</tr>
<tr>
<td>High (Some College or above)</td>
<td>17</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

*2000 LA Census Data Local Parishes includes: East Baton Rouge, West Baton Rouge, Washington, and Ascension Parishes

**Procedures**

Over a 3-year period, community-wide falls risk screenings were performed at ten community organizations. The screenings were scheduled with community center or facility directors in advance for a 3-hour period. Approximately one to two weeks before the scheduled falls risk screening, community members were asked to sign-up for a 20-minute testing block of time for the screening. Upon sign-up, the interested participants were issued a Medication List
Form and Home Assessment Checklist to complete and bring with them on the date of the screening. On the day of the screening, the participants completed four stations designed for the falls risk screening. The following stations were managed by trained testers and consisted of: (a) informed consent, demographics, and home safety; (b) medical history and medications; (c) mobility and balance; and (d) vision.

After completing all four stations, the participants were issued falls risk scores that took approximately 15 minutes to calculate. Scores were calculated using information gathered about falls and participant health and fall history, medications, home safety, mobility and balance, and vision. The tester reviewed the score reports with the participant and educated the participant on ways to lower his or her individual falls risks scores to prevent falls.

**Measures**

**Demographic and Medical History Information**

Information about participant’s age, race, gender, education level, household income, and medical history concerning hypertension and diabetes was collected using a questionnaire developed for this project.

**The Comprehensive Falls Risk Screening Instrument (CFRSI)**

The falls risk screening was performed using the CFRSI developed for the study to test various falls risk subscales within older adults. A total falls risk score was calculated by averaging the falls risk subscale scores found by utilizing the relative risk (RR) or odds ratio (OR) as determined by the AGS (2001). The falls risk subscales that were tested included history, medication, environment, physical, and vision and were averaged to formulate a total falls risk score. Each of the individual falls risk subscales and the total falls risk scores were calculated with the lowest risk of 0 to a highest risk of 100.
**History Subscale.** The history risk score was determined from the participants’ self-reported age (RR/OR = 1.7), history of falls (RR/OR = 3.0; number of falls within the past 12 months and within the past 3 years), assistive device usage (RR/OR = 2.6), and diagnosis of arthritis (RR/OR = 2.4; AGS 2001). Self-reported age, falls history, assistive device usage, and history of arthritis were on an ordinal scale with numerical values, ‘1’ and ‘2’, recoding an answer of ‘yes’ or ‘no’, respectively. Falls risk was higher for participants reporting an age over 80, falls history, a diagnosis of arthritis, and/or usage of an assistive device.

**Medication Subscale.** The participants were asked to bring a completed Medication List Form. The participants also answered questions about whether they experienced any side effects (such as dizziness, lightheadedness, drowsiness) while taking these medications, if they use multiple pharmacists, and the frequency of pharmacy consult. High risk medication use and more than four medications were classified and scored according to the OR indicated by the AGS (2001). The ORs for the medications were as follows: psychotropics (OR = 1.7), class 1a anti-arrhythmics (OR = 1.6), digoxin (OR = 1.2), and diuretics (OR = 1.1). Values for side effects, use of multiple pharmacists, and frequency of pharmacy consults were also calculated on an ordinal scale with numerical values, ‘1’ and ‘2’, recoding an answer of ‘yes’ or ‘no’, respectively. For participants who reported taking any of the identified high risk medications, experiencing side effects from the medication usage, filling prescriptions at different pharmacies, and/or not undergoing a pharmacy consult about medication usage achieved higher falls risk scores.

**Environment Subscale.** The participant completed a Home Assessment Checklist to gather information about the home environment. Sample questions included “Are stairways well lit with lights at the top and bottom of the stairs; Are your steps, landings, and floors clear of clutter; If you have area rugs, do they have rug-liners underneath, dual-sided tape, or non-skid
backs?” with ‘yes or no’ responses. Because the checklist identified possible home hazards, the more ‘no’ responses indicated a higher environmental falls risk score.

**Physical Subscale.** The AGS specifies relative risks for the areas of muscle weakness (RR = 4.4), gait deficits (RR = 2.9), and balance deficits (RR = 2.9). The physical mobility and balance tests used to calculate the physical falls risk score were measures of functional mobility (Expanded Timed Get Up and Go Test; ETGUG; Dite & Temple, 2002; Mathias, Nayak, & Isaacs, 1986; Podsiadlo & Richardson, 1991; Trueblood, Hodson-Chennault, McCubbin, & Yougclarke, 2001; Wall, Bell, Campbell, & Davis, 2000) and standing balance (Functional Reach Test; FRT; Duncan, Weiner, Chandler, & Studenski, 1990). Both are considered to be quick, valid, reliable, and low-effort tests and are predictive of falls among older adults (Botolfsen, Helbostad, & Wall, 2006; Duncan et al., 1990; Shumway-Cook, Brauer, & Woollacott, 2000; Trueblood et al., 2001).

The ETGUG (Botolfsen et al., 2006) measures functional mobility and the ability of an older adult to rise to standing from a chair without use of his or her arms, walk 10 meters around a cone, and return to the chair in a seated position. Scoring of the ETGUG is based upon the time (in seconds) taken to complete the task. The longer it takes the participant to complete the task, the lower the functional mobility, and consequently the higher the falls risk.

The FRT (Duncan et al., 1990) measures standing balance and the participant’s ability to reach forward as far as possible with the dominant arm along a measurement tape affixed to a wall, without taking a step. The distance reached was measured in inches between the starting position of the middle finger and the final position of the middle finger after reaching forward. A shorter distance reached was associated with a higher falls risk. Scores for the ETGUG and FRT were recorded on the CFRSI and were used for calculation of the physical falls risk score.
**Vision Subscale.** The vision risk score was calculated from questions about the use of corrective lenses, lens use compliance, visual screen within the previous 12 months, and results from a visual acuity test. The visual acuity test was performed using the Snellen eye chart read from 20 feet with corrective lenses (as applicable) and the denominator was recorded on the CFRSI. The three questions for the vision risk score were calculated from ‘yes’ or ‘no’ answers from the participant. More ‘no’ answers and a higher Snellen denominator score indicated a higher risk for falls.

**Statistical Analysis**

Based on an alpha level of $\leq .05$ and a medium power (80%), the target $N$ was 192 for the factorial design (Cohen, 1992). Due to possible non-usable data or participant non-responses, a 50% attrition rate was set making the target sample size for the study at $N = 384$ ($N = 192/.50$; Marcus & Telesky, 1983). The demographic dichotomous variables were classified as follows: (a) gender = male and female, (b) race/ethnicity = White/Caucasian and Black/African American/Other, (c) income level = low ($\leq$ $1571 or less monthly) and high (greater than $1571 monthly), and (d) educational level = low (high school graduate/GED or less) and high (some college or above). Age, gender, race/ethnicity, income, education, falls history within the past 12 months, history of diabetes, hypertension, osteoarthritis, usage of an assistive device, and medication usage frequencies were summarized using descriptive analyses. The ranges, means, and standard deviations for age, individual falls risk factor subscale and total falls risk scores were also summarized with descriptive analyses.

To examine hypotheses a and b and answer research question a, a $2 \times 2 \times 2$ (race x education x income) factorial ANOVA was used to determine any main effects and interactions among and between race, educational level, and individual income status as related to the total falls risk score. The proportion of variance in the dependent variable explained by the
independent variable (i.e., partial eta squared) was determined by using thresholds of .01 = small, .06 = moderate, and .14 = large variance (Cohen, 1988). To examine hypothesis c and answer research question b, three chi-square tests were performed to determine group differences (fallers vs. non-fallers) based on race, education, and income. All results were analyzed using SPSS Version 16.

Results

The final sample included 286 community-dwelling older adults (ages 51-95; M age = 74.2 years, SD = 10.0) with the majority being women (75.9%). In addition, 52.9% of the participants were White/Caucasian, 52.4% of the participants were classified in the low-income status category (n = 111), and 43.1% of the participants were classified in the low educational level (see Table 18). Descriptive statistics of the participants are presented in Table 19 and Table 20. Means and SD of the CFRSI falls risk subscale and total falls risk scores are included in Table 21.

Table 18. Sociodemographic Factors and Falls: Demographic Profiles of the Participants

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender n = 286</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>217</td>
<td>75.9</td>
</tr>
<tr>
<td>Male</td>
<td>69</td>
<td>24.1</td>
</tr>
<tr>
<td>Race/Ethnicity n = 272</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>144</td>
<td>52.9</td>
</tr>
<tr>
<td>Black/African American/*Other</td>
<td>128</td>
<td>47.1</td>
</tr>
<tr>
<td>Income Status n = 212</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low ($1571 or Below)</td>
<td>111</td>
<td>52.4</td>
</tr>
<tr>
<td>High (Greater than $1571)</td>
<td>101</td>
<td>47.6</td>
</tr>
<tr>
<td>Highest Educational Level n = 262</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low (High School Graduate/GED or less)</td>
<td>113</td>
<td>43.1</td>
</tr>
<tr>
<td>High (Some College or above)</td>
<td>149</td>
<td>46.9</td>
</tr>
</tbody>
</table>

*Other descents include those of American Indian/Alaskan Native (n=2), Hispanic or Latino (Mexican, Puerto Rican, Cuban, Other) (n=1), Asian (Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese) (n=2), Other than defined (n=2)
Table 19. Sociodemographic Factors and Falls: Descriptive Statistics for Participants

<table>
<thead>
<tr>
<th></th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall in the past 12 months</td>
<td>94</td>
<td>32.9</td>
</tr>
<tr>
<td>Diabetes</td>
<td>48</td>
<td>17.3</td>
</tr>
<tr>
<td>Hypertension</td>
<td>112</td>
<td>40.4</td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>175</td>
<td>63.2</td>
</tr>
<tr>
<td>Use of Assistive Device</td>
<td>59</td>
<td>21.3</td>
</tr>
</tbody>
</table>

Table 20. Medication Descriptives

<table>
<thead>
<tr>
<th></th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than four medications</td>
<td>144</td>
<td>51.8</td>
</tr>
<tr>
<td>Psychotropic</td>
<td>7</td>
<td>2.5</td>
</tr>
<tr>
<td>Anti-arrhythmic</td>
<td>18</td>
<td>6.5</td>
</tr>
<tr>
<td>Digoxin/Lanoxin</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>Diuretic</td>
<td>38</td>
<td>13.7</td>
</tr>
</tbody>
</table>

According to the 2x2x2 factorial ANOVA, the main effect for education (hypothesis a) was the only significant main effect ($F [1, 205] = 10.19, p = .002$) with a moderate variance ($\eta^2 = .05$) and sufficient statistical power to identify group differences in falls risk. Specifically, the total falls risk score was significantly greater for participants with a lower educational level ($M = 41.1$) than for those participants with a higher educational level ($M = 34.5$). All other power levels were small to insubstantial and the main effects for income (hypothesis b) or race (research question a) were not significant. The estimated marginal means of the factorial design
for total falls risk scores of the sociodemographic variables are presented in Table 22. In Table 23, the $F$ values, $p$ values, explained variances, and observed statistical power are reported for all main effects and interactions.

There were no interaction effects for the total falls risk scores. Although the interaction effect between race and income approached significance ($F [1, 205] = 3.71, p = .056, \eta^2 = .02$), there was a significant difference in total falls risk between White/Caucasian participants and African American/Black/Other participants with low-income levels. Specifically, the total falls risk scores for White/Caucasian participants with low-income levels were significantly higher ($M = 40.5$) than the total falls risk scores for African American/Black/Other participants with low-income levels ($M = 35.7$). This significant difference led to the “regression to the means” phenomenon (both groups “moved from the extremes to the overall average;” Thomas, Nelson, & Silverman, 2005). In other words, the falls risk score for White/Caucasian participants with high-income levels decreased whereas the falls risk score for African American/Black/Other participants with high-income levels increased to approach the overall average (see Figure).

Table 21. *Means* and *SD* of the CFRSI Falls Risk Subscale and Total Falls Risk Scores

<table>
<thead>
<tr>
<th>Fall Risk Scores</th>
<th>Range</th>
<th>$M$</th>
<th>$SD$</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>0-92.5</td>
<td>41.4</td>
<td>23.8</td>
</tr>
<tr>
<td>Physical</td>
<td>0-97.4</td>
<td>40.4</td>
<td>17.4</td>
</tr>
<tr>
<td>Medication</td>
<td>11.6-98.9</td>
<td>45.6</td>
<td>26.3</td>
</tr>
<tr>
<td>Vision</td>
<td>7.9-86.4</td>
<td>28.3</td>
<td>17.0</td>
</tr>
<tr>
<td>Environment</td>
<td>1.5-82.0</td>
<td>27.3</td>
<td>19.1</td>
</tr>
<tr>
<td><strong>Total Falls Risk</strong></td>
<td>10.5-69.0</td>
<td>36.3</td>
<td>10.4</td>
</tr>
</tbody>
</table>
Table 22. Estimated Marginal Means of Total Falls Risk Score

<table>
<thead>
<tr>
<th>Group(s)</th>
<th>$M$</th>
<th>95% Confidence Interval</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>38.2</td>
<td>36.0</td>
<td>40.5</td>
<td></td>
</tr>
<tr>
<td>African American/Other</td>
<td>37.4</td>
<td>34.0</td>
<td>40.8</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>41.1</td>
<td>37.7</td>
<td>44.5</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>34.5</td>
<td>32.3</td>
<td>36.7</td>
<td></td>
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<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Low</td>
<td>38.1</td>
<td>35.8</td>
<td>40.4</td>
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</tr>
<tr>
<td>High</td>
<td>37.6</td>
<td>34.2</td>
<td>40.9</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>White/Caucasian</td>
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<td></td>
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</tr>
<tr>
<td>African American/Other</td>
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</tr>
<tr>
<td>Education</td>
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<td></td>
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</tr>
<tr>
<td>Low</td>
<td>39.9</td>
<td>36.3</td>
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<td>High</td>
<td>36.5</td>
<td>34.0</td>
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<td>Income</td>
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</tr>
<tr>
<td>Low</td>
<td>40.5</td>
<td>37.3</td>
<td>43.6</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>36.0</td>
<td>32.9</td>
<td>39.2</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>40.8</td>
<td>38.2</td>
<td>43.4</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>41.4</td>
<td>35.0</td>
<td>47.7</td>
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<td>Income</td>
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<td></td>
</tr>
<tr>
<td>Low</td>
<td>35.3</td>
<td>31.5</td>
<td>39.1</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>33.8</td>
<td>31.6</td>
<td>36.0</td>
<td></td>
</tr>
<tr>
<td>Race</td>
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<td></td>
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<tr>
<td>White/Caucasian</td>
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<tr>
<td>African American/Other</td>
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<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>42.1</td>
<td>37.6</td>
<td>46.6</td>
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<tr>
<td>High</td>
<td>37.8</td>
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<tr>
<td>Low</td>
<td>38.8</td>
<td>34.5</td>
<td>43.2</td>
<td></td>
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<tr>
<td>High</td>
<td>34.3</td>
<td>31.5</td>
<td>37.0</td>
<td></td>
</tr>
<tr>
<td>Education</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Low</td>
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<td>37.0</td>
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<tr>
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<td>56.3</td>
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<td>Income</td>
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<tr>
<td>Low</td>
<td>31.7</td>
<td>25.5</td>
<td>37.9</td>
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<tr>
<td>High</td>
<td>33.3</td>
<td>29.9</td>
<td>36.6</td>
<td></td>
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</tbody>
</table>

To control for this significant difference, an ANCOVA was performed to identify any differences in total falls risk based on income levels after controlling for race. The results indicated a significant difference in income groups when controlling for race ($F [1, 204] = 10.4,$
\( p = .001, \eta^2 = .05 \) in that individuals with low-income levels reported higher falls risk scores \( (M = 39.2) \) than individuals with high-income levels \( (M = 34.5) \).

Table 23. Tests of Between-Subjects Effects

<table>
<thead>
<tr>
<th>Source</th>
<th>F value</th>
<th>Significance ((p))</th>
<th>( \eta^2 )</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td>.17</td>
<td>.69</td>
<td>.001</td>
<td>.07</td>
</tr>
<tr>
<td>Education</td>
<td>10.19</td>
<td>.002</td>
<td>.05</td>
<td>.89</td>
</tr>
<tr>
<td>Income</td>
<td>.06</td>
<td>.81</td>
<td>.00</td>
<td>.06</td>
</tr>
<tr>
<td>Race x Education</td>
<td>2.41</td>
<td>.12</td>
<td>.01</td>
<td>.34</td>
</tr>
<tr>
<td>Race x Income</td>
<td>3.71</td>
<td>.06</td>
<td>.02</td>
<td>.48</td>
</tr>
<tr>
<td>Education x Income</td>
<td>.25</td>
<td>.62</td>
<td>.001</td>
<td>.08</td>
</tr>
<tr>
<td>Race x Education x Income</td>
<td>.19</td>
<td>.66</td>
<td>.001</td>
<td>.07</td>
</tr>
</tbody>
</table>

Figure. Estimated Marginal Means: Race by Income Graph

The range of total falls risk scores of fallers \((n = 90)\) were between 17.1 and 61.7 \((M = 41.0; SD = 9.4)\). The range of total falls risk score for non-fallers \((n = 188)\) were between 10.5
and 69.0 ($M = 34.1; SD = 10.1$). According to the chi-square tests, there were no significant differences between fallers and non-fallers by education ($\chi^2 [1, N = 262] = .03, p = .86$) or income ($\chi^2 [1, N = 212] = .38, p = .54$; hypothesis c). However, there were significant differences between fallers and non-fallers by race ($\chi^2 [1, N = 267] = 6.44, p = .01$; research question b). Specifically, White/Caucasian participants (63.2%) were more likely to fall than those who were Black/African American/Other (36.8%).

**Discussion**

The overall purpose of the study was to determine associations between sociodemographic characteristics of education (hypothesis a) and income (hypothesis b) with the total falls risk score as determined by weighted AGS falls risk factors in addition to determining whether fallers had a lower average education and income level than non-fallers (hypothesis c). In addition, two research questions were proposed to determine if there was any relation between race and total falls risk score (research question a) and whether there was a relation between race and falling status (research question b). Overall, findings revealed only a main effect of education on the total falls risk score such that the total falls risk score was significantly greater for those with a lower educational level than those with a higher educational level. Neither income nor race demonstrated a significant effect on the total falls risk score with the 2x2x2 factorial ANOVA. However, after controlling for race (i.e., ANCOVA), a significant difference in falls risk was revealed based on income levels. Specifically, participants with lower income levels demonstrated higher total falls risk scores than participants with higher income levels. For hypothesis c and research question b, the results also showed that there were no significant differences between fallers or non-fallers by education or income, but there was a significant difference in falling status by race (White/Caucasian participants were more likely to be fallers as compared to Black/African American/Other races).
The current study consisted of 286 community-dwelling older adults from a 100-mile radius of Baton Rouge, LA. According to Census 2000 data, the sociodemographic findings of the study sample were not comparable to the parishes outside of East Baton Rouge, Louisiana, and the United States target profile regarding gender, race, and education. For example, over 75% of the participants were female versus the target profile of surrounding parishes (56%), Louisiana (57%), and the United States (56%). Although research shows that females use medical services more often than men (Backer, Gregory, Jaen, & Crabtree, 2006), the larger number of females in the current study suggested that there was an oversampling of female older adult participants.

There also appeared to be more of a homogenous group of White/Caucasian older adults in the regional (combined East Baton Rouge [EBR], West Baton Rouge, Washington, and Ascension), state, and U.S. cohorts as compared to this study sample. The number of White/Caucasian older adults declines within Louisiana and more so in the local parishes and immediate Baton Rouge, LA area to a more diverse mixture of older adults in terms of race/ethnicity. Within this sample, just over half of the older adult participants were White/Caucasian, suggesting that a higher than targeted number of older adult participants were African American/Black/Other (US Census Bureau, 2001).

The participants had a higher educational level (57% with some college or above) as compared to state (13%) and national (17%) averages, but had a lower income level than the state or national target profile. Due to lack of representation of the target profile, it appears that there is selection bias in terms of gender, race/ethnicity, educational level, and income level. This diversity of the participant profile may cause there to be certain sociodemographic influences within the findings that may not be applicable when attempting to compare results to and/or support other falls risk screening studies. However, the investigation of the relationships between
falls risk, falling status, and sociodemographic characteristics of race, income, and education highlight a unique aspect of this research.

Of previous studies that performed falls risk screenings for community-dwelling samples, none reported sociodemographic variables other than age and gender. Thus, no other falls risk screening study data were available for demographic comparison. Although it appears that the current study is not comparable to the target profile in terms of sociodemographic characteristics, the sample in entirety is similar to other groups used in falls risk identification and intervention programs in terms of community-dwelling status, age (Boulgarides, McGinty, Willett, & Barnes, 2003; Muir, Berg, Chesworth, & Speechley, 2008; Raiche, Hebert, Prince, & Corriveau, 2000), female majority (Boulgarides et al., 2003), educational and income status as related to falls risk, and activity level as related to age and gender. Approximately 33% of the study older adult participants reported a fall within 12 months of the screening, which is comparable to national data suggesting one of every three older adults experiences a fall per year (CDC, 2004). In summary, this study sample as compared to local parish, state, and national data, on average, was slightly more diverse in terms of race/ethnicity, but was quite similar to immediate geographical data (EBR).

The CFRSI falls risk subscale and total falls risk scores were scored on a 0 to 100 scale, with a higher score indicating a higher falls risk. Within the study sample, the mean subscale scores ranged from 27.3 to 45.6 and the average total falls risk score was 36.3. There were no significant differences in total falls risk score based on gender ($t [276] = .14, p = .893$). According to the 2x2x2 (race x education x income) Factorial ANOVA, only the main effect of educational level on total falls risk score was statistically significant. This finding supported hypothesis a, and is similar to previous research performed by Hanlon et al. (2002) and Gill et al. (2005). Specifically, these researchers reported that lower educational level was significantly
associated with a high risk for falls (Hanlon, et al., 2002) and that greater education was associated with a decreased falls risk (Gill et al., 2005). Thus, the sociodemographic variable of educational level is an important factor to measure when attempting to identify older adults at risk for falls.

The non-significant main effect for income on total falls risk score may be attributed to the small statistical power (see Table 23). Specifically, the ANCOVA revealed significant total falls risk score differences based on income after controlling for race. Specifically, the higher the income levels the lower was the total falls risk within the entire group of older adults. Similar findings were reported elsewhere (i.e., Gill et al., 2005). According to the estimated power analysis, 192 participants were needed to achieve significant main effects and interactions in the factorial design. However, actual power analysis was low and only the main effect for education reached the desired power levels (.89; see Table 23). There was not a significant main effect for race and there were not any significant interactions among the sociodemographic variables. Had the power levels been higher it might have been possible to observe additional differences. Thus, future studies need to repeat the current study with a larger and more homogeneous sample.

The understanding of the relation between race and falls risk is still not clear. For example, Hanlon and colleagues did find that African Americans had a 23% decreased risk of experiencing a fall within the preceding year as compared to White older adults (Hanlon, et al., 2002). Contrasting findings by Means et al. (2000) and Studenski et al. (1994) reveal no difference in falls data between races. Therefore, future researchers need to use larger samples to investigate the relation between falls risk and race.

Additional research is encouraged not only to recruit more racially diverse samples, but to also report sample characteristics and sociodemographic influences as related to falls risk in the literature. With the evidence that is currently available, healthcare providers need to educate
older adults about the importance of physical activity and ways to decrease falls risk. Lower socioeconomic status, in general, is associated with less access to physical activity programs and consequently lower physical activity levels (Clark, 1995), and better income is associated with better access to healthcare, greater physical activity levels (Statistics Canada, 2001), and greater efforts to combat modifiable risk factors, as well as decreasing the threat from stressors that may influence falls risk (Kahn, 1991; Lantz, 2005). Other studies also show associations between physical activity declines and those with lower education, lower income, and lower perceived health (Droomers, Schrijvers, & Mackenbach, 2001; Kaplan, Strawbridge, Cohen, & Hungerford, 1996; Schmitz, French, and Jeffery, 1997).

Thus, the importance of falls prevention needs to be reinforced by healthcare providers and community liaisons by providing ways to increase knowledge about falls in older adults among older adults with various educational levels and promoting improved access to free or low-cost physical activity programs to decrease overall falls risk in older adults. For example, opportunities for free or low-cost access to public health clubs and falls prevention programs or providing additional education and physical activity programming within lower socioeconomic communities may lead to improved education and increased physical activity levels, and thus a decreased falls risk in older adults. Evidence-based practice in community interventions can also aid further research and encourage policy changes to benefit those with a lower socioeconomic level as more information on the influences of sociodemographic variables on falls and falls risk in older adults is published. Consequently, policies can be made in efforts to reduce the demand for preventative healthcare and programs, encourage affordable healthcare and community program usage, and allow easier access to falls prevention and intervention opportunities for older adults who have socioeconomic characteristics related to an elevated falls risk.
Of the total sample, one-third of the participants reported a 1-year fall history. The average total falls risk score for the fallers was 41.0, which was significantly higher than non-fallers (34.1). Thus, older adults within the study sample that scored a total falls risk score of 41 or greater had a higher chance of experiencing a fall. There were no significant differences between gender ($\chi^2 [1, N = 286] = .04, p = .842$) or age group ($\chi^2 [1, N = 286] = 2.55, p = .110$) in participants who reported a fall (fallers) as compared to those who reported no falls (non-fallers). Non-significant findings for gender and age may be because proportionally there were not a large number of men or younger adults in the study sample. Thus, results regarding age or gender differences in total falls risk scores cannot be conclusive. Consequently, the demographics of gender and age were not included in the main analyses.

Additionally, there were no significant differences between educational levels or income levels on 1-year fall history. Thus, neither part of hypothesis c was supported. However, based on the chi-square test for race and 1-year fall history, White/Caucasian participants had a greater likelihood of actually experiencing a fall within 1-year compared with African American/Black/Other participants, answering research question b. These findings have been supported elsewhere (CDC, 2008b, Faulkner et al., 2005, Hanlon et al., 2002). Therefore, the sociodemographic variable of race/ethnicity is an important factor to measure when attempting to identify those who have fallen when promoting falls prevention strategies to subgroups of the older adult population. Community health promoters can assist falls prevention in racially diverse older adult populations by increasing the number of programs offered within diverse older adult communities, and furthermore recruit, increase the number of older adult participants, and improve retention from these communities involved in falls prevention programs. It is also important for health promoters to work closely with organizations in place that already
successfully offer other healthcare and community services for various older adult populations to educate them on the importance of falls prevention within their communities.

Several limitations were noted for the current study. The study sample was more diverse in terms of race/ethnicity, had a higher educational level, and a lower medium income as compared to the general population outside of the immediate surrounding area. Thus, the cohort that was used in this study may not be appropriate for other studies with different populations or objectives. Second, other than the altered sample sociodemographic characteristics from the target profile, there was selection bias due to the voluntary nature of the falls risk screenings and using a convenience sampling method among a pool of older adults who were already using services provided by community organization sites. Thus, the participants do not necessarily represent all older adults within their ethnic groups, but possibly those more inclined to use public services and organization programs. Older adults already involved in community programs may actually be more physically active and may consequently have a lower falls risk. The lack of older adults that are not participants of community programs within the study sample could cause an overall reduction in the range of the CFRSI total falls risk score. Therefore, recruitment of participants outside of this setting is warranted.

Third, self-report data may be flawed by inaccurate reporting in terms of medical and falls history. This is an issue when collecting interview data and relying on recall of information. Although the participants were without noticeable cognitive deficits, which is in itself a falls risk factor, the chance for inaccurate falls history information was possible. Therefore, future researchers may want to use diaries, fall report calendars or logs, and frequent follow-up for better accuracy, to assist participants with correct accounts of falls and consequences of falls, and to better document causes and timing of falls within older adults.
Lastly, the observed statistical power for the factorial design was low for all main effects and interactions except for the main effect for education, which reached desired power (.89; see Table 23). Additional main effects or interactions were not found. Thus, future studies need to repeat the current study with a larger sample to possibly achieve a significant observed power for other main effects and/or interactions.

Despite the limitations, this study has important strengths. There is interest in community organizations and healthcare professionals to help older adults in prevention of falls. However, much of the published research does not take into account all of the underlying factors and effects associated with falls risk and weight contributing factors. This study, however, not only utilizes the newly developed and validated CFRSI to determine associations between falls risk and sociodemographic factors of education and income, but also determines a relationship between race and history of falls, topics that are limited in the existing literature.

In addition, this study also uses minority participants making this study unique from other falls and falls risk screening studies showing relationships among demographic factors (race, education, and income), falls risk, and falling status among an underserved older adult population (older adults of diverse socioeconomic backgrounds). Thus, this study does suggest that it is imperative for healthcare providers and researchers to take into consideration the sociodemographic profiles of race, education, and income levels of the participants and the community and/or region in question when determining target populations for falls prevention program implementation for rural or urban communities.

Along the same lines, there is scarce information regarding sociodemographic influences on falls history and falls risk in older adults. Thus, future researchers are also encouraged to recruit more racially diverse samples and to report sample characteristics of sociodemographic influences in their research findings among many different older adult cohorts (community-
dwelling, institutionalized, and assistive care). These efforts are needed to better identify factors mediating the relationship between income, education, race, and falls/falls risks. Attempts at identifying barriers to participation in screening and/or intervention programs and removing sociodemographic inequalities within communities would be helpful precursor interventions to decreasing the overall risk/need for continuity of care and prevention programs. Barriers may include income limitations to participation, decline in functional ability, lack of access and means to attend education or physical activity programs, decreased confidence in performance, or lack of knowledge about benefits.

It is also recommended that the investigation of these factors be continued with a greater number of participants. A greater number of participants used for the factorial ANOVA would increase power to possibly detect a significant difference based on the other sociodemographic variables of income and race and the interactions of income, race, and education on falls risk. This study also needs to be repeated by using advanced statistical techniques (e.g., structural equation modeling) to test how sociodemographic profiles may moderate the relations between physical activity, physical function, falls efficacy, and falls risk among similar and different populations with large samples. From all of these efforts, policies can be made that promote preventative healthcare and decrease the demand for excessive healthcare usage as a result of falls in older adults. Policies can also aid in allowing easier access and offering greater opportunities for all older adults of various socioeconomic backgrounds to participate in falls prevention programs so that better assessments can be made regarding what aspects of programs are critical for success for older adults in widespread living situations, of various levels of assistance, and who have certain socioeconomic characteristics that are related to an elevated falls risk.
In summary, the current study did not find any associations between falls risk and race, but educational level and income level appeared to have an association with total falls risk in community-dwelling older adults as determined by the CFRSI. Although a significant relationship between falls risk and race was not found, a significant pattern of relation was found between race and falling status such that White/Caucasian older adults reported more 1-year history of falls than African American/Black/Other older adults did. Considering that fall history elevates risk for future falls, the current study suggests that the factor of race in determining risk for multiple falls is worthy of additional research. Thus, this study does suggest that it is imperative to take into consideration the sociodemographic profiles of the participants and the sociodemographics of the community and/or region in question when targeting populations for falls prevention program implementation for rural or urban communities. Specifically, consideration of education and income level in targeting older adults at risk for falls is important when developing falls prevention and education programs to decrease risks in addition to understanding that there are also race/ethnic influences on likelihood of falling in community-dwelling older adults. Future prospective cohort studies to determine additional associations between sociodemographic variables such as income, race, and education against similar and differing cohorts and/or there are underlying factors not considered in the current study are warranted.
CHAPTER 5
GENERAL DISCUSSION

The overall objective of this dissertation was to summarize information about identification of falls risk factors, methods to identify older adults at risk for falls, and discuss strategies for falls risk screening and assessment. This was in efforts to develop and validate a comprehensive falls risk screening instrument that included a variety of weighted falls risk factors according to previously published evidence by the American Geriatrics Society, within a diverse group of older adults. Two studies were performed to meet this objective. The purpose of Study 1 was to validate the Comprehensive Falls Risk Screening Instrument (CFRSI; using subscales of history, physical, medication, vision, and environment) within a diverse group of community-dwelling older adults (Chapter 3). The purpose of Study 2 was to determine any relationships between the total falls risk score (as derived from the CFRSI) and falling status, against the sociodemographic characteristics of education, income, and race (Chapter 4). The purposes of this chapter (Chapter 5) are to discuss the main findings of both studies, highlight any strengths, unique aspects, and limitations of the studies, and define any areas for future research.

Summary of Dissertation Studies

Study 1. Validation of the CFRSI

The main purpose of Study 1 (Chapter 3) was to validate the CFRSI that included the subscales of history, physical, medication, vision, environment, and total falls risk against the falls risk subscale scores, self-reported physical activity levels, self-reported physical function, health-related quality of life (HRQL), and self-reported 1-year history of falls. Another aim of Study 1 was to determine if any of the falls risk subscales would be predictors of fallers and non-
fallers. The final sample included 286 community-dwelling older adults with a mean age of 74.2 years from ten local community centers within a 100-mile radius of Baton Rouge, LA. Within the sample, 75.9% were female and 52.9% were White/Caucasian. Approximately one-third of the participants reported a fall within 1 year of the screening.

The total falls risk score was significantly associated with all of the falls risk subscale scores (hypothesis a), and the average CFRSI total falls risk score was 36.3. The total falls risk score was moderately associated with the total PASE score (physical activity; hypothesis b), the total FSI score (physical function; hypothesis c), and the summary composite scores of the SF-36 (HRQL; hypothesis d). Fallers also had a significantly higher total falls risk score (mean total falls risk score of 41.0) as compared to non-fallers (mean total falls risk score of 34.1; hypothesis e), and only the CFRSI history risk score discriminated between fallers and non-fallers (research question). The results of Study 1 provide evidence of the construct validity of the CFRSI.

**Study 2. Relationships among Sociodemographic Factors and Falls in Older Adults**

The main purpose of Study 2 (Chapter 4) was to determine associations between the sociodemographic characteristics of education, income, and race and the total falls risk score calculated using the newly developed and validated CFRSI (as described in Study 1) in community-dwelling older adults. The second objective of Study 2 was to determine if there was a pattern of relations among education, income, and race and falling status (fallers vs. non-fallers) from a self-report 1-year history of falls. The final sample included 286 community-dwelling older adults, and 52.9% were White/Caucasian, 52.4% reported a low-income level, and 43.1% indicated a low educational level.

A significant main effect of education (hypothesis a) was found indicating that the total falls risk score was significantly greater for participants with a lower educational level ($M = 41.1$) than for those participants with a higher educational level ($M = 34.5$). However, there were
no significant main effects of income (hypothesis b) or race (research question a) on total falls risk score. Due to the “regression to the means” phenomenon in looking at the race and income interaction, an ANCOVA was performed to control for race. It was then found that the higher the income levels, the lower the total falls risk within the entire group of older adults. In addition, there were no significant differences between fallers and non-fallers by education (hypothesis c) or income (hypothesis c), but there was a significant difference between fallers and non-fallers according to race (research question b). This suggests that there were more White/Caucasian participants (63.2%) who fell within the year prior to the screening as compared to Black/African American/Other participants. Therefore, it is important to consider factors such as education, income, and race when determining applicability of falls risk screening instruments and falls reduction programs within various older adult populations.

**Strengths and Limitations of the Dissertation Studies**

In addition to the construct validation of the CFRSI within a diverse older adult population, the CFRSI also appears to add to the current screening tools the ability to identify fallers and falls risk in older adult groups based on the sociodemographic factors of race, education, and income. Several strengths of the two studies are identified. First, most falls-reduction programs recognize and/or target several risk factors for intervention. A substantial number and variety of reliable and valid falls risk screening tools are readily available for use in older adults, but none utilize comprehensive weighting of risk factor subscales and is validated for use among a diverse group of older adults. The development and validation of the CFRSI against the falls risk subscales scores, physical activity, physical function, and HRQL was an important preliminary step for investigation of a comprehensive screening instrument that assesses multiple falls risk factors simultaneously and can generate an overall falls risk score. The CFRSI also serves as a cost-effective, easily administered, and time-efficient screening
instrument, which can be used for falls risk screenings among diverse groups of older adults. This instrument will be beneficial in aiding clinicians, healthcare providers, and community organizations in identifying those with a fall history and older adults at risk for falls. This is necessary to implement targeted falls risk reduction and prevention programs specific to falls risks identified by the CFRSI in promotion of improved physical activity, physical function, and HRQL to reduce falls risk and prevent falls.

Second, in both studies, the participants’ rate of falls was similar to that of national data and other falls studies within older adults. In addition, community-dwelling participant recruitment, average age and range, physical activity level within age groups and genders, and predominant female gender were all comparable to other similar study samples. Third, the studies include minority participants, which is a unique aspect compared to other falls risk screening studies. Thus, other variables such as sociodemographic factors among an underserved older adult population are found to be influential in the current study findings. Just a few studies discuss relationships among sociodemographic factors as compared to falls and falls risk in older adults. Study 2 offers findings and explanations of other influential variables such as race, education, and income in addition to exposing these variables to comparison against the newly validated CFRSI falls risk and history of falls.

The goal of the newly developed CFRSI was to identify those at risk for falling who may be appropriate for further in-depth assessment and intervention. Although the current studies improve on the scarcities in the current literature, some limitations exist. The current studies relied on self-report of fall history and medical information. Self-report of fall history, medication, and health history data by older adults in general may be inaccurate and is considered to be a limitation of the studies. Specifically, the history of falls was from a 1-year
and 3-year recall and methods other than self-report of this data, such as logs or diaries, may be necessary for improved information gathering.

The dissertation studies also utilized a convenience sample of older adults recruited from community organizations, and the participation in the screening was voluntary. Therefore, the community-dwelling older adults that were sampled were already involved in the community programs and may not be typical of all older adults within the area. For example, community-dwelling older adults who are not participants of the community programs may not be inclined to participate in physical activities, may be less active, and may be at greater risk for falling. Further research is needed to determine if there is a difference in falls risk between community-dwelling older adults who are participants in community programs as compared to those who are not.

These studies were beneficial for measuring and documenting falls risks among an understudied diverse group of older adults, and may be applicable across a wider spectrum of older adult groups. But, the sociodemographic characteristics of the sample were not consistently representative of the local parishes in terms of race, education, and income. There were fewer White/Caucasian older adults than expected as compared to national, state, local surrounding parish data indicating a more diverse racial/ethnic group of participants in the current sample. In addition, there was a higher educational level and a lower income status as compared to national and state data. In other words, the study sample was more diverse in terms of race/ethnicity, had a higher educational attainment, and had a lower median income. In addition, a larger sample was required for the factorial design in Study 2 to identify potential significant main effects and interactions between the socio-demographic variables and falls risk.

**Implications of Research Findings and Areas for Future Research**

The CFRSI is a valid, quick method for screening for falls risk among older adults, and it
has the potential for ease of use for therapists, healthcare professionals, and trained investigators within the community. It can be used to establish if further balance assessment and interventions are required with the inclusion of specific targeted interventions against identified falls risks as determined by the CFRSI. Implementation of programs should be focused on improvement of physical activity, physical function, and HRQL to aid in falls risk reduction and falls prevention. For example, promotion can include: (a) administering physical activity programs and exercise groups or individualized targeted interventions focused on balance, functional mobility, and other identified falls risk factors; (b) education about falls prevention and alleviating barriers to participation in falls prevention programs in hopes to promote mental health and social involvement as related to fall-related anxiety; and (c) providing medical screenings and intervention as related to reduction of falls risk in older adults. In addition, the CFRSI can be used to compare falls risks between large community-based groups of older adults, to describe falls risk within an individual, to monitor falls risk over time, and to monitor the effectiveness of evaluation, prevention, and treatment for falls and falls risks.

It would be beneficial to take into consideration the influences of sociodemographic variables on falls risk and history of falls within other older adult groups of other ages, those with different medical conditions, and those of various physical activity and physical function levels to aid in the reduction of the burden of injury from falls across subgroups of older adults. Increasing awareness within the community and older adult organizations about falls issues, screening and prevention strategies, and intervention programs, in addition to supporting balance and falls-risk clinics are ways to promote safety and encourage a primary method of falls prevention.
Although the oversampling of females for healthcare services is common in the literature, the two studies recruited more sampled females (3:1) as opposed to a 1.25:1 ratio of females to males in the target demographic profile. Indeed, there was not a significant difference between genders on outcome variables, but some may argue that the oversampling of females possibly limits generalization of the study findings to older adult males. Further research is needed to determine if there is a difference in falls risk between males and females within the specific target demographic profile ratio.

As related to the outcomes of Study 2, it is also beneficial for community governing bodies and organizations to promote falls risk interventions by encouraging improvement of educational levels of the community members. Organizations can also provide falls risk reduction materials that are easy to understand for all educational levels. In addition, community programs should provide easier access and/or free or lower cost healthcare and access to physical activity and falls reduction programs for those who may be of lower socioeconomic status. It will also be beneficial to identify ways to successfully disseminate effective falls prevention interventions based on these CFRSI falls risk score outcomes, to translate these intervention strategies into programs, to encourage implementation in community settings, and to promote widespread adoption at the local level particularly in comparison of different sociodemographic older adult groups (Faulkner et al., 2005). The successful implementation of these programs will also require a clear set of operating procedures to ensure that older adults receive appropriate falls risk prevention services and treatments targeting the learning styles and cultural attitudes of their cohort in a timely manner, with continuum of care and progress monitored over the long term.

There are other areas worthy of additional study in relation to falls and falls risks in older adults. The CFRSI was validated against physical function and physical activity. Thus, it is
imperative that appropriate programs proposed to improve these outcomes are implemented according to the abilities, accessibility, and function of the older adult. Current research findings indicate that different types of stand-alone exercise interventions or multi-factorial interventions that include exercise as the core component of physical activity have the potential to significantly reduce many of the risk factors that contribute to falls and, in the case of community-dwelling older adults, the actual number and rate of falls. In addition, the benefits of physical activity methods such as line dancing, ballroom dancing, exercise with music, or other recreational activities that may provide general exercise benefits, social activity, and attraction for seniors to promote HRQL. These activities can further improve retention and decrease the barriers and resistance to participation in exercise programs among the older adult population. The benefits of these programs as related to falls risk reduction warrant additional research.

Other areas for research include defining optimal frequency intervals for testing (in relation to acuity and to the changing medical condition of the older adult) and defining how to link interventions with specific identified falls risk factors (Perell et al., 2001). Medical conditions of older adults change frequently. Thus, determining which exercises or falls risk reduction programs are best for older adults with chronic health conditions, functional disabilities, or cognitive impairment (Shaw et al., 2003) is also of importance to clinicians and is imperative when establishing programs for continuum of care. Lastly, determining if one type of exercise, group of multi-factorial activities, or specific physical activity program is more effective than others in reducing falls and falls risk has not been defined in the literature.

The newly developed CFRSI has potential discriminatory ability for identifying fallers using threshold values of total falls risk. The effectiveness of using the CFRSI as a dichotomous-rating scale (i.e. “low fall risk” or “elevated fall risk”) is worthy of additional research using prospective data for predictive value. In addition to establishing threshold total falls risk scores,
the predictive quality of the history falls risk score and its components are worthy of additional research. In development of falls risk programs based on use of the CFRSI, it is necessary to further investigate the sub-components of the CFRSI history falls risk score (advanced age, assistive device usage, presence of osteoarthritis, and falls history). Based on Study 1, history of falls is an important predictor of falls risk and falling status.

In conclusion, falls among older adults exert a significant burden of injury to society, the healthcare system, individuals, and their families. However, it is important to note that falls risk factors can be identified and weighted using the CFRSI, and that the CFRSI can be applied to diverse groups of older adults. Identified falls risks according to the CFRSI may be modifiable. Those older adults with a falls history and those most susceptible to falling and sustaining a falls-related injury can be identified using the CFRSI and furthermore be educated on falls prevention, introduced into a falls risk reduction or intervention program, and referred for additional medical services as deemed medically necessary. There is a significant body of research in support of falls risk identification and strategies to reduce falls in the older adult population. However, future research considerations to determine the efficacy of community-wide falls risk identification, reduction, prevention, and intervention models as related to physical function, overall health, and quality of life in diverse groups of older adults will allow broader application of this growing body of information. Researchers and clinicians can then anticipate and overcome likely barriers in promotion of future valuable falls risk reduction programs and be able to estimate the eventual public health impact falls prevention programs have on the ever-growing older adult population.
REFERENCES


Hodkinson, H. M. (1972). Evaluation of a mental test score for assessment of mental impairment

and Control.

Hopman, W. M., Berger, C., Joseph, L., Towheed, T., vandenKerkhof, E., Anastassiades, T., et

265-271.

Hornbrook, M. C., Stevens, V. J., Wingfield, D. J., Hollis, J. F., Greenlick, M. R., & Ory, M. G.
(1994). Preventing falls among community-dwelling older persons: results from a
randomized trial. *Gerontologist, 34*(1), 16-23.

falling among the community-dwelling elderly. *Journal of Aging and Health, 5*(2), 229-
243.

older adults: the Blue Mountains Eye Study. *Journal of the American Geriatrics Society,
46*(1), 58-64.


correlates of the Dizziness Handicap Inventory. *Journal of the American Academy of

review of evidence for validity, reliability and responsiveness of tests. *The Journal of
Hand Surgery, 30*(3), 252-264.


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APPENDIX A

IRB APPROVAL

Project Report and Continuation Application
(Complete and return to IRB, 203-B1 David Boyd Hall,
Direct questions to IRB Chairman Robert Mathews 578-8692.)

IRB#: 2017 Your Current Approval Expires On: 1/8/2018
Review type: Expedited Risk Factor: Minimal
PI: Maria Kosma Dept: Kinesiology Phone: (225) 578-8016
Student/Co-Investigator: Delilah Moore
Project Title: Falls and Fracture Risk in Southeast Louisiana Seniors
Number of Subjects Authorized: 1000

Please read the entire application. Missing information will delay approval!

I. PROJECT FUNDED BY: Faculty Research Grant Program/AAPHRED LSU proposal #

II. PROJECT STATUS: Check the appropriate blank(s); and complete the following:
   1. Active, subject enrollment continuing; # subjects enrolled: 140 (Some have done screening more than one time)
   2. Active, subject enrollment complete; # subjects enrolled:
   3. Active, subject enrollment complete; work with subjects continues.
   4. Active, work with subjects complete; data analysis in progress.
   5. Project start postponed
   6. Project complete; end date ___/___/___
   7. Project cancelled; no human subjects used.

III. PROTOCOL: (Check one).
   X Protocol continues as previously approved
   _ Changes are requested*
      * List (on separate sheet) any changes to approved protocol.

IV. ADVERSE EVENTS: (possible study-related events affecting subjects):
   > State number of events since study inception: 0 since last report: 0
   > Have there been any previously unreported events? Y/N _?
   (If YES, attach report describing event and any corrective action).

V. CONSENT FORM AND RISK/BENEFIT RATIO:
   Do new knowledge or adverse events change the risk/benefit ratio? Y/N _
   Is a corresponding change in the consent form needed? Y/N _
   (Medication/ treatment done during the year)

VI. ATTACH A BRIEF, FACTUAL SUMMARY of project progress/results to show continued participation of subjects is justified; or to provide a final report on project findings.

VII. ATTACH CURRENT CONSENT FORM (only if subject enrollment is continuing); and check the appropriate blank:
   X 1. Form is unchanged since last approved
   _ 2. Approval of revision requested herewith: (identify changes)

Signature of Principal Investigator: __________________________ Date: 11/07/07

IRB Action: _/ Disapproved. Approval Expires: 11/19/08
             _/ File closed
Signed: _____________________________________ Date: 11/18/07

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APPENDIX B

CONSENT FORM

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Title of Study:
Falls and Fracture Risk in Southeast Louisiana Seniors

What you should know about a research study
• We give you this consent form so that you may read about the purpose, risks and benefits of this research study.
• The main goal of research studies is to gain knowledge that may help future patients.
• You have the right to refuse to take part, or agree to take part now and change your mind later on.
• Please review this consent form carefully and ask any questions before you make a decision.
• Your participation is voluntary.
• By signing this consent form, you agree to participate in the study as it is described.

1- Who is doing the study?
Principal Investigator: Maria Kosma
Rebecca Ellis
Jennifer M. Fabre
Dellihah S. Moore
Tel: 225-578-8016

2- Where is the study being conducted?
The falls risk screening in which you participate will require you to attend a 30 to 60-minute session at one of several locations where testing is provided. The testing sites will include several Councils on Aging offices, multiple chapters of the YMCA, community centers, and residential living centers for older adults. A complete list of the testing sites will be provided upon request. Up to two follow-up phone calls or interviews will also be requested within 12 weeks of the screening.

3- What is the purpose of this study?
The purposes of this study are to evaluate the usefulness of a fall-risk screening tool, and to examine rate of self-reported falls and changes in falls and fracture risk over 5-years among older adults residing in Baton Rouge and the surrounding parishes.

4- Who is eligible to participate in the study? Who is ineligible?
We expect to enroll as many as 1000 participants in this study all over the age of 50.

Inclusion Criteria:
• This study requires that participants are 60 years of age or older.

Exclusion Criteria:
• Persons who are known to have severe memory problems
• Persons who are wheel-chair bound, or who are otherwise completely incapable of walking.
5- What will happen to you if you take part in the study?

The purpose of the study is to assess your falls-risk and to monitor your falls-risk on an annual basis over a 5-year period. Some of this information will be collected in person at the falls risk screenings and others will be obtained during follow-up phone calls.

The assessments will include:

- **Personal History Questionnaire**, which will include questions about age, race, gender, education level, income, marital status, and so on.
- **Medical History Questionnaire**, which will ask questions about any diseases or conditions that you have experienced, current medication usage, number of falls within recent years, injuries due to recent falls, alcohol consumption, use of assistive devices, etc.
- **Physical Activity Questionnaire**, which will require you to respond to questions about your activities of daily living, leisure-time physical activity, and any exercise in which you have been engaged.
- **Psychological-related Falls Questionnaires**, which will require you to answer questions about your confidence level with regard to performing certain activities without falling.
- **Home Safety Checklist**, which will ask you to respond to close-ended (yes or no) questions about certain items that may exist in your home and may pose a falls-risk.
- **Vision Tests**, that will include reading letters off of a standard vision-test chart from 20 feet, and reporting differences in shading of objects from a contrast vision-test chart.
- **Physical Function Tests**, which will include measuring your ability to reach forward without stepping, and your ability to get up from a chair with no arms, walk 10 meters, and return to the chair and sit.
- **Self-report of Physical Function**, which will require you to answer questions describing your ability and comfort when performing activities of daily living.
- **Health-related Quality of Life**, which will require you to answer questions about your appraisal of your own health and how it impacts your quality of life.
- **Bone Stiffness Assessment**, which will require you to sit in a chair, remove a shoe and sock or stocking and place your heel on a small device that uses sound waves to assess your bone stiffness. The assessment is very brief, lasting only 30 seconds.

6- What are the possible risks and discomforts?

There are no known risks associated with any of the assessments. However, rising from a seated position may result in dizziness, and performing activities may also cause you to feel unsteady or lose your balance. You should report any such feelings to the tester, who will be with you throughout the screening to assist you. If you typically use assistive devices such as walkers or canes, you may use them during the screening.

7- What are the possible benefits?

While there are no particular health benefits to having the above procedures performed, the information gathered will allow us to provide you with some information about the
extent to which you might be at risk for falling, and may assist you identifying steps to reduce your risk of falling. The information will also be used to further our understanding of falls-risk and falls so that we might improve falls prevention strategies.

8- If you do not want to take part in the study, are there other choices?
You have the right to withdraw from this research study at any time without penalty. If you choose not to participate in this study, this will not affect any rights or benefits to which you are otherwise entitled.

9- If you have any questions or problems, whom can you call?
If you have any questions about your rights as a research volunteer, you should call the Institutional Review Board Office at 225-578-6692. If you have any questions about the research study, contact Dr. Maria Kosma at 225-578-8016.

10- What information will be kept private?
Every effort will be made to maintain the confidentiality of your study records. Only those investigators listed on this consent form will be able to access your information. Results of the study may be published; however, we will keep your name and other identifying information private. Other than as set forth above, your identity will remain confidential unless law requires disclosure.

You may request a copy of your records for a period up to three years after the planned conclusion of the study (January 2011), and you may request that a copy of your records be sent to your physician.

11- Can your taking part in the study end early?
The investigators can withdraw you from the study for any reason or for no reason. You may withdraw from the study at any time without penalty. Possible reasons for withdrawal include inability or unwillingness to complete the required testing.

12- What if information becomes available that might affect your decision to stay in the study?
During the course of this study there may be new findings from this or other research, which may affect your willingness to continue participation. Information concerning any such new findings will be provided to you.

13- What charges will you have to pay?
None.

14- What payment will you receive?
You will be not be reimbursed for completing the assessments.

15- Will you be compensated for a study-related injury or medical illness?
No form of compensation for medical treatment or for other damages (i.e., lost wages, time lost from work, etc.) is available from LSU A&M College. In the event of injury or medical illness resulting from the research procedures in which you participate, you will be referred to a treatment facility. Medical treatment may be provided at your expense or at the expense of your health care insurer (e.g., Medicare, Medicaid, Blue Cross-Blue Shield, Dental Insurer, etc.), which may or may not provide coverage.

16- Healthy Insurance Portability and Accountability Act (HIPAA)
Records that you give us permission to keep, and that identify you, will be kept confidential as required by law. Federal Privacy Regulations provide safeguards for privacy, security, and authorized access. Except when required by law, you will not be identified by name, address, telephone number or any other direct personal identifier.

17- Signatures
The study has been discussed with me and all my questions have been answered. I understand that additional questions regarding the study should be directed to the study investigators. I agree with the terms above and acknowledge that I have been given a copy of the consent form.

With my signature I acknowledge that I have been given either today or in the past a copy of the Notice of Privacy Practices for Protected Health Information.

________________________________________  Date
Signature of Volunteer

________________________________________
Date of Birth of Volunteer

________________________________________  Date
Signature of Person Administering Informed Consent

The study volunteer has indicated to me that the volunteer is unable to read. I certify that I have read this consent form to the volunteer and explained that by completing the signature line above the volunteer has agreed to participate.

________________________________________  Date
Signature of Reader

Study Approved By:
Dr. Robert C. Mathews, Chairman
Institutional Review Board
Louisiana State University
203 B-1 David Boyd Hall
225-578-8692 | www.lsu.edu/irb
Approval Expires: __-__-20__
**List your prescription and over the counter medicines as well as your dietary supplements**

Please bring this completed list with you for your screening visit. If you need additional space, continue on a separate page.

<table>
<thead>
<tr>
<th>Name of Medicine</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX D

HOME ASSESSMENT CHECKLIST

Home Assessment Checklist Form

Name: ________________________ Date ________________

Please take a walk through your home with this checklist. Taking a few extra minutes to improve your home could prevent a fall and add years to your life.

Please bring this completed checklist with you for your screening visit.

***Do you have stairs within your home or to enter your home? If so, answer questions 1, 2, and 3. If not, skip to question 4. ***

1. Do you have handrails on both sides of all stairways in your home – including the outside stairs? □ Yes □ No
2. Do the stair rails extend the full length of the stairway? □ Yes □ No
3. Are stairways well lit with lights at the top and bottom of the stairs? □ Yes □ No
4. Do you have nightlights to help light your bathrooms, bedrooms, and hallways during evening hours? □ Yes □ No
5. Are you able to turn on a light immediately upon entering a room? □ Yes □ No
6. Do you have grab bars in your bath and shower stalls as well as on the sides of the toilet? (Never use towel racks or soap dishes as grab bars, they can easily come loose, causing a fall) □ Yes □ No
7. Do you have a non-slip mat or safety decals in your bath and shower? □ Yes □ No
8. Do you remove soap build-up in the tub and shower on a regular basis to avoid slipping? □ Yes □ No
9. If you have area rugs, do they have rug-liners underneath, dual-sided tape, or non-slip backs? □ Yes □ No
10. Are your steps, landings, and floors clear of clutter? (Always keep these areas clear, and don’t forget to safely tuck telephone and electrical cords out of walkways) □ Yes □ No
11. Do you keep floors clean by promptly wiping up grease, water, and other spills? □ Yes □ No
12. Are things you use often stored on easy-to-reach shelves, so that you don’t need to reach too high or bend too low to get them? □ Yes □ No

APPENDIX E

PARTICIPANT INFORMATION FORM

Participant Information Form

Date ____________________

Identification
1. Name: Last: __________________ First: ________________ Middle: _________________

2. Marital Status: □ S □ M □ W □ D

3. Gender: □ Male □ Female

4. Address: ________________________________________________________________
   Street/PO Box __________________ Town __________________ State __________ Zip ______

5. Do you use a walking aid such as a cane or walker? □ Yes □ No
   If so, what do you use most often? __________________________________________
   Have you fallen while using one? When? ________________________________
   Have you fallen when you were not using one? ________________________________

6. History of Diseases: ________________________________________________________
   __________________________________________________________

7. What is your race or ethnic background?
   a. _____ White or Caucasian
   b. _____ Black or African American
   c. _____ American Indian / Alaskan Native
   d. _____ Hispanic or Latino (Mexican, Puerto Rican, Cuban, Other)
   e. _____ Asian (Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, Other)
   f. _____ Native Hawaiian and Other Pacific Islander
   g. _____ Other (specify: _________________________________________ )

8. Household Size:
   a. _____ 1 person
   b. _____ 2 people
   c. _____ 3 people
   d. _____ 4 people
   e. _____ 5 people

9. Education Level (check highest level):
   a. _____ Less than 9th grade
   c. _____ High school graduate/GED
   d. _____ Some college, no degree
   e. _____ Associated degree
   f. _____ Bachelor’s degree
   g. _____ Graduate or professional degree

10. Income:
    a. _____ $776 or less monthly
    b. _____ $1041 or less monthly
    c. _____ $1306 or less monthly
    d. _____ $1571 or less monthly
    e. _____ $1836 or less monthly
    f. _____ Annual $25,000 to $34,999
    g. _____ Annual $35,000 to $49,999
    h. _____ Annual $50,000 or greater

Emergency Contact Information
Relative / Friend: ____________________________________________________________
   (Name) ____________________ (Phone) ____________________ (Phone) ____________
# Appendix F

## Score Report Form

### Medical/Fall History

<table>
<thead>
<tr>
<th>Score Yes/no</th>
<th>Points calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>Falls 1: Have you fallen in the past 3 years</td>
<td></td>
</tr>
<tr>
<td>Yes = 3.0</td>
<td></td>
</tr>
<tr>
<td>No = 1</td>
<td></td>
</tr>
<tr>
<td>How did the fall happen? Any fractures?</td>
<td></td>
</tr>
<tr>
<td>Falls 2:</td>
<td></td>
</tr>
<tr>
<td>If yes to Falls1, were any within the past 12 months?</td>
<td></td>
</tr>
<tr>
<td>Yes = - 0.0</td>
<td></td>
</tr>
<tr>
<td>No = - 0.5</td>
<td></td>
</tr>
<tr>
<td>-How did the fall happen? Any fractures?</td>
<td></td>
</tr>
<tr>
<td>If no to Falls1, Falls2 no = 0.</td>
<td></td>
</tr>
<tr>
<td>Do you use any walking aids (cane, walker etc.)?</td>
<td></td>
</tr>
<tr>
<td>Yes = 2.6</td>
<td></td>
</tr>
<tr>
<td>No = 1</td>
<td></td>
</tr>
<tr>
<td>Do you have Arthritis</td>
<td></td>
</tr>
<tr>
<td>Yes = 2.4</td>
<td></td>
</tr>
<tr>
<td>No = 1</td>
<td></td>
</tr>
</tbody>
</table>

### Mobility/Balance

<table>
<thead>
<tr>
<th>Score</th>
<th>Points calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Reach Test (inches)</td>
<td></td>
</tr>
<tr>
<td>Get Up and Go Test score (seconds)</td>
<td></td>
</tr>
</tbody>
</table>

### Medications

<table>
<thead>
<tr>
<th>Yes/No</th>
<th>score</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Attach list of known meds. Take the greater value of the following</td>
<td></td>
</tr>
<tr>
<td>More than 4 prescription meds = 2.5</td>
<td></td>
</tr>
<tr>
<td>Psychotropic Meds = 1.9 points</td>
<td></td>
</tr>
<tr>
<td>Anti-arrhythmic Meds = 1.7 points</td>
<td></td>
</tr>
<tr>
<td>Digoxin/Lanoxin = 1.6 points</td>
<td></td>
</tr>
<tr>
<td>Diuretics = 1.1</td>
<td></td>
</tr>
<tr>
<td>None of the Above = 1</td>
<td></td>
</tr>
<tr>
<td>Have you experienced any of the following side effects due to your medications? Drowsiness, dizziness, impaired balance.</td>
<td></td>
</tr>
<tr>
<td>Yes = 1.5</td>
<td></td>
</tr>
<tr>
<td>No = 1</td>
<td></td>
</tr>
<tr>
<td>Do you fill ALL of your prescriptions at the same pharmacy or had a pharmacist review your current medications?</td>
<td></td>
</tr>
<tr>
<td>Yes = 1.0</td>
<td></td>
</tr>
<tr>
<td>No = 1.5</td>
<td></td>
</tr>
</tbody>
</table>

### Vision

<table>
<thead>
<tr>
<th>Yes/No</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you have a prescription for corrective lenses?</td>
<td>1 (always)</td>
</tr>
<tr>
<td>If yes, Do you wear your corrective lenses as prescribed?</td>
<td></td>
</tr>
<tr>
<td>Yes = 1 pts</td>
<td></td>
</tr>
<tr>
<td>No = 2 pts</td>
<td></td>
</tr>
<tr>
<td>Have you had a vision test in the past 12 months?</td>
<td></td>
</tr>
<tr>
<td>Yes = 1 pts.</td>
<td></td>
</tr>
<tr>
<td>No = 1.6 pt.</td>
<td></td>
</tr>
<tr>
<td>Date of last checkup: ____________________</td>
<td></td>
</tr>
<tr>
<td>Snellen Score w/ lenses: __________</td>
<td>calculated</td>
</tr>
</tbody>
</table>
Score Report Form
Falls Risk Screening

Name: ____________________________ Date: _____________

Do you have handrails on both sides of all stairways in your home – including the outside stairs?  "Yes"  "No"
Do the stair rails extend the full length of the stairway?  "Yes"  "No"
Are stairways well lit with lights at the top and bottom of the stairs?  "Yes"  "No"
Do you have nightlights to help light your bathrooms, bedrooms, and hallways during evening hours?  "Yes"  "No"
Are you able to turn on a light immediately upon entering a room?  "Yes"  "No"
Do you have grab bars in your bath and shower stalls as well as on the sides of the toilet? (Never use towel racks or soap dishes as grab bars, they can easily come loose, causing a fall)  "Yes"  "No"
Do you have a non-slip mat or safety decals in your bath and shower?  "Yes"  "No"
Do you remove soap build-up in the tub and shower on a regular basis to avoid slipping?  "Yes"  "No"
If you have area rugs, do they have rug-liners underneath, dual-sided tape, or non-slip backing?  "Yes"  "No"
Are your steps, landings, and floors clean of clutter? (Always keep these areas clear, and don’t forget to safely tuck telephone and electrical cords out of walkways)  "Yes"  "No"
Do you keep floors clean by promptly wiping up grease, water, and other spills?  "Yes"  "No"
Are things you use often stored on an easy-to-reach shelves, so that you don’t need to reach too high or bend too low to get them?  "Yes"  "No"

Total number of “No” responses __________

DOB / Age  ____________________________ Telephone  ____________________________

Primary Care Physician

ID _____________________________
## APPENDIX G

### FUNCTIONAL STATUS INDEX

**Functional Status Index**

*(Courtesy of Jette, 1980)*

<table>
<thead>
<tr>
<th>Activity</th>
<th>Assistance(1-5)</th>
<th>Pain(1-4)</th>
<th>Difficulty(1-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mobility</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking inside</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Climbing up stairs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rising from a chair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Personal care</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Putting on pants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buttoning a shirt/blouse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washing all parts of the body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Putting on a shirt/blouse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Home chores</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vacuuming a rug</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reaching into low cupboards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing laundry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing yardwork</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hand activities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Writing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opening a container</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dialing a phone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Social activities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performing your job</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driving a car</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attending meetings/ Appointments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visiting with friend/relatives</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTALS**
APPENDIX H

PHYSICAL ACTIVITY SCALE FOR THE ELDERLY

PASE: Physical Activity Scale for the Elderly

LEISURE TIME ACTIVITY

1. Over the past 7 days, how often did you participate in sitting activities such as reading, watching TV or doing handcrafts?

   [0.] NEVER
   [1.] SELDOM (1-2 DAYS)
   [2.] SOMETIMES (3-4 DAYS)
   [3.] OFTEN (5-7 DAYS)

   GO TO Q.#2

   1a. What were these activities?

   1b. On average, how many hours per day did you engage in these sitting activities?

      [1.] LESS THAN 1 HOUR
      [2.] 1 BUT LESS THAN 2 HOURS
      [3.] 2-4 HOURS
      [4.] MORE THAN 4 HOURS

2. Over the past 7 days, how often did you take a walk outside your home or yard for any reason? For example, for fun or exercise, walking to work, walking the dog, etc.?

   [0.] NEVER
   [1.] SELDOM (1-2 DAYS)
   [2.] SOMETIMES (3-4 DAYS)
   [3.] OFTEN (5-7 DAYS)

   GO TO Q.#3

   2a. On average, how many hours per day did you spend walking?

      [1.] LESS THAN 1 HOUR
      [2.] 1 BUT LESS THAN 2 HOURS
      [3.] 2-4 HOURS
      [4.] MORE THAN 4 HOURS
3. Over the past 7 days, how often did you engage in light sport or recreational activities such as bowling, golf with a cart, shuffleboard, fishing from a boat or pier or other similar activities?

[0.] NEVER [1.] SOMETIMES (1-2 DAYS) [2.] SOMETIMES (3-4 DAYS) [3.] OFTEN (5-7 DAYS)

GO TO Q.#4

3a. What were these activities?

3b. On average, how many hours per day did you engage in these light sport or recreational activities?

[1.] LESS THAN 1 HOUR [2.] 1 BUT LESS THAN 2 HOURS
[3.] 2-4 HOURS [4.] MORE THAN 4 HOURS

4. Over the past 7 days, how often did you engage in moderate sport and recreational activities such as doubles tennis, ballroom dancing, hunting, ice skating, golf without a cart, softball or other similar activities?

[0.] NEVER [1.] SOMETIMES (1-2 DAYS) [2.] SOMETIMES (3-4 DAYS) [3.] OFTEN (5-7 DAYS)

GO TO Q.#5

4a. What were these activities?

4b. On average, how many hours per day did you engage in these moderate sport and recreational activities?

[1.] LESS THAN 1 HOUR [2.] 1 BUT LESS THAN 2 HOURS
[3.] 2-4 HOURS [4.] MORE THAN 4 HOURS
5. Over the past 7 days, how often did you engage in strenuous sport and recreational activities such as jogging, swimming, cycling, singles tennis, aerobic dance, skiing (downhill or cross-country) or other similar activities?

[0.] NEVER
[1.] SELDOM (1-2 DAYS)
[2.] SOMETIMES (3-4 DAYS)
[3.] OFTEN (5-7 DAYS)

5a. What were these activities?

5b. On average, how many hours per day did you engage in these strenuous sport and recreational activities?

[1.] LESS THAN 1 HOUR
[2.] 1 BUT LESS THAN 2 HOURS
[3.] 2-4 HOURS
[4.] MORE THAN 4 HOURS

6. Over the past 7 days, how often did you do any exercises specifically to increase muscle strength and endurance, such as lifting weights or pushups, etc.?

[0.] NEVER
[1.] SELDOM (1-2 DAYS)
[2.] SOMETIMES (3-4 DAYS)
[3.] OFTEN (5-7 DAYS)

6a. What were these activities?

6b. On average, how many hours per day did you engage in exercises to increase muscle strength and endurance?

[1.] LESS THAN 1 HOUR
[2.] 1 BUT LESS THAN 2 HOURS
[3.] 2-4 HOURS
[4.] MORE THAN 4 HOURS
7. During the past 7 days, have you done any light housework, such as dusting or washing dishes?

[1.] NO  [2.] YES

8. During the past 7 days, have you done any heavy housework or chores, such as vacuuming, scrubbing floors, washing windows, or carrying wood?

[1.] NO  [2.] YES

9. During the past 7 days, did you engage in any of the following activities?

Please answer YES or NO for each item.

   a. Home repairs like painting, wallpapering, electrical work, etc.

   b. Lawn work or yard care, including snow or leaf removal, wood chopping, etc.

   c. Outdoor gardening

   d. Caring for an other person, such as children, dependent spouse, or an other adult

   NO  YES
   1    2
   1    2
   1    2
   1    2
WORK-RELATED ACTIVITY

10. During the past 7 days, did you work for pay or as a volunteer?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[1.] NO</td>
<td>[2.] YES</td>
</tr>
</tbody>
</table>

10a. How many hours per week did you work for pay and/or as a volunteer?

<p>| |</p>
<table>
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<tbody>
<tr>
<td>HOURS</td>
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10b. Which of the following categories best describes the amount of physical activity required on your job and/or volunteer work?

<p>| |</p>
<table>
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<tbody>
<tr>
<td>[1] Mainly sitting with slight arm movements. [Examples: office worker, watchmaker, seated assembly line worker, bus driver, etc.]</td>
</tr>
<tr>
<td>[2] Sitting or standing with some walking. [Examples: cashier, general office worker, light tool and machinery worker.]</td>
</tr>
<tr>
<td>[3] Walking, with some handling of materials generally weighing less than 50 pounds. [Examples: mailman, waiter/waitress, construction worker, heavy tool and machinery worker.]</td>
</tr>
<tr>
<td>[4] Walking and heavy manual work often requiring handling of materials weighing over 50 pounds. [Examples: lumberjack, stone mason, farm or general laborer.]</td>
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APPENDIX I
SF-36 / FUNCTIONAL STATUS INDEX INTERVIEW

LAAAP Falls and Fracture Risk in Southeast Louisiana Seniors

SF-36 and FSI Interview
<table>
<thead>
<tr>
<th>IF DID NOT PARTICIPATE (Circle one):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Deceased</td>
<td></td>
</tr>
<tr>
<td>2 Refused to participate</td>
<td>Reasons for refusal</td>
</tr>
<tr>
<td></td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>Not interested/Doesn't want to get involved       1 2</td>
</tr>
<tr>
<td></td>
<td>Sick/poor health                             1 2</td>
</tr>
<tr>
<td></td>
<td>Too busy/Takes too much time                   1 2</td>
</tr>
<tr>
<td></td>
<td>Doesn't want to give out personal information   1 2</td>
</tr>
<tr>
<td></td>
<td>Doesn’t do studies/surveys                     1 2</td>
</tr>
<tr>
<td></td>
<td>Doesn’t want to do physical assessments         1 2</td>
</tr>
<tr>
<td></td>
<td>Other                                          1 2</td>
</tr>
<tr>
<td></td>
<td>SPECIFY</td>
</tr>
<tr>
<td>3 Other person refused participation</td>
<td></td>
</tr>
<tr>
<td>4 Scheduled for return phone call</td>
<td>DATE / TIME:</td>
</tr>
<tr>
<td>5 Scheduled for interview</td>
<td>DATE / TIME/ LOCATION:</td>
</tr>
<tr>
<td>6 Not Home/ Not Available</td>
<td>DATE / TIME:</td>
</tr>
<tr>
<td>RECORD CALL ATTEMPTS</td>
<td>DATE / TIME:</td>
</tr>
<tr>
<td>7 Other</td>
<td>SPECIFY:</td>
</tr>
</tbody>
</table>
“Hello. My name is __________________. I’m calling from the Department of Kinesiology at LSU to ask some follow-up questions to the falls risk screening. May I please speak with (NAME).”

IF DECEASED, End call with the following: “I’m sorry to hear that. Thank you very much for your time.”

IF NOT HOME: “When would be a good time for me to call back?” ______________
(RECORD CALL BACK TIME ON PAGE 2)

IF ANSWERING MACHINE: HANG UP AND TRY BACK LATER, DIFFERENT TIME OF DAY. (DO NOT LEAVE NAME, MESSAGE OR ANY INFORMATION).

IF ANSWERED THE PHONE, READ: “Hello, (PARTICIPANT NAME). I’m calling to ask you some follow-up questions to the recent falls risk screening at ______ (identify their location). At the screening, you indicated that you would be willing to answer some additional questions for us, is that still the case?

IF AT HOME AND DID NOT ANSWER THE PHONE, READ THE FOLLOWING WHEN THEY GET ON THE PHONE:
“Hello, (NAME). My name is __________________. I’m calling from the Department of Kinesiology at LSU about the recent falls risk screening at ______ (identify their location). At the screening, you indicated that you would be willing to answer some additional questions for us, is that still the case?

IF YES, WILLING TO PARTICIPATE: Well, the interview will likely take about 20 minutes. Do you have time to answer these questions right now while I have you on the phone?”

IF YES: CONTINUE WITH INTERVIEW QUESTIONS. RECORD ANSWERS DIRECTLY ON QUESTIONNAIRES. REMEMBER TO RECORD PARTICIPANT ID # ON THE TOP OF EACH QUESTIONNAIRE. AT THE END OF INTERVIEW, THANK THEM FOR THEIR HELP.

IF NO: “Ok, then we’d like to set up an appointment to call you back.”

“What day and time is most convenient for an interview?”

DAY ______________

DATE __ __/____/____

TIME __ __ : __ __ AM/PM
"Thank you, again, for your time. We look forward to talking to you on (DAY, DATE, TIME). In the meantime, if you need to reach us or have any questions about the study, the interview, or this telephone call, please feel free to contact _______________."

END TELEPHONE CALL.

IF NO, NOT WILLING TO PARTICIPATE: “Would you please tell me the reason you would not like to participate?”

(Listen to reason: and respond); List
Reason _____________________________

“I understand your concerns. We are trying to better understand how to prevent falls in older adults, and would truly value any help you can provide. I want to assure you that your responses will be kept confidential, and that you can refuse to answer any question that you do not want to answer.”

“Would you be willing to participate in this interview?” Y N

IF NO CONTINUES:

“Would you prefer for us to speak with you in person?” Y N

IF YES: “Ok, then we'd like to set up an appointment to meet with you.”

“What day and time is most convenient for an interview?”

DAY ____________________________ DATE ____/__/__

TIME ____:__ AM/PM PLACE ______________________________

“Thank you, again, for your time. We look forward to meeting with you on (DAY, DATE, TIME). In the meantime, if you need to reach us or have any questions about the study, the interview, or this telephone call, please feel free to contact _______________."

IF NO CONTINUES: “If you change your mind or you would like to talk with someone about the study at another time, please call us at 225-578-9142. Thank you for your time.”

END TELEPHONE CALL.

RECORD FINAL STATUS “REFUSED” AND REASONS ON PAGE 2.
VITA

Mrs. Jennifer M. Fabre received her Bachelor of Arts in Liberal Arts and Sciences degree from Louisiana Scholars’ College at Northwestern State University in Natchitoches, Louisiana, in 1999 and received her Master of Physical Therapy degree in 2001 from Louisiana State University Health Sciences Center in Shreveport, Louisiana. Since obtaining physical therapy licensure in 2001, Mrs. Fabre joined the clinical scene to provide physical therapy and wellness services in many practice settings. In 2003, Mrs. Fabre decided to begin her doctoral studies at Louisiana State University in Baton Rouge, Louisiana. She has been an active member of the American Physical Therapy Association and Louisiana Physical Therapy Association since 1999 and began an independent practice, Therapeutic By Design Fitness and Wellness, LLC in Baton Rouge, Louisiana in 2004.

She has served as the American Physical Therapy Association and Special Olympics appointed Healthy Athletes FUNFitness Coordinator for Louisiana; American Physical Therapy Association Section on Geriatrics Wellness and Health Promotion Special Interest Group Vice-President, Nominating Committee Member, and Communications Moderator; and Louisiana Physical Therapy Association Wellness Special Interest Group Co-Chair. Mrs. Fabre serves as a mentor for many undergraduate students interested in the physical therapy field and has participated as a clinical instructor for students of the profession in hopes to encourage the growth and development of the wonderful field of physical therapy. She earned a certification as Certified Strength and Conditioning Specialist in 2003, and apart from being involved in the Louisiana Physical Therapy Association and American Physical Therapy Association Education Orthopedic, Research, and Geriatrics Sections, she maintains active memberships in the Southern Regional Education Board Doctoral Scholars Program, American College of Sports Medicine, and National Strength and Conditioning Association.
The Doctor of Philosophy degree will be conferred at the May 2009 commencement, and Mrs. Fabre will maintain her independent practice, begin her journey of professoriate, and continue providing additional clinical education following degree completion.