Fall Accidents Among the Elderly

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1 INTRODUCTION

Injuries associated with fall accidents pose a significant problem to society both in terms of human suffering and economic losses. Falls are among the most common and serious problems facing older adults, and falling is associated with considerable mortality, reduced functioning, and premature nursing home admissions. Falls generally result from an interaction of multiple and diverse risk factors and situations. This interaction is modified by age, disease, and the presence of hazards in the environment. Frequently, older people do not appreciate the seriousness of or report these problems to their physicians and, thus, the problems remain undetected until preventable injury and disability occur. Both the incidence of falls and the severity of fall-related complications rise steadily after about the age of 60. In the age group 65 and over, approximately 35 to 40% of community dwelling, generally healthy elderly persons fall annually. After the age of 75, the rates are higher (Rubenstein and Josephson 2002). Incidence rates of falls in nursing homes and hospitals are almost three times the rates for persons older than 65 years of age living in the community (1.5 falls per bed annually). Complication rates are also considerably higher, with 10 to 25% of institutional falls resulting in fracture, laceration, or the need for hospital care.

Fall-related injuries account for 6% of all medical expenditures for persons aged 65 and older in the US (Rubenstein and Powers 1999). Approximately 95% of all hip fractures in the US are the result of falling; as such, falls and hip fracture among the elderly rank as one of the most serious public health problems in the US with costs expected to exceed $43.8 billion by the year 2020 (National Center for Injury Prevention and Control 2004).

Falls are the leading cause of death from injury among people aged 65 years and older. Accidents are the fifth leading cause of death in older adults (after cardiovascular, neoplastic, cerebrovascular, and pulmonary causes) and falls constitute two thirds of these accidental deaths. The National Safety Council reported that in 2001, 15,400 Americans met their death by falling, and of these deaths, the majority (over 80%) were people over the age of 65 (National Safety Council 2002).

In addition to physical injury, falls can also have psychological and social consequences. Fear of falling and postfall anxiety syndrome are recognized as negative consequences of falls. The loss of self-confidence to ambulate safely can result in self-imposed functional limitations and can lead to total helplessness and a loss of independence.

2 ETIOLOGY AND RISK FACTORS

Even with the greater understanding of the occurrence of fall accidents among the elderly, falls continue to represent a serious problem for this age group. Falls also represent a substantial and expensive dilemma for institutional care organizations. To reduce the personal and economic losses associated with slips and falls, academic and geriatric professionals have examined risk factors related to the high occurrence of injuries and fatalities inflicted by slips and falls. A number of studies have identified risk factors for falling. These can be classified as either intrinsic (e.g. muscle weakness, poor balance, functional and cognitive impairment, visual deficits, etc.) or extrinsic (e.g. poor lighting, loose carpets, lack of bathroom safety, etc.). Most falls are precipitated by a combination of both extrinsic factors, which are believed to be contributed by environmental hazards influenced by a situation, and intrinsic factors, which are the result of a medical illness.

2.1 INTRINSIC RISK FACTORS

Intrinsic risk factors for falls generally include sensory loss or changes, syncope, hemiplegia, hypotension, cardiac problems, balance impairment, gait impairment, progressive neurological disorders, decreased range of motion and muscle strength, side effects of medications, cognitive or perceptual impairment, vertigo, or any disease state that may influence mobility. These factors usually cannot be changed, but they can be managed and controlled.

2.1.1 Musculoskeletal system

As a person ages the musculoskeletal system, responsible for balance, declines. Muscle atrophy, calcification of tendons and ligaments, and increased curvature of the spine
affect balance. Once an elderly person starts to fall it is very difficult, if not impossible, for them to stop or recover from a fall.

Profound changes in muscle properties take place as individuals age. As individuals reach their mid-twenties, physiological changes occur that affect the potential for slip and fall incidents. This is evident by the fact that isometric and isokinetic muscle strengths peak in the mid-twenties and then gradually decline. This decline accelerates after the age of 50. The changes in muscle force production and muscle strength based on effects of aging have the most influence on the initiation of slip-induced fall accidents. These same changes also play a significant role in the inability to recover from slips and falls (Bonder and Wagner 1994; Larsson 1982).

Do et al. (1982) stated that a person’s determination to react appropriately to regaining a loss of balance is based on his/her ability to generate explosive strength and control rapid, large-scale lower extremity motions. The inability of older adults to utilize their joints and extremities to counterbalance the body’s horizontal momentum during the recovery from a slip or fall, represents one hypothesis for the increased frequency of slip and falls among the elderly. Numerous studies supporting this hypothesis indicate declines in both voluntary muscle strength and rates of muscle force production increased probability of slips and falls.

2.1.2 Sensory degradation

Redfern and Schuman (1994) define postural control as the regulation of the body’s center-of-mass over its base of support. As a person ages the sensory system, responsible for postural control, declines. This decline of postural control is believed to be an integrative process associated with a greater risk of falling. Sensory inputs crucial to detecting perturbation and maintaining balance are vision, proprioception, and vestibular sensations.

Changes in vision occur with age. To see clearly, an older person needs three times the light and color contrast. This deficit in vision increases a person’s risk for falling. Consequently, objects that are not seen in poor light or are not noticed can become fall hazards.

Tinetti and Speechley (1989) state that vision is important in maintaining stability, both during standing still and while ambulating. Factors associated with stability that may be affected by age-related changes include visual acuity, adaptation to the dark, peripheral vision, contrast sensitivity, and accommodation. As a result, impairment of an older person’s use of visual reference information to detect loss of balance and recover from falls will be evident. Also, older individuals rely typically on slower (latency 120 to 200 ms) visual control of balance than on vestibular and proprioceptive control (Pytyanko et al. 1990). On the contrary, Strandberg and Lanshammar (1981) state that there is minimal time (0.1 to 0.2 s) available to attain ample frictional forces to avoid slips and falls at the heel contact phase of the gait cycle. Thus, the likelihood for slip- and fall-related accidents could be created due to visual deficits that may result in the increased time taken for the visual system to alert the central nervous system to initiate changes in posture to accommodate for a hazardous condition.

Several studies state that older adults also have significantly higher deficits in the reception of stimuli produced within the body. When an individual changes position the proprioceptive system contributes to his/her stability. The proprioceptive system contributes to stability, particularly during changes of position. Proprioceptive information also plays a vital role in modification of internal models using feedforward control mechanisms. During slip perturbation, motor programs have to be modified to maintain dynamic stability. Modification of the motor program is closely associated with visual input as well as proprioceptive input. However, in a situation where conflicting visual cues exist with the environment, proprioceptive input may be the quickest and most accurate modality associated with balance maintenance. As a result, older adults’ proprioceptive deficits may hinder optimum balance recovery during slip-induced perturbations and increase the likelihood of fall accidents.

Studies on the vestibular system indicate a marked decline in vestibular apparatus among the elderly. The major contribution of the vestibular apparatus to posture is in maintaining the whole body balance by perceiving the changes in direction as well as motion by adjusting the activity of the postural muscles. In the normal state, vestibular receptors in each labyrinth generate resting activity; subsequent head movement produces equal and opposite alteration in the activity in each ear. This in turn leads to the appropriate compensatory eye and muscle response for maintenance of posture. As indicated, the vestibular system contributes to stabilizing the eyes and head in space, but is also important during fast postural movements, such as in eliciting fall responses, and in resolving conflicting visual and proprioceptive information (Nashner 1973; 1982). As a result, older adults’ vestibular system may hinder the optimum balance recovery response and may increase the likelihood of falls among the elderly.

2.1.3 Gait adaptation

Elderly persons experience changes in gait. They do not lift up their feet as high as younger persons and therefore may not be able to swing their feet over a loose tile or a curled edge on a rug. Many orthopedic conditions can cause a person to be at a higher risk for injury from falls. Joint pain, arthritis, and osteoporosis can cause an unsteady gait that may result in falls. Amputation of a limb also results in instability in posture increasing a person’s risk. In the nursing home, the category of weakness and gait problems was the most common cause for falls.
Another aspect of older people’s gait characteristics is their tendency to walk slower resulting in a shorter step length and broader walking base. This slower walking pace also allows older adults to walk with an increase in stance time and double support time. In general, the shorter stride length, broader walking base, and the slower walking velocity are believed to result in a more stable, safer gait pattern. However, these gait changes may have some significant implications on the initiation of slip-induced falls. For example, Lockhart et al. (2003) indicated that older adults’ slower transitional acceleration characteristics of the whole body center-of-mass during gait influenced friction demand characteristics at the shoe–floor interfaces, increasing the potential to slip.

2.1.4 Nervous system
Many neurological conditions, such as Parkinson’s disease, seizure disorder, paralysis, and diabetic neuropathy affect the balance and mobility of the elderly. The stiffness and poor mobility that is characteristic of Parkinson’s disease often results in a halting gait that can lead to falls. Seizure disorder is uncontrolled seizures that are often the cause of serious falls as a person loses consciousness. Paralysis on one side of the body, due to hemiplegia/hemiparesis can cause functional instability. Falls can occur as the person overcompensates for this loss of function. Diabetic neuropathy is very common in the elderly and causes a loss of feeling in the extremities. This loss of feeling can result in a loss of balance, coordination, and sensitivity in the lower extremities. All this adds up to an increased fall risk.

2.1.5 Cognition
With longer life expectancy, an increasing number of older adults experience cognitive impairments and dementia. Older adults with dementia fall twice as often as older adults without cognitive impairment. Studies suggest that impaired gait characteristics and balance profiles were major contributing factors for the higher fall rates of persons with dementia. The problem is quite prevalent as the elderly with an odd gait were three and a half times more likely to possess characteristics of dementia, and experience more fall accidents than the elderly without an odd gait and dementia (Lockhart et al.). Furthermore, persons with poor cognition may make poor decisions, misperceive danger or place themselves in dangerous situations that can result in falls.

2.1.6 Cardiac system
Several physiological changes take place in the cardiovascular system that predisposes the elderly to low blood pressure (hypotension) and irregular heart beats (dysrhythmia). The systems that are sensitive to changes in blood pressure do not function as well as we get older. This may result in increased episodes of dizziness and vertigo, which can cause a person to fall.

2.1.7 Genitourinary system
Incontinent episodes are one of the leading causes of falls. Often a person slips on the floor after having an incontinent episode or falls trying to get to the bathroom in an attempt to avoid an incontinent episode.

2.1.8 Medications
One of the most important factors causing falls in the elderly is the use of medications. As the body ages, it becomes less efficient at handling many drugs. This inefficiency causes an adverse drug reaction, and can impair stability, and gait.

Strong association between psychotropic medication use (i.e. neuroleptics, benzodiazepines, and antidepressants) and falls have been reported. These medications can cause an older person to become dizzy or light-headed and are among the medications that cause the greatest risk for falls. Especially important are agents with sedative, antidepressant, psychotropic, and antihypertensive effects, particularly diuretics, vasodilators, and beta-blockers. Diuretics may cause fatigue, volume depletion, or electrolyte disturbance. Antihypertensive agents may impair alertness or cause postural hypertension or fatigue. Sedatives such as benzodiazepines, phenothiazines, and antidepressants appear to predispose the elderly to falling independently of the effects of dementia or depression, the diseases for which these drugs are most commonly used in the elderly. Specific classes of medications found to increase the risk of falling in nursing home residents include psychotropic drugs, sedatives, cardiac drugs, and nonsteroidal antiinflammatory drugs (Rubenstein et al. 1996). The fall risk is increased the more medications a person takes and increases greatly when a person is taking five or more medications.

2.1.9 History of falls
Once an elderly person falls, he or she is two to three times more likely to fall again within a year. Thus, a history of falls is often a predictor of future falls. The influence on the history of an individual’s falls on subsequent falls has been given minimal emphasis although it is consistently one of the strongest risk factors reported, particularly in studies conducted in long-term settings.

Experiencing a fall can have far more repercussions than just a physical injury. The fear of future falls and a reduced level of personal confidence may cause a reduced level of independence, isolation, lower levels of social contact, and depression. A fall event may initiate the cascade of decreased mobility, decreased activities of daily living, decreased body system functioning, and increased susceptibility to disease in the elderly. The causes and results of falls are cyclical in nature, whereby the fall leads to restriction of activity, loss of autonomy and self-confidence, depression and anxiety, deconditioning, possible prescription of psychoactive drugs, subsequently placing the individual at increased risk of falling. This may explain the increased risk of a fall in individuals who have had a past history of falls.
2.1.10 Other intrinsic factors
Acute conditions such as influenza, urinary infections, and pneumonia can cause hypotension, syncope, and electrolyte imbalance resulting in weakness. Any condition that causes an elevated temperature may also cause weakness and falls.

2.2 EXTRINSIC OR EXTERNAL RISK FACTORS
The second category of fall risk is extrinsic or external risk factors. Extrinsic factors involve the environment surrounding the person, such as placement of furniture, existence of obstacles, use of assisting walking devices, lighting, stairs, or any other object in the person’s environment that may put them at risk for falls. These factors can be adjusted, thereby decreasing fall risk.

2.2.1 Environmental
Forty percent of the falls in the elderly population involve environmental hazards (Acello 2001). Many factors in the environment can increase a person’s risk for falls. Glare on the floor, loose rugs, patterned carpets, and slippery floors are problems for older adults who have poor eyesight and are unable to recognize these hazards quickly. Also, improper footwear can cause falls. If the sole of the shoe is too thick it will not allow the person to “feel” the surface beneath their foot; as such, shoes should have nonslip soles but still allow a good base of support.

2.2.2 Appliances/devices
Various appliance and devices utilized by elderly nursing home residents can increase their risk for falling. The use of canes, walkers, and crutches increase the risk for falls if used improperly. These appliances can get caught on loose rugs or small elevations on the floor surface and cause a person to fall. Periods of lightheadedness or dizziness can occur due to irregular heartbeats caused by a malfunctioning pacemaker. Also, restraints and devices improperly used can be the cause of serious falls. Whenever possible, alternative interventions should be used. A mat on the floor with a lower bed is much safer for residents then side rails, which may cause injury if residents crawl over or fall through them attempting to get up. Bed and chair alarms are a safe and excellent way to monitor residents who are at risk for falls.

3 PREVENTION
There may be simple measures that could reduce the incidence of falls without the need for physical restraints, sedation, excessive supervision, or other measures that undermine an individual’s dignity and independence. Various researchers have identified risk factors that have a potential to predict falls in the elderly population, thus suggesting preventability.

As suggested, unstable dynamic postural control and poor gait dynamics negatively influence the likelihood of falls among older adults. Therefore, in efforts to improve unstable dynamic postural control and poor gait dynamics, strength and balance training have been proposed and implemented to reduce the likelihood of falls among the elderly. Currently, most interventions to minimize fall accidents among older adults have been focused on the improvement of lower extremity strength and balance. An exercise training program is found to be effective in lessening the degeneration of physical capability, contributing to a reduction in fall rates. Advantages of strength and balance training among older adults are that it plays a significant role in improving neural recruitment patterns resulting in strength gain. Moreover, strength gain by exercise training plays a role in the improved coordination of other fixator muscles necessary for body support while performing daily tasks such as cooking, gardening, and walking. Simply, the strength gains due to exercise training result in improving postural control while performing daily tasks. This improvement will eventually lead to a reduction in fear of falling and an improvement in social interactions among older adults, ultimately reducing fall accidents.

Research on the occurrence of resident falls indicates that the implementation of a falls prevention program can reduce the frequency of falls (Ruckstuhl et al. 1991). Fall prevention programs consisting of a fall assessment tool is essential to the provision of holistic care for older adults. Since normal and pathological changes, which are common in aging, contribute to falls, the assessment of residents to identify those at risk of falling by the use of risk-assessment tools has been suggested as a successful means of managing the issue. The use of risk-assessment tools has been successful in studies claiming a reduction in the incidence of falls (Kinn and Hood 2001). Cannard (1996) developed a risk-assessment tool for use with older adults. The approach is to select individuals at high risk and target prevention strategies. The scale was found to be effective in predicting the likelihood of falling, although no detail was given about how the risk factors, scores, or weightings were determined (Kinn and Hood 2001). Studies have identified a 60% reduction in falls following the introduction of fall risk evaluation forms and educational programs for both staff and residents.

Studies have shown a direct relation between the total number of medications used and the risk of falling (Tinetti et al. 1986). Although there are no randomized, controlled studies of manipulation of medication as a sole intervention, reduction of medications was a prominent component of effective fall-reducing interventions in community-based and long-term care multifactorial studies. Multifactorial studies suggest that a reduction in the number of medications in patients taking more than four preparations is beneficial (Lundebjerg 2001).

The majority of fall accidents among the elderly occur around their homes. As such, reducing environmental
hazards (tripping, slipping, stair railings, grab bars, unstable furniture, poor lighting, etc.) in their home can reduce fall accidents.

REFERENCES


TINETTI, M., WILLIAMS, T. and MAYEWSKI, R., 1986, Fall risk index for elderly patients based on the number of chronic disabilities. American Journal of Medicine, 80, 429–34.

AUTHOR QUERIES

AQ1: In the section Sensory degradation should one of the following sentences be deleted or altered as they both say the same thing more or less “When an individual changes position the proprioceptive system contributes to his/her stability. The proprioceptive system contributes to stability, particularly during changes of position”

AQ2: Please add the citation ‘Nashner 1973” in the reference list.

AQ3: Please update reference “Lockhart et al”.

AQ4: In the text Rubenstein et al. 1996 are cited but in the reference list Bedsine is named as the first author.

AQ5: Please cite references “Centre for Disease Control 2000; Gronqvist et al. 2001; Woolacott et al. 1982” in the text.

AQ6: Please update the reference “Gronquist et al. 2001”.

AQ7: Is it possible to replace the references Lundebjerg 2001 unpublished and Rubenstein and Powers with published references

AQ8: Please update the reference “Rubenstein and Josephson, 2002” in press.