Evaluating Fall Risk in Older Adults: Steps and Missteps

Tamar C. Rubinstein, MSc, Neil B. Alexander, MD, and Jeffrey M. Hausdorff, PhD

Educational Objectives

1. To understand the factors that contribute to falls in older adults
2. To underscore the importance of asking about a history of falls
3. To describe how to evaluate fall risk in an office setting
4. To outline steps that can be taken to reduce fall risk and minimize future falls

During an office visit, health care professionals routinely ask older adults to roll up their sleeves to measure their blood pressure. It is much less common, however, to evaluate for fall risk, to provide preventive strategies, or to ask about any history of falls.1 Yet, falls in older adults are a major public health problem with serious medical and economic consequences.2-4 Falls occur annually in approximately 35% of community-dwelling elderly and are even more frequent among nursing home residents and hospitalized patients.5 Depending on the published series, between 10-16% of falls result in serious injuries, of which about 5% are fractures.6-9 In fact, in Finland, falls recently replaced traffic accidents as the leading cause of serious injuries.10 Other injuries include head trauma, soft-tissue injuries, and lacerations.11 Even falls that do not result in injury may have significant consequences. The fear of another fall can cause a loss of confidence and self-esteem, leading many elderly to impose restrictions on their own mobility.12,13 Decreased activity can lead to a vicious cycle of increased joint stiffness, weakness, and frailty, which further compromises mobility.13 It is not uncommon that fear of falling and self-
imposed mobility restrictions lead to nursing home admission and a further loss of independence and function.\(^9,12\) Failure to evaluate fall risk is a major “misstep” in the treatment of older adults. This failure may be the result of misconceptions including that falls are an inevitable part of aging; there are no simple steps for evaluation of fall risk; and evaluation is pointless because little is known about how to reduce fall risk. Recent findings suggest that fall risk factors are less likely to be a direct result of the aging process but instead are associated with specific disease-related factors that become more prevalent with age.\(^14\) To provide a basis for fall management, this article reviews fall risk factors and provides recommendations for evaluating and reducing fall risk. By identifying those older adults who have specific, often treatable fall risk factors, it is possible to recommend preventive strategies, reduce the number of falls, and thus maximize the function and independence of older adults.

### ETIOLOGY OF FALLING

A number of factors can contribute to a fall. There is often a complex interaction between individual impairments (intrinsic factors) and environmental demands and hazards (extrinsic factors). In addition, aspects related to the action being performed (situational factors) are important considerations when determining what caused a fall.\(^15,16\) For example, an older woman with osteoarthritis and Parkinson’s disease (intrinsic factors) may trip over a rug (extrinsic factor) but only under certain conditions, such as walking to the bathroom at night (situational factors).\(^13\) It is often not easy to attribute a fall to any one particular factor. Whereas environmental and situational factors are often implicated in falls among those with intrinsic risk factors, the same environmental and situational risk factors might not cause a fall in a healthier person.

Intrinsic factors include age-associated and disease-related changes in central processing (dementia), neuromotor function (Parkinson’s, stroke, myelopathy, cerebellar degeneration, carotid sinus hypersensitivity, peripheral neuropathy, vertebrobasilar insufficiency), vision (cataracts, glaucoma, macular degeneration), vestibular function (acute labyrinthitis, Meniere’s disease, vertigo), proprioception (peripheral neuropathy, \(B_{12}\) deficiency), musculoskeletal function (arthritis, foot disorders), and systemic function (postural hypotension, metabolic and cardiopulmonary diseases, acute illnesses such as sepsis). These include muscle weakness, gait and balance disorders, and sensory or visual deficits. It is notable that although age-associated changes contribute to intrinsic risk factors, often the major contributors to fall risk are the underlying diseases that influence each factor.
Other factors are medication and the environment. Medication can cause falls by reducing alertness, slowing central processing, and impairing cerebral perfusion. In addition, some medications may cause direct vestibular toxicity or extrapyramidal syndromes (Table 1). Environmental or extrinsic factors can be divided into persistent hazards and variable hazards. Persistent hazards, such as flooring, tripping hazards, and stairways, are relatively easy to quantify and modify, whereas variable hazards, such as lighting and weather conditions, change frequently, which makes direct measurement and adaptation more difficult.17

Situational factors can include a combination of the type of task and the circumstances under which it is being performed. For example, tasks that require greater postural control (such as reaching for a high shelf) or situations that require changing positions (sitting to standing, or transferring to or from a bed or wheelchair) increase the risk of falling. Awareness of the increased risks involved in certain tasks is an important step toward appropriate behavior modification and fall risk reduction.

IDENTIFYING SPECIFIC RISK FACTORS FOR FALLING

It can be difficult to accurately evaluate fall risk factors, because of the many variables associated with falls and fallers. Fall risk factors vary depending on the type of faller (recurrent vs. one-time faller, independently mobile vs. disabled faller, community-living vs. nursing home resident) and the type of fall (injurious vs. non-injurious falls, or falls caused by intrinsic factors vs. falls caused by extrinsic factors).

The relative contribution of intrinsic, extrinsic, and situational risk factors depends to a large degree on the functional ability and living environment of the faller. Community-dwelling fallers tend to be exposed to greater environmental demands and hazards, and tend to be less physically impaired; thus, it might be expected that extrinsic factors make a larger contribution to fall and fall injury risk. Nursing home fallers are usually more physically impaired and are exposed to less environmental hazards and demands; thus, intrinsic factors such as weakness and balance disorders would likely make a larger contribution to fall risk and fall injury in this group. In an analysis by Rubenstein et al,11 the two primary causes of falls in older adults living in a nursing home or board and care facility were gait/balance disorders and weakness, which accounted for 26% of falls and dizziness or vertigo, which accounted for 25% of falls. Accident or environment-related factors were responsible for 16% of falls. In contrast, by far the most common causes of falls among community dwellers were accident or environment-related factors, which were responsible for 41% of all falls. Gait/balance disorders or weakness and drop attacks were each responsible for 13% of falls, and dizziness or vertigo for 8% of falls.

A recent analysis of 16 different studies that evaluated for fall risk factors calculated the relative risk (RR) of falling for persons with each of the risk factors examined.18 The top five risk factors were muscle weakness (RR, 4.4), history of falls (RR, 3.0), gait deficits (RR, 2.9), balance deficits (RR, 2.9), and use of assistive devices (RR, 2.6). Other risk factors that have been identified include visual deficits, arthritis, impaired activities of daily living, depression, cognitive impairment, and age older than 80 years.18

A number of medications have been associated with an increased risk of falling, although it is sometimes difficult to know if the medication itself is causing the fall or if the underlying disease for which the medication has been prescribed is responsible.19-21 A meta-analysis of studies evaluating the effects of various drugs on falls in older persons found a small but consistent increased risk of falling in those on psychotropic medication...
EVALUATING FALL RISK

People who reported using more than three medications of any type were at increased risk of recurrent falls. This, however, may be a reflection of the multiplicity of the underlying diseases, as opposed to a direct result of the medications.

In addition to identifying the individual risk factors associated with falling, it is important to recognize the interaction that exists between the various risk factors. Several studies have shown that the risk of falling increases significantly as the number of risk factors a person has increases. This is most likely due to the fact that falling often results from the combined effect of multiple disabilities. For example, in one study, the risk of falling increased from 8% in persons with no risk factors, to 78% in persons with four or more risk factors.

EVALUATING FALL RISK

The primary goal of fall risk evaluation is to identify individuals with an increased risk of falling so that steps can be taken to reduce this risk via appropriate interventions. In order to balance the benefits of assessment and intervention with the accompanying increase in cost and time, it is necessary first to identify those individuals who have an exacerbated fall risk. Once these individuals have been identified, they can be evaluated to determine specific risk factors and appropriate interventions can be implemented. There are some simple steps that can be taken, as part of a physician’s routine care for older persons, to identify those persons who have an increased risk, noting that referral to a specialist, such as a geriatrician or physical therapist, may sometimes be necessary. In addition, there are several fall risk assessment batteries that can be useful for simply and quickly identifying those persons who are at a high risk for falling.

PHYSICIAN’S EVALUATION

Step 1: Initial screening: Fall history.

A history of previous falls provides important predictive information about future falls. Fall history can be obtained easily and quickly. A history of falls should be taken at least once a year for all elderly persons (over 65) during their routine check-up. If one or more falls are reported, a more thorough evaluation should be performed (see Step 3). It is worth mentioning, however, that others take a slightly less aggressive approach, recommending a full fall evaluation only if two or more falls are reported in the history, or the subject demonstrates difficulty with gait or balance and any fall history. These guidelines note, however, that when implementing their guideline within a local setting, it is necessary to consider the costs of increased assessment vs. the benefits of broad range screening.


If no falls are reported, there are several short, easy-to-implement tests that can performed to identify non-fallers who need further evaluation. One simple and quick option is the Timed Get Up and Go test. In this test, the person is observed as they stand up from a straight backed chair without using their arms, walk 3 meters, turn around, and return to their original sitting position in the chair. Patients who have difficulty performing this test (require more than 13.5 seconds) should undergo a more thorough fall evaluation (Step 3).

Step 3: Fall evaluation: History.

Fall circumstances are examined in the history, including when, where, and how did the fall occur (explore associated movements/activities that may have elicited the fall); were environmental hazards involved; and did the patient experience any premonitory or associated symptoms such as palpitations, chest pain,
EVALUATING FALL RISK

Medical background. A review of past and present medical problems should be done in each patient. There should also be a complete assessment of medication usage.

Physical examination. Physical examination of the patient should include checking for acute illness, such as infection, dehydration and anemia; evaluating visual acuity and hearing ability; and performing a complete assessment of the cardiovascular, musculoskeletal, and neurological systems.

Assessment of the cardiovascular system involves assessing the heart rate and rhythm; measuring supine and standing blood pressure and pulse; checking for arrhythmias, valvular heart disease, and acute cardiopulmonary disorder; and evaluating heart rate and blood pressure response to carotid sinus stimulation.\(^1\)

For the musculoskeletal system, the clinician should examine neck, spine, and extremities for deformities; check for pain or limitations in range of motion; and evaluate lower extremity joint function.

Finally, assessment of the neurological system includes assessing strength and tone; sensation (including proprioception); coordination (cerebellar function); balance (Romberg, one-legged stance); gait (note that when checking balance and gait, it may be useful to observe the response to more challenging tasks, for example, tandem walking and/or rapid stepping abilities\(^3\)); and mental status.

Findings that point to undiagnosed or untreated medical illness that may be amenable to treatment should be referred to the appropriate specialist or therapist.

FALL RISK ASSESSMENT BATTERIES

In a recent survey of doctors with private independent patients, 97% reportedly did not use any type of formal screening test.\(^1\) However, screening tests may be used to provide a quick and simple way of identifying those at high risk of falling.\(^7\) These tests are generally designed for a specific population, such as nursing home residents. Because every subgroup of fallers (and falls) has different fall risk factors, these tests cannot be accurately used on a population for which they have not been specifically designed.

A variety of screening tests are now available to identify fall risk in different populations, including the Mobility Interaction Fall chart,\(^3\) the Elderly Fall Screening Test (EFST),\(^3\) and the St. Thomas’s Risk Assessment Tool In Falling Elderly Inpatients (STRATIFY).\(^3\) Generally, these tests check for a few prominent intrinsic risk factors (such as medication usage, gait disturbances, dementia, and visual impairment) with points being given for each risk factor present. Other tests assess the home environment for presence of extrinsic hazards, with points being given for each home safety hazard present.\(^3\) Then, a cut-off score is chosen, and anyone who scores above the cut-off is classified as high risk. To choose the correct cut-off score, a balance must be achieved between specificity and sensitivity. Depending on what the practical implications are of being classified as high risk, the cut-off score can be adjusted to achieve either greater specificity or greater sensitivity. Table II lists some of the tests currently available for screening different populations.\(^22,28,29,32-46\)

FALL PREVENTION AND TREATMENT

Once a person has been identified at high risk for falling, the more difficult task of trying to prevent future falls begins. Because of the multi-factorial nature of falls, it is difficult to identify any one method of fall
It is often difficult to ensure patient compliance, particularly when dealing with cognitively impaired persons. Investigations in this area are extremely diverse, with variations in the populations studied (ranging from fit non-fallers to disabled recurrent fallers), the outcome measures used (number of falls during a given follow-up period or time to the first fall event), and the methods for documenting outcome measures (ranging from daily calendar recordings to a single telephone interview at end of the intervention). Interventions to prevent falls are designed to eliminate or decrease intrinsic or extrinsic risk factors. Often, greatest efficacy is achieved when the intervention is tailored to the individual (eg, by reviewing results of Step 3 above).

Interventions that deal with intrinsic factors generally focus on decreasing disease-related impairment, if possible. For example, visual problems can often be corrected or modified, for example, cataracts can be extracted; and certain neuromotor diseases can be improved with drugs, for example, Parkinson’s disease can be treated with dopaminergic drugs. Other intrinsic risk factors, however, such as cognitive impairment or peripheral neuropathy from diabetes, are generally less reversible. When it is not possible to correct or improve the underlying disease, physical therapy or exercise programs may be helpful in dealing with symptoms of the disease, such as muscle weakness, gait instability, and balance problems. Exercise has many proven benefits and appears to

### TABLE II

<table>
<thead>
<tr>
<th>Title</th>
<th>Populations Tested</th>
<th>Items Evaluated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berg Balance Test</td>
<td>Outpatient, after cerebrovascular accident</td>
<td>Balance, gait</td>
</tr>
<tr>
<td>Elderly Fall Screening Test</td>
<td>Outpatient</td>
<td>Fall history, injurious falls and near falls, gait</td>
</tr>
<tr>
<td>Dynamic Gait Index</td>
<td>Outpatients with vestibular disorders</td>
<td>Fall history, gait</td>
</tr>
<tr>
<td>Fall-risk Screening Test</td>
<td>Outpatient</td>
<td>Fall history, urinary incontinence, vision, use of benzodiazepines, functional limitations</td>
</tr>
<tr>
<td>History and mobility index</td>
<td>Outpatient</td>
<td>Fall history, balance difficulty or dizziness, mobility difficulty</td>
</tr>
<tr>
<td>Modified Gait Abnormality Rating Scale</td>
<td>Outpatient</td>
<td>History of falls, gait</td>
</tr>
<tr>
<td>Mobility Interaction Fall chart</td>
<td>Residential care</td>
<td>Independent walking ability, mobility, ability to carry a glass of water while walking, vision, concentration</td>
</tr>
<tr>
<td>Performance Oriented Mobility Assessment (POMA)</td>
<td>Inpatient, outpatient</td>
<td>Multiple domains of physical function including gait, stair climbing, and simulated activities of daily living</td>
</tr>
<tr>
<td>Physical Performance Test</td>
<td>Outpatient</td>
<td>Vision, peripheral sensation, quadriceps strength, reaction time, sway, mental status, psychoactive drug use, gait, palpitations</td>
</tr>
<tr>
<td>Simple physiologic and clinical test for prediction of falling in older people</td>
<td>Outpatient</td>
<td>Mental status, nurse-administered judgments about behavior, transferring, etc.</td>
</tr>
<tr>
<td>STRATIFY</td>
<td>Inpatient</td>
<td>Rise from chair, gait</td>
</tr>
<tr>
<td>Timed Up and Go</td>
<td>Outpatient</td>
<td></td>
</tr>
</tbody>
</table>

Over the years, many tests have been used to evaluate fall risk. This list is not exhaustive but illustrates components commonly used. The POMA is one of the oldest formal tools designed to assess fall risk and is widely used. The Timed Up and Go is also frequently used. It is a very simple, easy-to-use, and quick screen for lower-extremity impairment and fall risk.
help reduce fall risk; however, the optimal type, duration, and intensity of exercise that is best to prevent falls remains uncertain.\textsuperscript{18,47,51} Balance training, such as Tai Chi, appears to be a promising option, but further evaluation is required before it can be unequivocally recommended.\textsuperscript{52-55} Individually tailored exercise programs such as progressive muscle strengthening, are apparently more effective than group exercise interventions.\textsuperscript{56} One consideration when evaluating exercise programs for prevention of falls is that increased physical activity, although it improves functioning and quality of life, also increases the opportunity for falls to occur.

Interventions that deal with extrinsic factors focus primarily on decreasing environmental demand and hazards. Examples include improving lighting, adding grab bars, raising the toilet seat, and finding an appropriate bed height. Although commonly attempted, it is not clear how effective these environmental interventions are in ultimately reducing falls, perhaps due to the difficulty in ensuring patient compliance to these interventions and the complexity of fall causation.\textsuperscript{17,57} Interventions targeting environmental hazards should be combined with other intrinsic interventions.

Adjusting medication dosages and/or eliminating or replacing certain types of medication is another key step to fall prevention, with particular attention being given to older persons taking four or more medications and to those taking psychotropic medications.\textsuperscript{18,21,58} In addition, drugs that cause postural hypotension or have sedative effects should be avoided when possible. However, it has been noted that patients are sometimes reluctant to comply with medication changes, especially with respect to psychotropic medications.\textsuperscript{56,59}

Multi-factorial intervention programs that combine a variety of medical, rehabilitative, and environmental strategies have generally been most effective in decreasing fall risk.\textsuperscript{56,60} This reflects the fact that many falls have multiple causal factors and are therefore best targeted by a multi-disciplinary approach. According to recently published guidelines,\textsuperscript{18} multi-factorial interventions among community-dwelling older persons should include: gait training; advice on appropriate use of assistive devices; review and modification of medication usage, especially psychotropic medications; exercise programs with balance training as one of the components; treatment of postural hypotension; modification of environmental hazards; and treatment of cardiovascular disorders. Unfortunately, this type of approach may often be expensive and difficult to implement.

A number of other potential interventions have not been proven to be beneficial on their own in preventing falls, but have been included in successful multi-factorial intervention programs. Assistive devices such as walkers or canes can provide stability and confidence for persons with balance and gait difficulties. Behavioral and educational programs can highlight unsafe behavior and teach safer methods of performing everyday activities. It is also important to educate fallers about what to do in case they do fall and cannot get up. Turning from the supine position to the prone position and crawling to a strong support surface before pulling oneself up can help. Frequent contact with family or friends, a phone that is reachable from the floor, or a remote alarm system can decrease the likelihood of an older person lying on the floor for a prolonged period.

Finally, because much of the suffering, functional deterioration, and health care costs associated with falling are caused by falls resulting in serious injuries, it may be helpful to try to prevent these injuries. The risk of sustaining a fracture as the result of a fall is greater in persons with a low body mass index, decreased bone density, and osteoporosis. If these risk factors can be decreased or eliminated (eg, with proper nutrition, hormone replacement therapy, bisphosphonates), then the chances of a fracture
occurring also decrease, even if a fall does occur. Protective padding worn over the hip has also been shown to significantly reduce the risk of sustaining a hip fracture, although patient compliance is often an issue.61

SUMMARY

We have reviewed the intrinsic, extrinsic, and situation- al factors that contribute to the etiology of falls and outlined the risk factors associated with fallers and falls. We also provided some guidelines on how to evaluate fall risk and preventive strategies for diminishing fall occurrence. It is important to note that the fall risk interventions have varying levels of effectiveness and that it may not be possible to completely eliminate falls or prevent injury.62 However, given that about two-thirds of older adults living in the community do not fall in any given year, falls in older adults should not be considered an inevitable part of aging, but a sign that something is amiss. Steps should be taken to reduce the number of fall risk factors and thus minimize the occurrence of falls and fall-related injuries. Further work is needed to develop the most simple-to-use, sensitive, and specific tests of fall risk and to find optimal treatment strategies for those at high risk.47,49,62-64 In the meantime, clinicians should choose a screening test that is appropriate for their setting and patient population (Table II) and utilize the guidelines outlined herein and elsewhere18,65 to evaluate fall risk and reduce the risk of future falls.

REFERENCES

EVALUATING FALL RISK


DISCLOSURE STATEMENT

As a sponsor accredited by the Accreditation Council for Continuing Medical Education (ACCME), it is the policy of Johns Hopkins University School of Medicine to require the disclosure of the existence of any significant financial interest or any other relationship a faculty member or sponsor has with the manufacturer(s) of any commercial product(s) discussed in an educational presentation. The presenting faculty reported the following: Dr. Hausdorff has disclosed that he has received grant/research support from the National Institutes of Health. Dr. Alexander and Ms. Rubinstein have indicated that they have not received financial support for consultation, research or evaluation or have a financial interest relevant to this article.

DISCLAIMER STATEMENT

The opinions and recommendations expressed by faculty and other experts whose input is included in this program are their own. This enduring material is produced for educational purposes only. Use of Johns Hopkins University School of Medicine name implies review of educational format design and approach.