Approximately 30% of older adults fall at least once per year, with falls being the leading cause of fatal and nonfatal injuries for individuals in this age group. Because of projected increases in the older adult population, the annual cost of fatal and nonfatal fall-related injuries is estimated to reach $32.4 billion in 2020. Falls in older adults are likely due to an interaction of multiple risk factors, including vitamin D deficiency, diminished strength and coordination, depression, multiple medications, and home hazards. Ultimately, the evidence supports a multifaceted approach to screening for fall-related risk factors and targeting treatment to address specific risks for each patient. While keeping in mind that the patient is the product of the dynamic interaction of body, mind, and spirit, the osteopathic physician is well suited to provide comprehensive, patient-centered care.

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Vitamin D supplementation can reduce the risk of falling by improving muscle strength and balance.

Musculoskeletal System
Vitamin D
The musculoskeletal system is a logical place to start when identifying fall-related risk factors in older adults and instituting appropriate management to reduce the risk of falling. It is well known that individuals with osteopenia or osteoporosis are more likely to sustain fractures after a fall, particularly of the hip and wrist. It has also been demonstrated that vitamin D deficiency is fairly prevalent in older adults, with an estimated 40% of older adults who have never sustained a fall and 70% of older adults who have sustained a fall having insufficient levels of vitamin D.7 Therefore, it comes as no surprise that the medical literature supports the use of vitamin D in the prevention of falls and fall-related injuries such as fracture.8

Interestingly, vitamin D supplementation (eg, ergocalciferol) helps prevent falls not only because of its effect on bone density and the regulation of calcium and phosphate metabolism, but also because of its effect on muscle and nervous system function. Visser et al9 described how low 25-hydroxycholecalciferol and high parathyroid hormone levels increase the risk of sarcopenia in individuals older than 65 years. One study demonstrated that vitamin D supplementation improves muscle strength and postural equilibrium, which may in turn reduce the risk of falling.10 Another study11 followed 242 independent community-dwelling adults aged 70 years or older who received 800 IU of vitamin D plus 1000 mg of calcium daily during a 12-month period. The number of individuals with first falls decreased 27% at month 12 and 39% at month 20. The treatment group was also found to have statistically significantly higher isometric leg extensor strength after treatment, as well as decreased postural sway and improved performance on the timed “Get-Up and Go” test, a validated measurement tool for mobility.12

Osteopathic physicians should consider vitamin D and its effect on the musculoskeletal and nervous systems when treating older adults. It is recommended that elderly patients receive at least 700 to 800 IU of vitamin D daily along with calcium supplementation.13 Although this is an approximate value, it is ultimately helpful to assess 25-hydroxycholecalciferol levels and dose vitamin D appropriately. The literature suggests that concentrations of at least 60 nmol/L are required for fall prevention and mean levels of approximately 75 to 100 nmol/L for optimal fracture prevention.14

Strength and Balance Control
In addition to vitamin D supplementation, evidence supports the use of exercise to reduce fall rates in older adults. A systematic review and meta-analysis by Sherrington et al15 that included 44 trials involving 9603 participants showed an overall reduction in the fall rate by 17% with the implementation of an exercise program. The study also demonstrated that exercise dose and balance training are important factors in determining the efficacy of an exercise program. Exercise interventions lower fall rates among older adults only when at least 50 hours of training have been completed.16 Similarly, weight-bearing activities that are performed with minimal support, including walking with a narrow base of support or on a variety of terrains, improve balance and result in improved fall-related outcomes.17

A variety of exercise programs exist, including programs that target resistance and strength training (eg, physical therapy) and programs that incorporate coordinated movement of the body’s center of gravity and limbs (eg, the Chinese martial art of tai chi).

Given the fact that exercise reduces falls in older adults,17...
it is important for physicians to assess a patient’s motor strength and coordination to institute an exercise program that incorporates both the appropriate amount and appropriate type of exercise. What is appropriate for one patient may be inappropriate or even harmful for another patient. For example, a walking program for an older adult at low risk for falls might improve his or her strength, endurance, and cardiovascular system function. However, for a frail older adult at high risk for falls, a walking program might increase his or her risk of falls and fall-related injuries. Table 1 defines levels of fall risk and shows the types of exercises that may be most appropriate for an older adult based on his or her risk level.

**Somatic Dysfunction and OMT**

To my knowledge, to date no research has specifically examined somatic dysfunction and its effect on balance control and falls. However, it seems logical that an older adult with restricted motion would have a higher likelihood of falling, especially if he or she had other risk factors such as decreased strength and coordination. Some small pilot studies have looked at the impact of OMT in conditions such as Parkinson disease and vertigo, which are prevalent in older adults and can be a precipitating factor for falls. 18-20

Parkinson disease is a neurodegenerative disorder that involves the loss of dopaminergic nigrostriatal function and extrapyramidal motor dysfunction. It is the second most prevalent neurodegenerative disease in North America, and in spite of the fact that longevity has been improved with dopamine replacement, individuals with Parkinson disease still have a higher mortality rate and an increased incidence of falls than those in the general population.18,19 In fact, individuals with Parkinson disease are 5 times more likely to have fall-related injuries.18,19 For this reason, gait and mobility-related measures have been the focus of at least 1 study20 that examined potential predictors of falls and efficacy of treatment strategies for patients with Parkinson disease.

Impaired components of gait, such as step length, height, and balance, including postural sway in the anterior-posterior direction, have been shown to be predictors of falls.20 One study21 involving 28 participants looked at the impact of OMT on stride length, cadence, and extremity velocity in patients with Parkinson disease. Patients in the treatment group received a single session of OMT that consisted of the standardized application of 14 techniques, including myofascial release, muscle energy, articulatory, and occipitoatlantal joint release. Compared with healthy patients who received OMT and patients with Parkinson disease who received sham treatment, the patients with Parkinson disease who received OMT demonstrated a statistically significant improvement in their parameters of gait.21

Another study of 18 participants that examined the potential effect of OMT on patients with dizziness and vertigo revealed a statistically significant change in pre- and posttreatment Dizziness Handicap Inventory results, suggesting that OMT may be effective in reducing dizziness and improving balance.22 This finding may be clinically relevant because older adults with vertigo have a greater incidence of falls, and impaired balance is an independent risk factor for falling.23

One of the tenets of osteopathic medicine is the interrelationship of structure and function. Alteration of structure by somatic dysfunction, whether it is primary in nature or secondary to a condition such as Parkinson disease or vertigo, can result in impaired function and predispose an individual to fall. By treating somatic dysfunction, osteopathic physicians can help restore symmetry and range of motion in older adults and ideally reduce the risk for falls and fall-related injuries for patients in this population.

### Types of Exercise Appropriate for Older Adults Based on Level of Fall Risk

<table>
<thead>
<tr>
<th>Level of Fall Risk</th>
<th>Type of Exercise</th>
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</thead>
<tbody>
<tr>
<td>Low (no history of falls or fall-related risk factors)</td>
<td>Community-based exercise programs (eg, tai chi, dancing, walking program)</td>
</tr>
<tr>
<td>Moderate (history of 1-2 falls in past or presence of 1 or more fall-related risk factors)</td>
<td>Physical therapy (eg, strength training) to target specific strength and coordination deficits</td>
</tr>
<tr>
<td>High (injury-related fall within past 6 mo or presence of 2 or more fall-related risk factors)</td>
<td>Physical therapy (eg, strength and balance training in seated or supported standing position, weight shifting and transfer training, gait training, no independent walking program) to target specific strength and coordination deficits</td>
</tr>
</tbody>
</table>

**Exercise interventions lower fall rates among older adults only when at least 50 hours of training have been completed.**

**Medication, Behavior, and Environment**

Vitamin D deficiency, diminished muscle strength, and somatic dysfunction can all directly influence the musculoskeletal system and are known risk factors for falls in older adults.58-10 How
ever, other factors not directly related to the musculoskeletal system are important as well, including those that are behavioral and environmental in nature. A patient’s emotional state and the medical treatment that he or she has received or is receiving may not only be potential risk factors for fall but also need to be considered by physicians when they are using a comprehensive approach to patient care.

Fear of falling is very common among older adults living independently in the community. In addition, older adults who are depressed are at greater risk of falling. Both fear of falling and depression are important points to consider when taking care of elderly patients because these factors can cause activity restriction, social isolation, and decreased quality of life. It is important for osteopathic physicians to recognize the integral role of the mind and spirit in health and disease. Addressing depression if it is present will enhance an elderly patient’s mental health status and ultimately maximize the patient’s function, independence, and quality of life. In addition to appropriate medications, physicians can manage depression with interventions such as tai chi and exercise programs, which have been shown to reduce the fear of falling in older adults living in the community.

Although the use of medication can be helpful in treating older adults with depression, it should be remembered that the use of antidepressants, sedatives and hypnotics, and benzodiazepines are associated with falls in the elderly. It is also well known that older adults who use a higher number of different medications are at increased risk of falling. Managing medications by weighing the benefits and adverse effects, understanding potential interactions, and reducing or stopping medications when appropriate is therefore essential to reducing fall-related risk in older adults. A meta-analysis by Woolcott et al showed that the use of sedatives and hypnotics, antidepressants, and benzodiazepines was associated with falls in elderly individuals, and another study revealed a 66% decrease in the risk of falling in elderly patients with whom the dosage of psychotropic medications was gradually reduced.

A multifaceted approach to fall prevention in older adults, especially those with impaired vision, should also include an assessment of environmental or home hazards, such as tripping hazards (eg, rugs, low-standing furniture) and dim lighting. In addition, physicians should recommend that patients institute basic safety measures such as grab bars and antislip bath mats. In-home visits are 1 helpful way in which physicians can ensure that necessary home-hazard modifications are put in place. The risk for falls appears to be reduced by home-hazard modification, but not necessarily by clinical education alone.

Table 2 summarizes fall-related risk factors in the older adult population and the types of interventions that can be used to reduce these risks.

### Table 2.

<table>
<thead>
<tr>
<th>Fall-Related Risk Factor</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin D deficiency</td>
<td>Vitamin D supplementation (eg, 800 IU daily)</td>
</tr>
<tr>
<td>Decreased strength or balance control</td>
<td>Exercise program based on level of fall risk</td>
</tr>
<tr>
<td>Somatic dysfunction</td>
<td>Osteopathic manipulative treatment</td>
</tr>
<tr>
<td>Medication</td>
<td>Reduction or elimination of medication (eg, sedatives and hypnotics, antidepressants, benzodiazepines)</td>
</tr>
<tr>
<td>Depression</td>
<td>Judicious use of antidepressants; activities and exercise programs</td>
</tr>
<tr>
<td>Environmental hazards</td>
<td>Home-hazard modification; in-home visits</td>
</tr>
</tbody>
</table>

### References

9. Visser M, Deeg DJ, Lips P. Longitudinal Aging Study Amsterdam. Low vitamin D and high parathyroid hormone levels as determinants of loss of muscle strength and muscle mass (sarcopenia); the Longitudinal Aging Study Amsterdam. J Clin Endocrinol Metab. 2003;88(12):5766-5772.

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