Preventing Falls in Older People: The Role of Footwear and Lower-Extremity Interventions

INTRODUCTION

The Role of Podiatry in the Prevention of Falls in Older People

A JAPMA Special Issue

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Given the age-related decline in foot strength and flexibility, and the emerging evidence that foot problems increase the risk of falls, established guidelines for falls prevention recommend that older adults have their feet examined by a podiatrist as a precautionary measure. However, these guidelines do not specify which intervention activities might be performed. Published in this special issue of JAPMA are nine high-quality articles, including seven original studies and two basic science reviews, focusing on the benefit and impact of footwear and foot and ankle interventions in reducing the risk of falling. The selected studies discuss various relevant questions related to podiatric intervention, including adherence to intervention; preference and perception of older adults in selecting footwear; benefit of insoles, footwear, and non-slip socks in preventing falls; fear of falling related to foot problems; benefit of podiatric surgical intervention; and benefit of foot and ankle exercise in preventing falls. (J Am Podiatr Med Assoc 103(6): 452-456, 2013)

During the past several decades, the elderly population has increased substantially and steadily across most of the western world.1-3 This trend is expected to accelerate in the future. For example, it is estimated that more than 10,000 people will turn age 65 every day in the United States, and the number of adults age 65 years and older will reach more than 70 million in 20 years, compared to 40.4 million in 2010. In 2056, for the first time, the older population (65 years and older), is projected to outnumber the young (18 years old and younger).4 This continued growth will place significant financial and logistic burdens on the nation’s health-care system. Although life expectancy in the United Kingdom for example, has been increasing, the years spent in good health have not increased at the same rate, indicating poorer health in old age due to key factors such as falls and lack of mobility.5 As the population ages, there will be a greater need for preventive, acute, rehabilitative, and long-term health-care services for older people and for providing tools that enable older people to function independently during everyday activities.6,7

Falls represent an important source of preventable morbidity and mortality in older adults, with one in three people 65 years and older falling each year; 20% to 30% of those falls result in injuries.8,9 In 2000, falls among older adults cost the US healthcare system more than $19 billion dollars or $28.2 billion dollars in 2010.10 The cost of falls is...
estimated to reach $43.8 billion by 2020. Thus prevention of falls in older adults is a top health priority in the United States and many other developed countries.

A multifactorial fall risk assessment followed by intervention to modify any identified risks is a highly effective strategy to reduce falls and the risk of falling in older persons. Traditionally, falls prevention programs have targeted lower-limb muscle weakness, general balance improvements, medication intervention, and environmental modification. However, a relatively neglected area of risk for falls is foot problems, which are estimated to impact one in three community dwelling people older than 65 years.

This special issue aimed to provide further insight into the association of foot and footwear problems with falls in older adults, and the benefit of surgical and nonsurgical intervention targeting foot problems on improving fall-related parameters, eg, gait, balance, physical activity, and ultimately risk of falling in older adults.

Discussion and Summary of the Selected Articles

After review by an international panel and experts in the field, nine papers were chosen for publication in this special issue. These seven original studies and two systematic reviews are summarized below.

Is a Multifaceted Podiatry Intervention Program Perceived to Be Beneficial Among Older Adults?

In order for falls prevention programs to be effective at the broader population level, participation and adherence rates to the interventions need to be high. To address the feasibility of translating the findings of a podiatric intervention trial into clinical practice, Menz et al explored older people’s perceptions of the intervention after they had been involved in the study for 6 months. Specifically, they examined whether participants perceived any benefits from the program in relation to balance and foot and ankle strength, whether they considered the exercise component to be at an appropriate level of difficulty, and their overall level of satisfaction with the footwear and foot orthoses they received. After 6 months of performing the exercises, 86% of 134 participants considered the difficulty level of the exercises to be “about right.” In addition, 92% and 82% were somewhat or very satisfied with the provided footwear and orthoses, respectively. The authors concluded that the multifaceted podiatric intervention used in their trial was generally perceived to be beneficial and demonstrated high levels of satisfaction among participants.

Underlying Factors for Selection of Footwear Among Older Adults

Footwear selection is important for older adults and could impact the risk of falling and triggering further falls among older adults. Although previous studies of elderly populations have found that slippers are the predominant indoor footwear of choice, little is known about factors that influence footwear selection among older women during activities of daily living. To address this shortcoming, Davis and colleagues conducted a cross-sectional survey by telephone interview. Twenty-four older adults were interviewed. The main themes identified by the participants were aesthetics, comfort, and safety. A subtheme of comfort was foot pathology. Participants also identified feelings of loss of autonomy and loss of decision making in regard to choosing footwear. The authors concluded that older women are driven primarily by aesthetics and comfort in their footwear selection rather than wearing safe footwear.

Walking on Slippery Surfaces: Are Nonslip Socks Effective?

Slips are a common cause of falls, and nonslip socks have been marketed to prevent slips in older people. However, few studies have investigated the biomechanical and clinical effects of walking in nonslip socks. To fill the gap, Hatton and colleagues examined gait parameters of 15 older people performing five trials of the fast-paced Timed Up and Go (TUG) test on a slippery surface, wearing nonslip socks, compared with standard socks and barefoot conditions. Results suggest that older people who walk slower when wearing standard socks may benefit more from wearing nonslip socks. Participants rated the nonslip socks to feel less slippery than barefoot and standard socks. The authors concluded that compared with standard socks, wearing nonslip socks improves gait...
performance and may be beneficial in reducing the risk of slipping in older people.

**Does an Increase in Neuropathy Severity Increase the Fear of Falling?**

Concern about falling leads to loss of confidence; higher levels of anxiety, social withdrawal, and restrictions in physical activity; and can increase the risk of falling in older adults. It has also been demonstrated that diabetic peripheral neuropathy (DPN) magnifies the risk of falling in older adults. It is, however, unclear whether DPN is also associated with a greater concern for falling among older adults. To address this question, Kelly and colleagues\(^\text{18}\) assessed gait and fear of falling in 34 older adults with diagnosed diabetes and different levels of neuropathy. Fear of falling was assessed using a validated fear of falling questionnaire (Falls Efficacy Scale International [FES-I]). Gait was assessed over 20-m overground walking using a validated wearable gait analyzer technology. Their results suggest that although 82% of participants had a moderate to high concern about falling, no correlation was observed between level of DPN and the participant’s actual concern for falling. Among the tested variables, age, HbA1C, number of steps required to reach steady state walking (ie, gait initiation), and duration of double support were positively correlated with neuropathy severity. Only stride velocity and stride length had significant correlation with fear of falling. The authors concluded that fear of falling is prevalent among older adults with diabetes mellitus but appears to be unrelated to level of neuropathy.

**Can Podiatric Surgical Intervention Reduce Falls?**

Mounting evidence suggests that foot pain and deformity, which can affect up to 30% of older adults, are important risk factors for falling. It remains unclear, however, whether surgical intervention might affect balance control and fall risk in patients with foot deformity. To address this question, Sadra and colleagues\(^\text{19}\) explored whether corrective hallux valgus (HV) surgery might improve gait and balance performance in an adult patient population. Gait and static balance data were obtained from 40 adults: 19 patients with HV only (preoperative), 10 patients who recently underwent successful HV surgery (postoperative), and 11 healthy adults. Results revealed that patients in the preoperative group generally had poorer static balance control when compared to the other two groups. Despite similar age and body mass index, postoperative patients exhibited significant balance improvements on average by 29% and 63% than preoperative patients during double and single support balance assessments, respectively. No between-group differences were reported for gait performance, except for speed during gait initiation where lower speeds were encountered in the postoperative compared to the preoperative group. The authors concluded that corrective HV surgery leads to early improvements in static balance, but gait improvements may require a longer recovery time.

**Gamification of Lower Extremity Exercise and Its Application for Fall Prevention Among Patients with Diabetes and Peripheral Neuropathy**

Diabetes is a worldwide epidemic. Diabetic peripheral neuropathy (DPN) or diabetic foot disease is prevalent among 50% of patients with 20 years of diabetes and results in loss of protective sensation in lower extremities. This subsequently leads to a significant deterioration in lower-limb proprioception, touch sensation, vibration perception and kinesthesia, which in turn increase the risk of falling in this population. Balance rehabilitation/training is therefore an important aspect of the clinical management of diabetic foot disease, especially to improve postural stability and reduce the risk of falling. It is noteworthy that most of the balance training regimes, including physiotherapy, strength training, and Tai Chi, lack any visual feedback for joint perception. Grewal and colleagues\(^\text{20}\) suggested a novel game-based balance training, which uses visual feedback from the ankle joint to perform ankle exercise. The proof of concept of this technology was assessed within a prospective cohort study including 29 individuals diagnosed with DPN. Findings revealed a 22% reduction in center of mass (COM) sway post-training. In addition, a significant improvement was observed in postural coordination between the ankle and hip joint. The authors concluded that visual feedback generated from the ankle joint coupled with motor learning may be effective in improving postural control among patients with DPN.

**How Do Older Adults Perceive Footwear Beneficial for Improving Balance?**

Understanding patients’ specific needs and concerns relating to footwear and insole design is
recognized as fundamental to improving adherence. Paton et al. conducted a patient-centered study to explore the experiences and views of people with diabetes and neuropathy who have recently fallen. Their goals were to understand participants’ perception regarding benefit of insoles and footwear for avoiding falls and to identify the balance enhancement features of insoles and footwear of relevance to people with diabetes and neuropathy. Sixteen eligible individuals were interviewed. Although the majority of participants did not believe that the footwear in which they fell contributed to their fall, most revealed how footwear choice influenced their balance confidence to undertake daily tasks. Most found their therapeutic footwear “difficult” to walk in, “heavy,” or “slippery bottomed.” The authors suggest design recommendations for enhanced balance including a close fit with tight fastening, a lightweight and substantial tread, and a firm molded sole/insole.

Footwear Interventions in Older Adults

Footwear interventions, including shoe insoles and foot orthoses, have the capacity to enhance balance control and gait in older people. There is, however, limited understanding of the specific mechanisms by which footwear interventions can influence balance performance and gait in older people, and how this may impact the ability to perform daily activities, and the prevention of falls. Hatton et al. in a systematic review, assessed the evidence for how footwear interventions can influence static and dynamic balance performance, as well as gait in older people. Fourteen out of 115 relevant articles, which met the inclusion criteria, were discussed in this review paper. Selected articles were discussed in view of the impact of footwear and insoles on static and dynamic balance during standing and walking. In addition, the potential benefit of vibrating insoles, custom foot orthoses, and textured insoles on improving balance were overviewed. The authors concluded that footwear interventions do significantly alter static and dynamic balance performance and gait in older populations. Evidence shows a consistent trend for footwear interventions to bring about marked improvements on lateral stability measures, which are predictors of falls in the elderly. The authors also emphasized that in-depth investigation of neurophysiological responses to footwear interventions is necessary to help confirm any sensorimotor adaptations.

Current Evidence on the Benefit of Foot and Ankle Exercise for Preventing Falls in Older Adults

In addition to advice about footwear or foot orthoses, intuitively, it may be good practice to recommend exercise programs that focus specifically on strengthening and stretching the foot and ankle. Schwenk et al. conducted a systematic review and meta-analysis of level-one evidence studies, which explored the benefit of foot and ankle exercise for reducing the risk of falling. Eight publications out of 606 relevant articles, which met the inclusion criteria and were confirmed by authors as level-one evidence were discussed and included for meta-analysis. The authors concluded that there is evidence that foot and ankle exercise can improve selected fall-risk related motor outcomes such as balance and ankle flexibility. No significant overall effects were found for ankle plantarflexor strength and walking performance. The authors discussed that limited effects on ankle strength and functional ability might be related to insufficient training intensity and lack of adherence. The authors emphasized that further studies including progressive strength and flexibility training are necessary in order to validate which foot and ankle exercise programs are most effective at preventing falls.

Conclusion

This JAPMA special issue on falls prevention covers some of the critical questions related to the association between foot problems, footwear, and falls among older adults. It also addresses the role of podiatric interventions in reducing the risk of falling in older adults. The studies published in this special issue demonstrate that multifaceted podiatry interventions are not only beneficial for reducing the risk of falling but are also generally perceived to be beneficial by older adults. In particular, lower-extremity exercise, nonslip socks, footwear interventions, and surgical foot deformity correction have been highlighted as beneficial for reducing the risk of falling. Further studies are required to address new designs of footwear for older adults, incorporating their perception of benefit and their preferences for daily wear. Another interesting topic covered in this special issue is the fear of falling, which does not seem to have received enough attention in the area of podiatric intervention, but is nevertheless highly prevalent among diabetic patients with peripheral neuropathy. We hope that readers find this special issue beneficial.
for their clinical practice and developing further research projects in this important area.

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