

Effects of Aging on the Biomechanics of Slips and Falls

Thurmon E. Lockhart, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, James L. Smith, Texas Tech University, Lubbock, Texas, and Jeffrey C. Woldstad, Oregon State University, Corvallis, Oregon

Although much has been learned in recent decades about the deterioration of muscular strength, gait adaptations, and sensory degradation among older adults, little is known about how these intrinsic changes affect biomechanical parameters associated with slip-induced fall accidents. In general, the objective of this laboratory study was to investigate the process of initiation, detection, and recovery of inadvertent slips and falls. We examined the initiation of and recovery from foot slips among three age groups utilizing biomechanical parameters, muscle strength, and sensory measurements. Forty-two young, middle-age, and older participants walked around a walking track at a comfortable pace. Slippery floor surfaces were placed on the track over force platforms at random intervals without the participants' awareness. Results indicated that younger participants slipped as often as the older participants, suggesting that the likelihood of slip initiation is similar across all age groups; however, older individuals' recovery process was much slower and less effective. The ability to successfully recover from a slip (thus preventing a fall) is believed to be affected by lower extremity muscle strength and sensory degradation among older individuals. Results from this research can help pinpoint possible intervention strategies for improving dynamic equilibrium among older adults.

INTRODUCTION

Injuries associated with slip and fall accidents continue to pose a significant problem to older adults, in terms of both human suffering and economic losses. Many studies have indicated that with advancing age there is an increasing incidence of fatal slip and fall injuries (Agnew & Suruda, 1993; Campbell, Reinken, Allan, & Martinez, 1981; Donald & Bulpitt, 1999; Murphy, 2000; Rubenstein et al., 1988). Falls are the leading cause of death resulting from injury among older adults (over age 75) and the second highest cause of accidental death for 45- to 75-year-olds (National Safety Council, 2002). 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 65 years of age (National Safety Council, 2002). In terms of the injuries, more than 25% of fall-related injuries in older adults

result from slips, and 66% of fall-related hip fractures occur on wet or slippery floor surfaces (Norton, Campbell, Lee-Joe, Robinson, & Butler, 1997). Additionally, falls and hip fractures among older adults rank among the most serious public health problems in the United States, with costs expected to exceed \$43.8 billion by the year 2020 (Englander, Hodson, & Terregrossa, 1996). Furthermore, fall accidents are the second leading cause of work-related fatalities, after motor vehicle accidents, and compared with victims of all disabling injuries, victims of disabling falls are more likely to be older than 55 years (Courtney, Sorock, Manning, Collins, & Holbein-Jenny, 2001).

A review of literature on slip and fall accidents indicates that multiple mechanisms are involved. Numerous studies have identified age-related risk factors for falling. Factors intrinsic and extrinsic to older adults and the hazards and demands of the environment contribute to most