stepwise logistic model correctly classified 98% of outcomes based on, in order of entry: *pre-step limb support*, *step length*, *during-step limb support*, and *sit-to-stand speed*. Older adults, regardless of outcome, were deficient in *sit-to-stand speed*, *pre-step limb support*, and *limb orientation*. For these slips, hip height at step touchdown is the strongest predictor of slip outcome. *Pre-step limb support* was a primary determinant of this height and the factor most related to slip outcome. The deficits of older adults in this support and in *sit-to-stand speed*, also related to limb support, arguably increase their risk of falling. We conclude that deficits in limb support contribute no less than instability to age-differences in falling.

7055 We, 08:45-09:00 (P27)

Effects of aging on lower extremity joint torque and muscle activation patterns during slip-induced falls

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Injuries from slip-induced fall accidents represent a significant burden to aging population. Existing evidence has identified several aging effects related to slip and fall accidents, yet has not explained determining causes of older adults' higher likelihood of these accidents. Previous studies suggest that explosive strength generation and the ability to attenuate fast, large-scale lower extremity motions are critical in determining whether or not an elderly individual can respond appropriately to gait perturbations such as a slip. However, considering the phase-dependent modulation of response evident in normal gait, it is expected that correct motor control strategy in terms of timely and sufficient muscle activation pattern/torque production would be equally important in successful recovery process. As such, the objective of the current study was to investigate the aging effect on lower extremity muscle activation characteristics during unexpected slip-induced fall accidents. More specifically, temporal characteristics of slip-initiation (i.e., muscle activation time after slip perturbation), and torque generating capabilities of young and old adults during fall-recovery process were investigated. An empirical study was conducted on 10 young and 8 old healthy participants. Participants' dynamic balance was challenged when exposed to unexpected slippery floor surface condition after their normal walking. Kinematics, kinetics and EMG measures were obtained simultaneously from motion analysis system, force-plates and portable telemetry EMG device, respectively. EMG parameters (activation time, time to peak, and relative peak) were then derived from gastrocnemius, rectus femoris, and hamstrings on both legs. Sagittal joint moments at ankle and knee joints were estimated via inverse dynamics. Two-way repeated-measure ANOVA was employed to test the aging effect (young and old) and condition effect (normal, reactive-recovery, and fall). Preliminary results indicated that the muscles in both recovery and fall conditions were activated about 100 to 150 ms after slip initiation. And relative muscle activation magnitude (comparing to normal walking) of the hamstrings muscle was considerably larger than gastrocnemius and rectus femoris after slip-initiation. Further results including age-related differences in joint torque generation pattern during slip-recovery will be discussed.

5119 We, 09:00-09:15 (P27)

Concurrent control of multiple segments is required to avoid falling due to a slip induced during locomotion

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The extent to which aging affects the ability to concurrently restore control of the slipping foot, the trunk, and placement of the recovery foot on the ground after a slip induced during locomotion was characterized. Thirty-five young adults and 21 healthy older adults (age: 70.9±5.1 years) were subjected to an unexpected and unrestricted slip using artificial ice. The falls of 18 older adults were compared to the successful recoveries of 33 younger adults. Kinematic variables reflecting the states of the slipping limb, the trunk and the recovery limb during the recovery phase of the response, and for which between-group (recover vs. fall) differences were significant, were entered into a stepwise multivariable discriminant analysis that correctly classified 93.8% of the young and older adult subjects. The discriminant variables selected were the lateral displacement of the recovery foot relative to the center of mass, the difference between the velocity of the slipping foot and that of the center of mass at the instant at which the recovery foot was placed on the ground, the peak anteriorly-directed velocity of the slipping foot, and the trunk extension velocity at the endpoint of the analysis that preceded the engagement of the safety harness ($p < 0.001$; Wilk's $\lambda \approx 0.299$). Failure to restore control of the slipping limb and trunk appeared consistent with the delayed activation of key lower extremity and abdominal muscles. The results demonstrate the collective and concurrent importance of temporal and spatial control of lower extremities and trunk underlying successful performance of this complex motor task.

6829 We, 09:15-09:30 (P27)

Identification of high-risk fallers by force capacity measures in the elderly

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For effective fall prevention in the elderly, training programs should focus on high-risk fallers. From experimental studies on tripping reactions, we found that older fallers showed lower maximum moments around the ankle and adapted moments around all lower extremity joints at a lower rate during the push-off phase of balance recovery. During the landing phase, lower knee extension moments were generated. The aim of this study was to search for force generating capacity measures that can predict fall outcome in older adults. Seventeen healthy older adults (10 women, mean age 71±4.5 years) participated. First, subjects' capacity to recover balance after tripping was measured experimentally. In about 5 of 40 walking trials, they were tripped over an obstacle that suddenly appeared from the floor. Subjects wore a safety harness and were classified as fallers based on full use of the harness in at least 2 tripping trials. Next, maximum force generating capacity (maximum force and rate of force development) was measured statically (plantar flexion and knee extension in a dynamometer) and dynamically (push-off during jumping and in a leg-press fitness apparatus). A statistical stepwise discriminant analysis was used to find the best predictor(s) for falls and to quantify the predictive value. Seven older adults were classified as fallers. They were limited in their balance recovery by the rate of force generation in all joints during push-off. In the ankle, the tripping moments were larger and faster than the voluntary values measured in the dynamometer. Although all force producing capacity measures were strongly correlated, the maximum force by the whole leg produced on the leg press was the variable that discriminated best between fallers and non-fallers. Based on whole leg capacity measure, 100% of the fallers and 90% of the non-fallers were classified correctly.

6554 We, 09:30-09:45 (P27)

The biomechanical demands of stair descent in elderly and young adults

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Stair negotiation is a physically demanding task and may become more difficult in old age due to the deterioration of physical capacities. Furthermore, stair descent is associated with a high risk of falls (Startzell *et al.*, 2000 *JAGS* **48**, 567–580). We investigated the biomechanics of stair descent in 15 elderly adults (70–81 years) and 17 young adults (18–30 years). Subjects walked at their own speed down a custom-built staircase consisting of 4 steps, with force platforms mounted into 3 of the steps and one in the floor, at the base of the stairs. Kinematic data was obtained from markers placed on specific anatomical locations and captured using a 9-camera VICON system. Subjects always led with the same foot; knee and ankle joint moments and angles were analysed over one whole steady-state step cycle. There were no differences in the pattern of knee and ankle joint changes between young and elderly subjects during the step cycle. Ankle joint moment was significantly lower in the elderly compared to the young at critical points in the step cycle and was compensated for by higher knee joint moments. The lower ankle joint moments corresponded to the start of the single support phase at the beginning of the step cycle (young: 1.7 $Nm.kg^{--1}$; elderly: 1.18 $Nm.kg^{--1}$, $P < 0.01$) and the double support phase, prior to the swing phase (young: 1.53 $Nm.kg^{--1}$; elderly: 1.12 $Nm.kg^{-1}$, $P < 0.01$). The strategy of reducing joint moment at the ankle and increasing that at the knee in the elderly might be a result of maintaining the body centre of mass towards the back of the step as long as possible. In addition, the ankle joint moment required during stair descent may approximate the maximal capacity of the older adults, whereas the moment required at the knee lies well within their maximal.

6353 We, 11:00-11:15 (P30)

Choice stepping response and transfer times: effects of age, falls risk and secondary tasks

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As people age they experience a decline in factors that contribute to stable posture and gait, including sensory acuity, reaction time and lower limb