INTRODUCTION

Slips and falls are a major cause of occupational injury in young and older adults [1,2]. Gait characteristics are important in fall research. Falling history and hazardous slips have been associated with decreased gait speed, increased step length, and decreased cadence [3,4]. Proactive strategies, balance control mechanisms that take place before encountering a potential disturbance, serve to counteract the destabilizing effect of a disturbance. They have been shown to reduce slip probability and reliance on reactive strategies in avoiding a fall [5,6]. Age-related differences in proactive strategies are reported across studies are not consistent with some research finding older adults adopting a more cautious gait consisting of reduced gait speed, shorten step length, and increased gait variability [6,7]. However, these cautious gait adaptations have also been noted as risk factors for falls and may increase fall risk, rather than protect against it [3,4,7,8].

A better understanding of the changes in spatiotemporal gait characteristics when anticipating a slippery floor is important for injury prevention and may further explain the high prevalence of slip-related falls in older adults. The goal of this study was to investigate the impact of anticipating slippery floors on spatiotemporal gait characteristics, including gait speed control, during walking on dry surfaces in young and older adults.

METHODS

Eighteen healthy young (20-33 years) and thirteen healthy older adults (55-67 years) participated in this study after written informed consent approved by the University of Pittsburgh Institutional Review Board was obtained. Whole body motion data were collected using a custom marker set as participants walked at a self-selected pace across an 8.5 meter walkway (Moyer et al., 2006). Participants were informed that the first few trials would be dry to ensure natural gait and three to five dry trials were collected, “baseline dry”. Without the participant’s knowledge, the diluted glycerol solution was applied to the left/leading foot-floor interface and an “unsuccessful slip” was recorded. Subjects were then alerted that all remaining trials might be slippery but no further specific information was provided and they walked on a dry surface, “anticipation dry”.

General spatiotemporal gait characteristics, gait speed (m/s), cadence (steps/min), and step length (cm) were derived. The first two anticipation dry trials were used and compared to the baseline trials. Age- and baseline/anticipation-related differences in each spatiotemporal gait variable of interest were determined using a repeated measures ANOVA with age group (Y/O), anticipation condition (baseline/anticipation) and their interaction effects as independent fixed effects. Subject was included as a random effect. Statistical significance was set at 0.05.

RESULTS AND DISCUSSION

Anticipating slippery floors increased cadence (p<0.001) in both young and older adults (Figure 1). Specifically, cadence significantly increased by 6.04 steps/min in young adults and by 5.93 steps/min in older adults during anticipation compared to baseline. This gait adaptation is beneficial to reducing slip risk, as increased cadence has been shown to reduce the risk of experiencing a hazardous slip [3]. In general, younger adults took longer steps than older adults (p=0.003). Additionally, step length significantly increased in young adults by 1.06 cm while significantly decreasing 1.67 cm in older adults during
anticipation trials (p=0.0095) (Figure 1). Increased step length as a component of a proactive strategy to reduce slip risk may be maladaptive. Increased step length has been linked to increased RCOF and thus increased slip risk [3-5]. The aforementioned effects on step length and cadence, in combination, cause the gait speed in young adults to significantly increase by 0.10 m/s during anticipation (p=0.003). Gait speed in older adults was not significantly different during anticipation trials compared to baseline walking (Figure 1). Increased, or at least maintaining baseline gait speed, is a beneficial component of a proactive strategy, as slower gait speeds have been related to increased fall risk [2].

Due to laboratory constraints, the gait parameters calculated were based on a limited number of steps. Additionally, the older subject group was arguably not sufficiently old enough to demonstrate significantly altered gait parameters compared to the young subject group. Different trends in proactive strategies might be seen in elderly adults.

CONCLUSIONS

Interestingly, older adults were able to implement a more conservative proactive strategy consisting of maintaining gait speed without increasing step length. Young adults implemented a potentially more risky proactive strategy consisting of increasing gait speed through a combination of increased step length and increased cadence. Additional research is necessary to determine the effect of these changes in gait speed control on slip risk during walking and if these age-related differences in proactive gait adaptations are associated with reducing future slip events.

REFERENCES


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