THE EFFECT OF EXTENDED DURATIONS OF WALKING IN OCCUPATIONAL FOOTWEAR ON BALANCE

Harish Chander¹, John C.Garner¹, Chip Wade², Jennica Roche³, Nicole C.Dabbs¹, Rebecca L. MacNeill¹

¹Applied Biomechanics Laboratory, University of Mississippi, University, MS
²TigErgonomics Laboratory, Auburn University, Auburn, AL
³Human Movement & Balance Laboratory, University of Pittsburgh, Pittsburgh, PA
email: hchander@olemiss.edu

INTRODUCTION

Hazards and challenges present in the workplace pose a number of potential risks for injury and illness. Nearly 3.1 million nonfatal workplace injuries and illnesses were reported in 2010 [1]. A large portion of the injuries are attributed to slip and fall incidents, which have been positively correlated to balance decrements. Furthermore, 45% of all falls have been attributed to inappropriate footwear [2]. Previous studies have shown decrements in balance as a result of different footwear [2] and after an increased workload over a specific period of time [2,3]. Occupational footwear is often designed for safety and may fail to allow appropriate foot biomechanics during normal gait and standing. As such, the functionality of occupational footwear may impact balance characteristics over time. The purpose of the study is to examine the differences in balance while wearing different types of occupational footwear for extended durations.

METHODS

Fourteen healthy male adults (age: 23.6±1.2 yrs; ht: 181±5.3 cm; mass: 89.2±14.6 kg), with no history of orthopedic, musculoskeletal, cardiovascular, neurological and vestibular abnormalities completed the study. The experimental session included an extended duration of walking (4 hours) with balance measured at 30min intervals (Pre, 30, 60, 90, 120, 150, 180, 210 & 240 min). The standing balance protocol assessment was done using the six conditions of the Neurocom Equitest SOT with sway referencing capabilities of the platform and the visual surround (EO, EC, EOSRV, EOSRP, ECSRP and EOSRVP). The values of the dependent sway variables were derived from the center of pressure (CoP) movement. The average sway velocity (VEL) and the root-mean-square (RMS) sway of the CoP were used to characterize the postural sway in the anterior-posterior (APVEL & APRMS) and the medio-lateral (MLVEL & MLRMS) directions during the 60-second testing period. Participants were randomly assigned 3 different types of occupational footwear: Work Boots (WB) (mass 0.39±0.06 kg), Tactical Boots (TB) (mass 0.53±0.08 kg) and Low Top Shoes (LT) (mass 0.89±0.05 kg) with a minimum of 72 hours of rest between conditions.

RESULTS AND DISCUSSION

Balance dependent variables were evaluated using a 3 x 9 (Footwear [WB,TB, LT]) x (Extended duration of walking intervals [Pre, 30, 60, 90, 120, 150, 180, 210 & 240] RMANOVA and independently for the six SOT balance conditions (EO, EC, EOSRV, EOSRP, ECSRP and EOSRVP) to identify any existing differences within the exposure time as well as the footwear types. Significant differences were found over time in the EO, EC, EOSRV & EOSRP for MLRMS. Differences between footwear were seen in the APRMS and MLRMS for EC and the EOSRP for MLRMS, illustrated in Figures 1-3.
These results indicate a decrement in balance performance over time but the differences were limited to MLRMS. The decline in balance may be attributed to fatigue resulting from an extended duration of walking/standing, supporting previous literature. Significant differences were found among the WB, TB and LT, with the LT having higher RMS sway. The LT resulted in a relatively greater balance decrement, especially when vision was absent and with conflicting somatosensory input. The WB and TB, despite having a greater mass, had less balance decrement, which may be related to their elevated boot shaft height. Results from this data suggest that the high boot shaft supports the ankle, in turn attenuating fatigue, thus resisting balance decrements.

CONCLUSION

The current study accounts for balance decrements in a simulated occupational workload of standing and walking over an extended period of time with three commonly used occupational footwear. The findings from the study may help offer recommendations for efficient footwear design for the industrial populations to help resist fatigue and help prevent slip and fall-related injuries. Future research on the mechanical characteristics of the footwear are recommended to have a better understanding of the footwear functions and their importance in postural stability.

REFERENCES