THE INFLUENCE OF FIREFIGHTER BOOT TYPE ON POSTURAL MEASURES

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INTRODUCTION

The occupational hazards and challenges that are presented in the fire protection industry pose a number of potential risks for injuries and illness. The number of general industry non-fatal occupational injuries and illness reported in 2009, declined to 3.3 million cases compared to the 3.7 million cases in 2008 (BLS, 2010). However, the incidence rate in the fire protection industry has risen from 14.8% to 15.3% over the same period (BLS, 2010). The manipulation of relatively large objects was the most commonly encountered application of strength and endurance among firefighters. Further performing work activities in unfamiliar occupational environments while donning mandatory fire protection clothing, footwear, and accessories place extreme demands on the postural control systems. Increased probabilities of falls have been related to decrements in balance control with 45% of these falls attributed to inappropriate footwear. Firefighters use two types of federally approved boots, one made of leather and one made of rubber. Due to the primary safety concern in the design of the boots, the boots may fail to provide appropriate biomechanics that is necessary for a normal gait and maintenance of balance. Based on the previous studies, postural balance was shown to have a decrement with different footwear. Similar decrements in balance measures were also found in firefighters with protective equipment which included specific fire fighter boots (Punakallio, 2005 Kincl et al, 2002). Currently, there remains a dearth of literature that compares the effects of the two different boot types worn by firefighters on postural control measures. The purpose of the study is to examine the differences in balance in professional fire fighters wearing rubber and leather boots participating in a fire simulation activity.

METHODS AND PROCEDURES

Twelve professional firefighters (33 ± 6.8 years; height of 179 ± 6.47 cm; weight of 95.08 ± 21.47 kg), whom received, within the past 8 months a medical evaluation, including resting 12-lead EKG analysis, and clearance by a physician to participate in firefighting participated in this study. Each firefighter participated in two identical testing sessions [leather (2.44 ± 0.20 kg) and rubber boots (2.93 ± 0.24 kg)] on two separate days. Firefighters were tested with at least 6 days between the LB and RB sessions. A 22.68 kg weighted vest to simulate their typical personal protective equipment and two 5.67 kg weights on the shoulders to simulate the weight of a high-rise pack (hose bundle) were used. The 5.67 kg weights were only worn during the stair climbs. Balance assessments were done on the NeuroCom Equitest Balance Manager, using the Sensory Organisation Test in the
Eyes Open condition. Sway velocity was used as a dependent measure for balance assessments.

Each testing session consisted of three testing sequences: pre test, simulated stair climb-1 (SM1), and simulated stair climb-2 (SM2). Following an initial warm up, firefighters performed the postural stability test. Firefighters then were provided with the weights which simulated the breathing apparatus and hose weight, and conducted a 3-minute simulated stair climb test at 60 steps per min. Following the test, the participant exited the step mill and removed the added weights. Firefighters were then allowed to rest 3 minutes followed by a second simulated stair climb test with the simulated weights, then a final postural stability test.

RESULTS

Repeated Measures ANOVA revealed a statistically significant difference in sway velocity between the pre and post test measures and among the two different boots.

Fig.1: Eyes open - A/P & M/L sway velocity

DISCUSSION

An overall increase in sway velocity between the pre and post tests, indicates a diminished postural control in both the anterior/posterior direction and the medial/lateral direction for both conditions. However, the leather boots had a significantly smaller increase in sway velocity in both directions when compared to the rubber boots which indicates a decrement in balance. These results suggest that the heavier rubber boots may elicit greater fatigue in the firefighters, thus impairing balance and postural control measures.

REFERENCES


Kincl et al. (2002). *Applied Occupational & Environmental Hygiene*, 17, 4, 256-266.