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Effect of Protective Clothing and Fatigue on Functional Balance of Firefighters

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Abstract

We investigated the effects of wearing personal protective equipment (PPE), design of PPE (*Standard* vs. *Enhanced*), and fatigue during a simulated firefighting activity on the functional balance of firefighters. We defined functional balance as the ability to prevent a loss of balance and maintain body posture while performing functional tasks. A novel Functional Balance Test (FBT) was used to assess functional balance of firefighters while stepping up, stepping down, turning, walking along a beam, and passing under an obstacle. Data are presented from fifty-seven male firefighters, who were randomly divided into two groups: *Standard* PPE (n=28) and *Enhanced* PPE (n=29). The specially designed *Enhanced* PPE was lighter, more breathable, and capable of air circulation, compared to traditional *Standard* PPE. Each participant performed the FBT at three time periods (baseline with station uniform, pre-activity with PPE, and post-activity with PPE after a live-fire simulated firefighting activity). The firefighting activity involved alternating 2-minute rest- work cycles of four stations: stair climb, forcible entry, room search, and hose advancement. The FBT had four trials each with and without an overhead obstacle. Performance errors (major and minor), performance time, and a composite performance index were recorded. Wearing PPE significantly impaired functional balance, as noted by increases in all performance metrics. Following the firefighting activity, performance time increased by 3% but the number of minor and major errors decreased by 13% and 32%, respectively, suggesting that firefighters may trade-off between speed and accuracy depending on perceived threat to balance safety. There was no significant difference in functional balance between the *Enhanced* PPE and *Standard* PPE groups, suggesting that *Enhanced* PPE with a passive cooling system and an external circulating hose is not effective in improving functional balance of firefighters. A better designed PPE, with an improved cooling system and minimal (or no) protruding attachments may be of benefit in terms of firefighter functional balance.