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## NIOSH Study Examines Safety, Health Implications of Fire Fighters' Boots

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Do the boots worn by fire fighters unintentionally put some of them at risk, particularly as the population of fire fighters becomes more diverse and one size or style may not fit all? Scientists at the National Institute for Occupational Safety and Health's (NIOSH) laboratories in Morgantown, W.Va., and Pittsburgh, Pa., are conducting research to understand the physiological and biomechanical effects of boot weight on male and female fire fighters.

More than 1.1 million men and women work as fire fighters in the U.S. Fire fighters have an increased risk of occupational injuries and fatalities due to the stressful nature of their work and the complexity of their work environment. According to the National Fire Protection Association (NFPA), fire fighters suffered an estimated 80,100 occupational injuries in 2007. About a quarter of these injuries were due to overexertion and another quarter were due to falls.

As part of their personal protective equipment, most fire fighters wear either heavily insulated rubber boots or leather boots. Rubber boots are 3 pounds heavier than leather boots, but generally cost about half as much. Standards-setting organizations, such as the NFPA, have expressed concern that boot weight may contribute to the stress of firefighting.

The participants in the NIOSH study were recruited from the Morgantown, W.Va., western Maryland, northern Virginia, and eastern Ohio areas. These fire fighters, while carrying a backpack and wearing a pair of randomly assigned rubber boots (2 models), leather boots (2 models), or safety shoes (baseline), were tested for oxygen consumption, joint movement, and walking patterns. The boots tested in the study were boots that NFPA and fire fighters reported as commonly used.

The preliminary findings from the study, which have been reported as work in progress at several scientific conferences, suggest that fire fighters adjusted their walking patterns and postures when wearing heavy firefighter boots. They walked slower, took wider steps, and for each stride they took, the percentage of time when both feet were in contact with the floor was longer with heavier boots, suggesting that they need more time to balance their body during walking. Female fire fighters tended to walk slower and take smaller steps than male fire fighters. The gender differences in gait patterns emphasize the importance for including female subjects in the study.

In other preliminary findings of this study, boots weight was found to affect the way study participants naturally move their lower bodies. The boots limited fire fighters' ankle, knee, and hip motions, and such restrictions may affect their ability to perform tasks efficiently, such as maintaining balance or crossing obstacles effectively during firefighting.

In addition to changing the way fire fighters move while performing certain tasks, an increase in boot weight can affect fire fighters' energy expenditure and breathing. In the NIOSH study, fire fighters performed two exercise tasks: 1) walking on a treadmill while carrying a hose, and 2) climbing a revolving staircase. For both tasks, fire fighters' oxygen consumption, the amount they breathed, and heart rate were significantly greater when wearing rubber boots as compared with leather boots. Such increases in breathing and energy expenditure could decrease the duration of a firefighter's self-contained breathing apparatus in an actual fire scenario.

NIOSH hopes that the final results of this research, when the study is completed and published, will provide needed information to the NFPA, fire departments and fire fighters. Further research will investigate the effects of different types of firefighter boot soles and the effect of boot weight on walking over obstacles.

NIOSH is the federal agency that conducts research and makes recommendations for preventing work-related injuries and illnesses. More information about NIOSH can be found at <u>www.cdc.gov/niosh/</u>.

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