

some work environments. This review is intended to summarize the occupational injury, illness, and fatality experience in this broad and diverse slice of U.S. economic activity and review what is known about risks and prevention, with a view toward outlining what yet needs to be discovered about risks, prevention options, vulnerable populations, and emerging issues to address these high-risk activities in WRT subsectors through future research and prevention efforts. The purposes are to inform, suggest, encourage, and facilitate collaborations and partnerships among researchers and the many other individuals and organizations with a stake in protecting workers and promoting economic health in these critical sectors of U.S. industry.

### **F3.4**

#### ***Title: A Systematic Review of the Effectiveness of Interventions to Prevent Agricultural Injury and Disease***

Authors: **Cryer C**, Lilley R

Introduction: Agricultural injury and disease are significant contributors to the burden of occupational morbidity and mortality in Australasia. This paper presents the findings of a systematic review of the efficacy of interventions to prevent agricultural-related ill health.

Methods: A review was undertaken using literature databases, citation searches, and journal hand searches. The review built upon previous interventional reviews in agricultural injury: one each in adult and childhood injury. Papers published since these reviews were included. Relevant study types included controlled trials and observational studies. All studies were evaluated for methodological quality.

Results: 32 papers were identified for inclusion: 15 involved education interventions; 9 engineering, ergonomic, or personal protective equipment interventions; 2 health screening; 2 financial/organizational interventions; and 4 mixed interventions. The educational interventions were evenly split between childhood and adult injury prevention. Seven randomized control trials were judged to have excellent methodological quality, and the remaining studies were of moderate quality.

Conclusion: The findings provided very limited evidence of interventions effective at reducing agricultural injuries. Moderate evidence was found for interventions that were effective at improving farm safety behaviors/knowledge but no supporting

evidence for subsequent injury reductions. Few studies, mostly of poor rigor, were found that evaluated strategies to reduce farm exposures known to lead to agricultural health problems. Despite a lack of strong evidence for the establishment of an evidence-based agricultural intervention, potentially promising interventions and future directions were identified.

Session: **F4.0**

#### ***Title: Preventing Injuries Among Fire Fighters***

Moderator: Stephen Miles

### **F4.1**

#### ***Title: Preventing Deaths and Injuries of Fire Fighters Working Above Fire-Damaged Engineered Wood Floor Joists***

Authors: **Merinar T**, Tarley J

Introduction: Fire fighters are at risk of falling through fire-damaged floors. Fires burning underneath floors can significantly degrade engineered wood floor systems with little indication to the fire fighter working on the floor. Engineered wood I-joists represent an emerging technology in the building sector that offers several advantages over traditional sawn lumber. It is estimated that engineered wood I-joists are used in over half of all new wood-frame construction.

Methods: The NIOSH Fire Fighter Fatality Investigation and Prevention Program conducts investigations of fire fighter line of duty deaths to identify causal factors and formulate recommendations for preventing future deaths and injuries. The program does not seek to determine fault or place blame but to learn from these tragic events and prevent future similar occurrences.

Results: Structure fires are the third leading cause of fire fighter fatalities, behind only CVDs and motor vehicle incidents. In the past 2 years, NIOSH has investigated 3 incidents involving 3 fire fighter fatalities and 1 injury in which the fire fighters fell through fire-damaged engineered wood floors containing I-joists. The use of engineered wood I-joists and other engineered wood products will continue to increase.

Conclusions: Evidence collected during NIOSH investigations suggest that fire fighters may not be adequately trained in recognizing the hazards of working above fire-damaged engineered wood floor systems. Fire fighters need to be trained to identify

the presence of engineered wood I-joists and actions they can take when engineered wood floor systems are encountered. Fire Departments need to identify structures within their jurisdiction containing engineered wood products through pre-incident planning and inspections and develop appropriate response procedures. Builders, contractors, and owners should consider protecting engineered wood I-joists by covering the underside with fire-resistant materials.

#### **F4.2**

##### ***Title: Preventing Fire Fighter Deaths and Injuries Caused by Failure to Wear Vehicle Safety Restraints***

Authors: **Lutz V**, Romano N

Introduction: The National Fire Protection Association (NFPA) reports that motor vehicle incidents are consistently the second leading cause of on-duty fire fighter fatalities. A NFPA 30-year study (1977-2006) reveals that only 13% of the 406 fatal crash victims were wearing safety restraints, and 45 fire fighters died when they fell from a moving apparatus.

Methods: The NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) studies fatal fire fighter occupational incidents, with the goal of identifying effective prevention measures. Through on-site investigations, FFFIPP personnel collect agent, host, and environmental information from the pre-event, event, and post-event phases of the fatal incident.

Results: A review of FFFIPP investigations from 1998 - 2007 identified 63 motor vehicle related cases involving the death of 46 fire fighters where not being seated and restrained in a moving vehicle likely contributed to the fatality. Relevant findings from these investigations include: (1) fire departments often have established safety restraint standard operating procedures (SOPs) that are not enforced, and (2) there have been instances when fire fighters had to remove safety restraints to perform required tasks because of apparatus/equipment design and/or placement.

Conclusions: Evidence collected during FFFIPP investigations suggests that fire departments must not only develop, but need to enforce SOPs that require all occupants in moving apparatus to be seated and restrained at all times the vehicle is in motion. Manufacturers, fire departments, and those who refurbish emergency vehicles must take into consideration all movements needed to reach

equipment and ensure that safety restraints can be worn by all occupants when performing required tasks.

#### **F4.3**

##### ***Title: Physiological Effects of Boot Weight in Men and Women Fire Fighters***

Authors: **Turner N**, Chiou S, Zwiener J, Weaver D, Spahr J, Sinkule E, Haskell W

Introduction: Most fire fighters wear heavy rubber boots or lighter leather boots. Increases in oxygen consumption per kg of weight added to the foot may depend on gender, boot material, and whether or not subjects are wearing additional protective clothing or equipment.

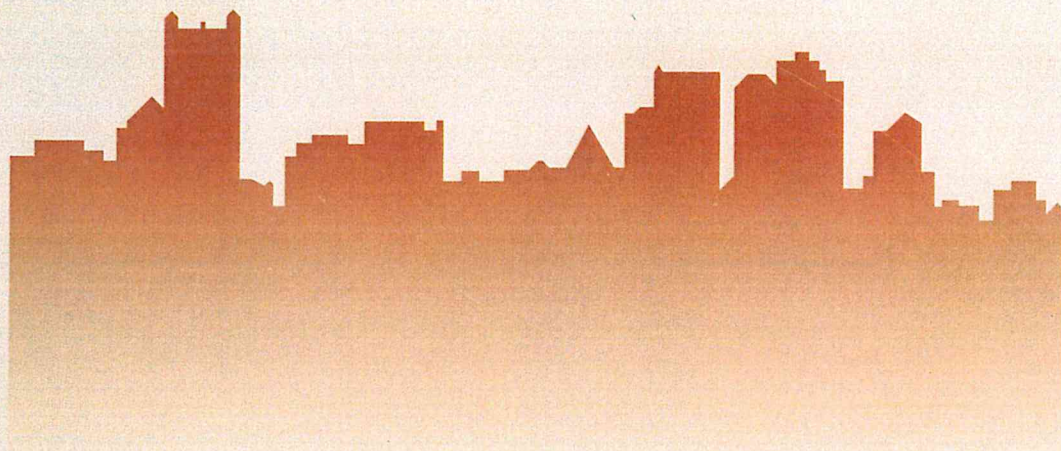
Methods: Twenty-five men and 25 women fire fighters, while wearing full turnout clothing, a 10.5-kg backpack, gloves, helmet, and one of six randomly assigned pairs of fire fighter boots, walked for six minutes at three mph on a treadmill while carrying a 9.5-kg hose and then climbed a stair ergometer for six minutes at 45 steps per minute.

Results/Discussion: Minute ventilation (VE), oxygen consumption (VO<sub>2</sub> and VO<sub>2</sub>kg), CO<sub>2</sub> production (VCO<sub>2</sub>), and heart rate (HR) were measured, and an average of the breath-by-breath data from minute six was used for analysis. During treadmill exercise, boot weight had a significant effect ( $p \leq 0.05$ ) on VO<sub>2</sub>, VO<sub>2</sub>kg, and VCO<sub>2</sub> in men and women; boot weight had a significant effect ( $p \leq 0.05$ ) on VE and HR for men only. In men, a 1-kg increase in boot weight caused a 9% increase in VE and 6 - 8% increases in VO<sub>2</sub> and VO<sub>2</sub>/kg. The increase in VE observed in men could result in an approximate 8% decrease in service time for a 45-min SCBA cylinder. In women, 3% increases in VO<sub>2</sub> and VO<sub>2</sub>/kg were observed. Gender differences observed during treadmill walking may be due to a decrease in women's stride length while carrying a load. During stair climbing, a 1-kg increase in boot weight caused a 3.5% increase in VO<sub>2</sub> in men only ( $p \leq 0.05$ ). This 3.5% increase is less than the 5% increase observed in a previous study of leather and rubber boots where subjects wore only gym shorts and may reflect a diminished effect of boot weight with full turnout gear.



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