

Wearing Personal Protective Equipment and Carrying Tools Effect on Cardiac and Metabolic Stress of Firefighters

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Average firefighter carries approximately 70 lbs of gear when ready to fight a fire. This amount of gear with added heat stress may cause further physiological and metabolic stress on a firefighter's body. **Purpose:** To determine and quantify the amount of physiological stress that is placed on a firefighter while wearing different levels of personal protective equipment (PPE) and carrying a tool. **Methods:** Ten male volunteer and career firefighters (age 20.9 ± 1.8 years, height 175.8 ± 6.6 cm, weight 79.3 ± 9.3 kg) performed a submaximal walk test on a treadmill while wearing three different levels of PPE: 1) street clothes (SC), 2) PPE and self-contained breathing apparatus (SCBA), and 3) PPE with SCBA and carrying a hose bundle (PPET). Each subject performed the exercise test and each condition was separated by minimum of one week. During the exercise test, subjects' rate of perceived exertion (RPE), heart rate (HR), mean arterial pressure (MAP) and VO_2 were measured. One-way analysis of variance was used to compare the differences in physiological measures under three conditions. **Results:** SCBA condition showed significantly higher RPE, HR, and VO_2 responses when compared to SC ($p < 0.05$) while mean arterial pressure (MAP) did not have a significant different. No significant difference was observed between SCBA and PPET conditions.

Conditions	RPE	HR (bpm)	MAP (mmHg)	VO ₂ (L·min ⁻¹)
SC	6.4 ± 0.5	91.8 ± 7.2	90.7 ± 5.1	0.7 ± 0.1
SCBA	$9.1 \pm 1.7^*$	$115.5 \pm 9.8^*$	95.5 ± 5.3	$1.1 \pm 0.1^*$
PPET	10.2 ± 2.0	123.5 ± 12.7	99.1 ± 4.5	1.1 ± 0.2

*Significantly different from SC condition ($p < 0.05$).

Conclusion: Wearing PPE can significantly increase metabolic and cardiac stress of firefighters, while added weight of a hose bundle to the PPE did not significantly increase physiological stress. These findings could be used to aid future research in designing new, lighter PPE or implementing more comprehensive physical training for the firefighters to maintain in the best physical condition.