

ESTIMATION OF MYOCARDIAL WORKLOAD DURING TREADMILL EXERCISE IN DIFFERENT ENSEMBLES OF FIREFIGHTING TURN-OUT GEAR

Denise L. Smith¹, Steven J. Petruzzello², Jeffrey M. Kramer²,
Sally E. Warner¹, Bradley Bone², and James E. Misner²;
¹Skidmore College, Saratoga Springs, NY 12866;
²University of Illinois, Urbana, IL 61801

INTRODUCTION

Firefighting turn-out gear is designed to protect the firefighter against burns and thermal injuries. However, turn-out gear also increases the cardiovascular stress of performing work by a) adding weight to the load the firefighter must carry, thus effectively increasing the workload, and b) decreasing the body's ability to dissipate heat (1,2). The extent to which different ensembles of turn-out gear affect cardiovascular stress, however, is not known. The purpose of this study, therefore, was to estimate myocardial work during treadmill exercise in different ensembles of firefighting turn-out gear.

METHODS

Ten healthy, male career firefighters who had received annual medical examinations and been cleared for active duty within the last 12 months served as subjects. All subjects provided written informed consent to participate in this study. On three separate days subjects walked on a motor-driven treadmill (3.5 km·hr⁻¹, 10% grade, 23.9°C) for 15 min in one of 3 different clothing ensembles. These ensembles were: (a) "station blues", (b) a hip boot (HB) ensemble, and (c) a low boot/bunker pant (LB/BP) ensemble. The station blues (i.e., the work uniforms worn at the fire station) consisted of fire resistant pants, fire resistant short-sleeved shirt, and work boots. The HB ensemble consisted of Servus 3/4 hip boots, full length turn-out coat (8.5 oz Nomex shell with neoprene vapor barrier, non-quilted liner), Cairns helmet and Fire Grip Gloves. The LB/BP ensemble consisted of Servus bunker boots, bunker pants, turn-out coat (8.5 oz PBI shell with Gortex barrier), Nomex hood with full gauntlet, Cairns helmet, and Fire Grip gloves. A modified, self-contained breathing apparatus (SCBA) and face piece was worn for both the HB and LB/BP ensembles. The mean weights of the turn-out gear for the HB and LB/BP ensembles were 20.2 and 21.2 kg, respectively. The order of testing was randomized.

Prior to walking on the treadmill the subjects sat quietly for 5 minutes. Subject then walked for 15 min at a 10% grade at 3.5 km·hr⁻¹. Following the 15-min walking test the subjects recovered for 10 minutes. Heart rate (ECG) and blood pressure (auscultation) were recorded pre-exercise, during the last minute of exercise, **and** during recovery. Rate pressure product (RPP=HRxSBP) was then used to estimate myocardial workload.

RESULTS

Listed below are the RPP means (standard error) for each ensemble prior to exercise, at the end of 15 min of exercise and after 10 minutes of recovery:

	<u>BLUES</u>	<u>HB</u>	<u>LB/BP</u>
Pre-Exercise	6,889.8 (± 534.1)	10,051.1 (± 526.5)	11,703.8 (± 568.3)
Post-Exercise	22,476.3 ($\pm 1,114.2$)	29,745.3 ($\pm 1,535.9$)	32,085.8 ($\pm 1,907.6$)
Recovery	11,150.2 (± 549.4)	13,511.1 (± 812.7)	16,337.0 (± 760.4)

Repeated measures ANOVA revealed significant main effects for condition, time, and interaction ($p < .001$). Post-hoc analysis indicated that both gear ensembles resulted in a larger increase in RPP than the blues, and that the LB/BP gear resulted in a larger increase in RPP than the HB configuration.

CONCLUSIONS

These findings suggest that exercise at ambient temperatures (23.9°C) produces significantly higher estimated oxygen demand of the myocardium when done in turn-out gear. This is particularly important since approximately 36% of all on-duty firefighter deaths in 1990 were due to myocardial infarction (3). The RPPs reported in this study suggest that moderate exercise in turn-out gear may provide sufficient cardiovascular stress to elicit myocardial ischemia in subjects who are predisposed to cardiac disease. One would expect this situation to be exacerbated when firefighters must perform work tasks in a hot and hostile environment. Furthermore, the turn-out gear ensemble that is worn affects the workload of the heart with the LB/BP gear (used by many stations) resulting in a greater RPP than the HB gear.

REFERENCES

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