THE ASSESSMENT OF COMFORT AND EFFICIENCY IN COOLING VEST FOR FIREFIGHTERS

Chinmei Chou (Yuan Ze University, Taiwan)
Yipin Chen (Yuan Ze University, Taiwan)
Yun-Ru Hung (Yuan Ze University, Taiwan)
Zi-Ying Li (Yuan Ze University, Taiwan)

1. Introduction
Fire extinguishing is difficult and a high-risk job faced by firefighters. However, the heavy airtight outfit may slow them down and block the sweat evaporation, which will suffocate them and result in indirect heatstroke. Cooling Vests were worn by firefighters worldwide to keep their body temperature normal.

The purpose of this study was comparing two kinds of cooling vest which included the back-pack types (BPT) and the plug-in types (PIT) and measuring the physiological and psychological effects to assess comfort and efficiency in the two experiments (the treadmill and motion) which was looking forward to enhance the comfort and efficiency of firefighters by applying the result of this study.

2. Methods
2.1 Subjects
Eight male participants were recruited for this study. All of them are healthy male and chosen randomly to conduct the two experiments in this study. Mean age of participants was 20.62 years old, mean height was 173.7 ± 4cm and the weight was 66 ± 12.2kg.

2.2 Experiment
There were two experiments in the study. Experiment 1 took 27 minutes to simulate the high-temperature environment on a treadmill. Ear temperature, heart rate, and blood temperature were measured.

Experiment 2 was defined twelve specific motions to be performed (Figure1). The action analysis was divided into upper and lower parts. The upper part of the body was defined to the neck, shoulders, arms, elbows and back; and lower body parts was defined to thighs and knees. Subjective perceptions were assessed by questionnaire. Also the participants’ complete time were measured after conducting each action in experiment 2 to evaluate the efficiency in different cooling vests.

Figure 1.
Motion Experiment
2.3 Equipment and Variables
The equipment of the study included BPT (Figure 2), PIT (Figure 3), photographic equipment and stopwatch. The independent variables in this experiment were two cooling vests. The dependent variables were the results of subjective questionnaire assessment.

3. Statistics
The physiological results of the treadmill experiment were analyzed. Also, the results of the motion experiment were determined by the interaction in Two-Way ANOVA which were utilized the parts of the body and the vests as primary factors. Subjective comfort and efficiency in questionnaire were used One-Way ANOVA to assess.

4. Result
4.1 The Experiment 1 (Treadmill)
The physiological results of the treadmill experiment showed that skin temperature of BPT (33.92 ± 0.55°C) was lower than PIT (34.33 ± 0.38°C) In the results of questionnaire in the experiment 1, BPT took longer cooling period (p<0.05). Also the comfort of the cooling vests was not only in inverse relationship between comfort and humidity, but also in direct relationship between comfort and satisfaction.

4.2 The Experiment 2 (Motion)
The results of the motion experiment showed that PIT was lither than BPT (p<0.05). It was easy to wear and did not affect the mobility when participants suited. The psychological results didn’t reveal significant difference.

5. Conclusions and suggestions
Due to the PIT which was made with non-absorbent material inserted with rapidly melting ice-pates, it could cause dampness. The participants with the PIT felt hotter and wetter than those in the other conditions.

Therefore, this study suggested that BPT was more comfortable and effective in physiological results which had a direct impact on the health of firefighters. Reductions in heat storage could enhance firefighters’ comfort and efficiency in hot environments.

6. References