International Journal of Chemical, Materials and Biomolecular Sciences
ISSN: 2415-6620
Vol:5, No:5, 2011

Investigation on Some Ergonomics and Psychological Strains of Common Militarism Protective Clothing

A. Ashjaran, A. Rashidi, R. Ghazi-Saeidi

***Abstract*—**Protective clothing limits heat transfer and hampers task performance due to the increased weight. Militarism protective clothing enables humans to operate in adverse environments. In the selection and evaluation of militarism protective clothing attention should be given to heat strain, ergonomic and fit issues next to the actual protection it offers.

Fifty Male healthy subjects participated in the study. The subjects were dressed in shorts, T-shirts, socks, sneakers and four deferent kinds of militarism protective clothing such as CS, CSB, CS with NBC protection and CS with NBC- protection added.

Ergonomically and psychological strains of every four cloths were investigated on subjects by walking on a treadmill (7km/hour) with a 19.7 kg backpack. As a result of these tests were showed that, the highest heart rate was found wearing the NBC-protection added outfit, the highest temperatures were observed wearing NBC-protection added, followed by respectively CS with NBC protection, CSB and CS and the highest value for thermal comfort (implying worst thermal comfort) was observed wearing NBC-protection added.

***Keywords*—**Militarist protective clothing, Ergonomic, Heat strain, Thermal comfort

I. INTRODUCTION

HUMANS are equipped with a wide range of physiological mechanisms to adapt to these adverse climates, some form of additional protection in the form of clothing and equipment is necessary [1],[2].Protective clothing also forms an extra strain for the human body due to its weight and due to the hampered heat transfer to the environment [4].A good balance has to be achieved between protections on the one hand and human factors aspects on the other hand. In general, the focus is on the protection and consequently human factors aspects are underestimated. Improving ventilation through and under the protective clothing increase sweat efficiency and thus reduces heat strain. Ideally, the sizing of the protective clothing should reflect the human body dimensions. A relatively loose fit enable a wider movement range and better ventilation [3],[5].This study summarizes some of the human factors such as ergonomically and psychological strains of protective clothing. The ergonomics, psychological and physiological strain of protection and function, four different clothing (combat suit (CS), CS + ballistic vest, CS + NBC ready, CS + NBC protection), were evaluated during walking on a treadmill.

Department of Textile and chemistry From Islamic Azad University, Shahr-e-Rey Branch-Tehran-Iran (+9821-55229301; fax: +9821-55229373; e-mail: A.ashjaran@gmail.com).

Department of Textile, Islamic Azad University, Science and Research Branch -Tehran-Iran

Department of Textile, Islamic Azad University, Science and Research Branch -Tehran-Iran

II. MATERIAL AND METHODS

A. Material

T-short, shorts, socks and sneaker purchased from Taha Co. (100% cotton). Cotton combat suit (CS), Cotton combat suit with ballistic vest (CSB or protective vest), Cotton combat suit with NBC protection (CSNBC or NBC ready) and Cotton combat suit with NBC protection and mask and rubber gloves (CSNBC added or NBC protection) purchased from Homa Co.

B. Methods

Fifty Male healthy subjects (age 21 ± 3 years, stature 180 ± 3 cm, weight 75 ± 8 kg) participated in the study. The subjects signed an informed consent after the stydy was explained to the study. The subjects were dressed in shorts, T-shirts, socks, sneakers and four deferent kinds of militarism protective clothing such as CS, CSB, CS with NBC protection and CS with NBC- protection added.

The combat suit weighed 1450 g. The ballistic vest, NBC protection and NBC protection added 6376, 2854 and 3478 g respectively.

Each soldier participates three times in this study and some Psychological strain and ergonomics of these clothes are investigated on them.

The subjects were exposed 20 minute walking on a treadmill (7 km/hour) with a 17.7 kg backpack. Heart rate, thermal comfort, temperature and mode sate were taken after 10 and 20 minute of exercise during every this cycle. Mean strain and ergonomics was defined as the average their factor after 10 and 15 minute of exercise.

III. RESULTS AND DISCUSSION

A. Heart rate

Heart rate measurements are shown in fig. 1. The highest heart rate was found wearing the NBC protection outfit. Heart rate was similar for NBC ready and the ballistic vest. The

lowest heart rate was observed wearing the combat suit. A higher heart rate was found after 15 minutes of exercise compared with the heart rate after 10 minutes. No interaction effects between clothing condition time cycle and/or measurements at 10 and 15 minutes were observed.

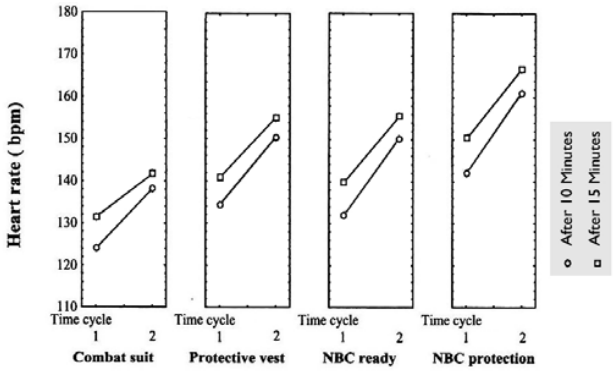

Fig 1Heart rate after 10 and 15 minutes of the time cycle wearing different clothing systems

B. Temperature

The higher temperatures were observed wearing NBC protection, following by respectively NBC ready, ballistic vest and combat suit. Fig. 2 shows the results for body temperature. Higher values of body temperature were measurements after 10 minutes. No interaction effect was found between clothing condition and the temperature measurements after 10 and 15 minutes.

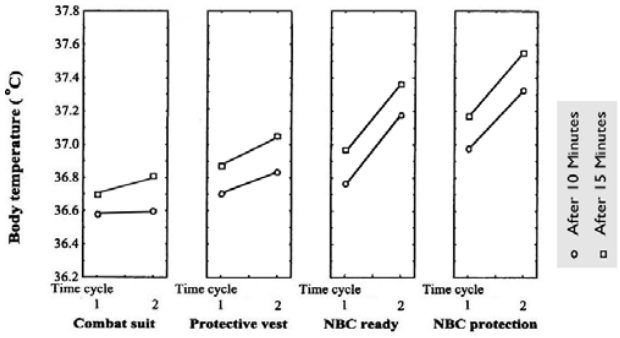

Fig 2 Body temperature during walking

C. Thermal comfort

The highest value for thermal comfort (implying worst thermal comfort) was observed wearing NBC protection (Fig. 3). Wearing NBC ready or the ballistic vest in the same assessment of thermal comfort. Wearing the combat suit resulted in the lowest value for thermal comfort (implying the best thermal comfort). Significant differences were observed between thermal comfort after 10 and 1 minutes, with higher values for thermal comfort after 15 minutes. NO difference in thermal comfort was found during the cycles.

Also, no interaction effects were observed between clothing condition, time cycle and measurement after 10 and 15 minutes.

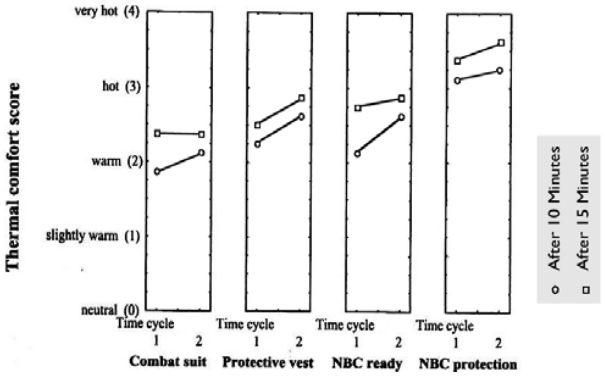

Fig 3 Thermal comfort after 10 and 15 minutes of exercise

D. Mode state

Clothing conditions had significant effects on all profile of mode items, with exception anger. Tension was significantly higher wearing NBC protection compared with the other clothing condition. The highest values for fatigue was also observed wearing NBC protection (Fig. 4). The highest score for vigor was observed wearing a combat suit, which was significantly different with the NBC ready outfit.

A significant interaction effect between clothing condition and time cycle was only observed for tension. This interaction effect was the result of a decrease in tension over the time cycles during the NBC protection, while tension remained the same during the other clothing conditions.

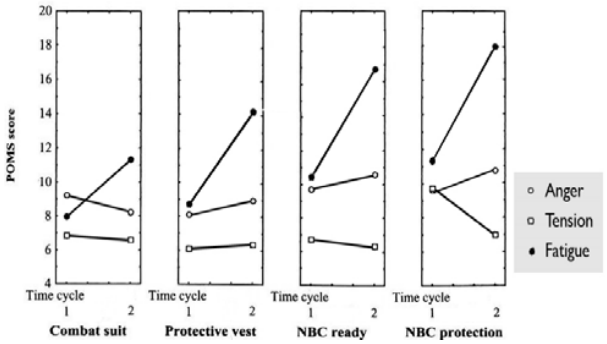

Fig 4 Profile of mood state scores

IV. CONCLUSIONS

The investigation on ergonomics, psychological and physiological strain of protection and function were shown that the highest heart rate was found wearing the NBC-protection added outfit, the highest temperatures were observed wearing NBC-protection added, followed by respectively CS with NBC protection, CSB and CS and the highest value for thermal comfort (implying worst thermal

comfort) was observed wearing NBC-protection added.

Psychological aspects may play a major role, which is confirmed by the results of the subjective rating scale items (POMS): tension, depression and fatigue. It can be conclude that psychological and physiological strain increased when wearing addition protection equipment. A ballistic vest decreased performance mainly through its weight; chemical protective clothing decreased the heat loss leading to performance degradation. A protection mask negatively affects the mood of the wearer.

The magnitude of the effects depended on the task, task duration and clothing system.

REFERENCES

[1] H. A. M. Daanen, Es. e. Van and J. De Graaf, "Heat strain and gross efficiency during endurance exercise after lower, upper of whole body precooling in the heat," Int. J . Sports Med. 2005, Vol.26, pp. 67-69

[2] G. Havenith, W.A. Lotens, "Clothing ventilation, vapour resistance and permeability index: changes due to posture, movement and wind," Ergonomics. 1990, Vol.33 No.8, pp.989-1005.

[3] N. C. Malaplane, M. N. Shaba, "Comparison of functional performance of a soldier in full chemical and biological protection versus battle dress," International Journal of industrial and ergonomics," 2001, Vol.27, pp. 393-398.

[4] H. A. M. Daanen, K. Hatcher and G. Havenith, "Determination of clothing microclimate volume, Environmental Ergonomics," Elsevier Ergonomics book, 2005, pp. 361-363.

[5] H. A. M. Daanen, T. K. Tan, C.L. Koerhuis and J. Vander Horn, "Performance degradation due to protective clothing in the heat," 2003, IEA conference Proceeding, Seoul, pp. 342-347