

Fire Service Instructor's undergarments choice can minimise physiological and perceptual strain

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Fire service instructors' are frequently exposed to high temperatures, whilst wearing encapsulating protective clothing, resulting in high levels of physiological and perceptual strain (Petruzello et al, 2009). The South East Regional Fire Service requested an investigation into the effect of different undergarments worn by fire service instructors, to help improve thermoregulation and reduce the levels of strain experienced. Recent literature suggests that wearing shorts and t-shirt may reduce heat stress by 10-15%, compared to full length clothing (McLellan & Selkirk, 2004), whilst no research has established the effect of wearing compression undergarments in fire environments.

The study investigated the use of three undergarments [boiler suit (BOILER), whole body compression garments (COMPRESSION) or shorts and t-shirt (SHORTS)] during intermittent exercise [5 mins walking ($4\text{km}\cdot\text{h}^{-1}$, 1% gradient), 5 mins standing] for 45mins in the heat (50°C and 10% RH). Eight males (age 20 ± 2 years; weight $75.7\pm 7.1\text{kg}$; height $177\pm 7\text{cm}$) completed all clothing conditions wearing full fire service kit and breathing apparatus, weighing 17kg in total. Physiological and perceptual measures were recorded every 5min. Venous blood samples were collected before and after heat exposure for analysis of interleukin (IL)-6, which is a marker of inflammatory response.

Two way (3x2) ANOVA's were conducted, and revealed significant interactions for change in heart rate, change in core temperature (ΔTre), VO_2 , physiological strain index (PSI) and IL-6, $p < 0.05$. End HR showed a meaningful difference between garment types, with COMPRESSION ($131.29 \pm 12.45\text{b}\cdot\text{min}^{-1}$) displaying a lower average end HR compared to SHORTS ($138.43 \pm 9.90\text{b}\cdot\text{min}^{-1}$) and BOILER ($140.14 \pm 15.14\text{b}\cdot\text{min}^{-1}$). ΔTre also displayed a meaningful difference, with BOILER causing a rise in Tre of $1.00 \pm 0.56^{\circ}\text{C}$, compared to an increase of $0.76 \pm 0.37^{\circ}\text{C}$ for SHORTS, and $0.70 \pm 0.31^{\circ}\text{C}$ for COMPRESSION. Mean \pm SD trends suggest that end PSI and IL-6 are lower in COMPRESSION (4.06 ± 0.85 , $6.45\pm 0.43\text{pg}\cdot\text{ml}^{-1}$ respectively), than SHORTS (4.50 ± 1.07 , $6.59\pm 0.30\text{pg}\cdot\text{ml}^{-1}$ respectively), and BOILER trials (5.07 ± 1.02 , $6.96\pm 0.28\text{pg}\cdot\text{ml}^{-1}$ respectively). BOILER generated the greatest VO_2 ($1.21 \pm 0.19\text{L}\cdot\text{min}^{-1}$), compared to SHORTS ($0.94 \pm 0.29\text{L}\cdot\text{min}^{-1}$) and COMPRESSION ($1.11 \pm 0.31\text{L}\cdot\text{min}^{-1}$) at 40mins, however this difference was not statistically significant. Body heat content, blood pressure, skin temperature, rating of perceived exertion and thermal sensation (TSS) did not display any significant differences between garment types. However, TSS exhibited a meaningful difference, with COMPRESSION (6.9 ± 0.7) making participants feel cooler than both SHORTS (7.4 ± 0.4) and BOILER (7.8 ± 0.3).

The lack of significance seen for some variables may be due to the small participant number used; however meaningful differences were exhibited for TSS, HR, ΔTre , and VO_2 . PSI and IL-6 both displayed statistically significant differences between

garment types. In comparison to standard issue boiler suits and shorts and t-shirt, wearing compression garments underneath protective clothing, during instructing exercises in the heat, may improve thermoregulation, by reducing physiological strain, inflammation and perceptions of stress.

References

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