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MEETING ABSTRACT Open Access

The physiological and thermal responses of military personnel undertaking a military exercise in Kenya

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Introduction

Undertaking operational patrolling activity in hot environments, carrying heavy loads and wearing personal protective equipment (PPE) presents a significant physiological challenge to Service personnel. Planned research trials involving volunteers exercising in the heat observe an important volunteer withdrawal criterion of attainment of a core body temperature of 39.5 °C. However, trained populations (marathon runners) have been shown to sustain exercise with core temperatures in excess of 40 °C with no recognised adverse health effects [1]. Thus, it could be hypothesised that military personnel with a good level of physical fitness might similarly sustain higher than usual core temperatures, albeit while wearing impermeable PPE. The aim of the present study was to measure the *actual* thermal response of military personnel while performing operationally specific exercises in the most arduous phase of a military exercise in a hot-dry environment.

Methods

A cohort of n = 28 male personnel from 3rd Battalion the Parachute Regiment volunteered to participate in this study (MODREC 465/Gen/13). Physical characteristics; age, 25 (5) years; height, 1.80 (0.06) m; body mass, 81.1 (9.5) kg; sub-group maximal oxygen uptake, 60.7 (6.3) $mL.kg.min^{-1}$ [2]. Physiological and thermal measures were made over two consecutive 24 hour periods (Day 1 and Day 2) during the military Exercise ASKARI STORM. This is a live firing tactical training activity in Kenya delivered by the British Army Training Unit Kenya. Each 24 hour period contained a combat scenario (Live Firing 1 and 2). Volunteers were instrumented with a heart rate monitor (Polar Team 2, Polar, Finland) *in situ* prior to the beginning of exercise on each day. Additionally, volunteers swallowed ingestible core temperature pills (VitalSense, Mini Mitter Company Inc, USA) at 12 hour intervals throughout the observation period.

Results

Mean WBGT for Day 1 and Day 2 were 25.9 (4.2) and 24.2 (4.9) °C, respectively. Throughout Day 1 and Day 2 mean core temperature remained below 38.5 °C (Day 1, 37.4 (0.4) °C; Day 2, 37.1 (0.4) °C and although there was a high degree of variation between individuals, all volunteers remained below the critical T_{core} of 39.5 °C. At the onset of each Live Firing scenario, T_{core} rose (Live Firing 1, 1.0 (0.6) $°C.hr^{-1}$; Live Firing 2, 0.3 (0.4) °C). However, after this initial rise, T_{core} either decreased (Live Firing 1) or attained a plateau (Live Firing 2). Rate of rise was lower when considered over the duration of each scenario (Live Firing 1, 0.2 (0.3) $°C.hr^{-1}$; Live Firing 2, 0.1 (0.4) $°C.hr^{-1}$). Due to technical difficulties, heart rate measurements were only collected during Live Firing 1, where the majority of time (60 (11)%) was spent in the moderate heart rate zone (40-59 %HRmax), whilst 20 (9)% was spent in the hard zone (60-84 %HRmax).

Discussion

Despite volunteers undertaking challenging military-specific work in the heat, core temperature was successfully regulated over both a prolonged period (Day 1 and 2) and during an intense combat scenario (Live Firing 1 and 2). This successful maintenance was most likely a result of good aerobic fitness and positive behavioural responses to the activity and environment (i.e. adequate

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rest and venting opportunities such as removing helmet and loosening PPE).

Conclusion

Throughout the 2 day observation period core temperature was elevated but successfully maintained below 39.5 °C. In this well-trained population, the risk of attaining a critical core temperature was low in the environmental conditions and at the intensities undertaken here.

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