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Thematic Oral Poster Session 4 – Load carriage

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The effects of body armour and load carriage on respiratory function and physical performance during a simulated military task in male and female soldiers

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Purpose: This study investigated the effect of wearing body armour and loads of varying masses on respiratory function and physical performance during prolonged marching, in male and female soldiers.

Methods: Twelve male and ten female soldiers conducted four 12.25 km treadmill marches (4.9 km/h in 3 × 50 min sessions) in different load configurations (21 kg, 26 kg, 33 kg and 43 kg), followed by a 2.4 km best time test wearing assault order load (26 kg). Respiratory mechanics, gait and movement analysis were measured before, during and/or after the tests.

Results: Only 50% of male and 10% of female participants were able to complete all conditions; statistical analysis was not possible for women wearing 43 kg. The main limiting factor for completing trials was self-reported discomfort, e.g. blisters and muscle discomfort. Women carried a significantly greater percentage of their lean body mass (44–93%) than men (36–74%). Time to complete the best effort test was unaffected by the load carried during the march. Women marched at a significantly increased percentage of $\dot{V}O_2$max compared to men (women: 36–55%; men: 31–41%). $\dot{V}O_2$ did not exceed the Gas Exchange Threshold (GET) in either group, indicating a moderate exercise intensity; percent GET was similar in both sexes (women: 50–73%; men: 50–62%). $\dot{V}O_2$ increased with load and over time ($\dot{V}O_2$ drift). $\dot{V}O_2$ drift was first observed in loads of 33 kg within 50 minutes of marching in women, and 110 minutes in males. Load carriage caused a restrictive ventilatory impairment in both sexes indicated by a reduction in lung volumes at rest (women: up to 15%; men: up to 17%). Increases in ventilation observed with load and over time were similar in men and women (women: 7–54%; men: 8–35%) and were achieved by increased breathing frequency, but not tidal volume. Breathing frequency was significantly greater (11–18%) in women than men throughout the march. Inspiratory and expiratory muscle fatigue was evident (7–22%) within the first 50 min of marching in all loads in both sexes.

Conclusions: Physical performance decrements during prolonged loaded marching are evident in both sexes, but occur in lighter loads and earlier during marching in women compared to men. This finding may reflect differences in body size between sexes; however, further analyses are required to understand the independent mediators of these findings. These data highlight the need to investigate, and improve, the load carriage ability of women.

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A contribution to understanding the impact of variations in body mass on fractionating the metabolic burden of military load carriage

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Purpose: The oxygen cost associated with load carriage is dependent upon both its mass and its placement about the body. For occupations in which load carriage is routinely performed, and involves identical loads for all individuals, the relative metabolic cost varies inversely with body mass. However, whilst we understand the average impact of varying load placement, our appreciation of its impact on a morphologically diverse, contemporary workforce is very limited.

Methods: The relationship between load placement and body mass was evaluated in 65 men (23.0 y [SD 3.0]; 80.5 kg [SD 1.7]: range 56.0–109.8 kg), matched for height-adjusted adiposity (59.3 mm [SD 25.4]) and height-adjusted body mass (65.9 kg [SD 22.0]). Participants were grouped into mass categories (55–65 kg [$N = 12$]; 66–76 kg [$N = 15$]; 77–87 kg [$N = 19$]; 88–98 kg [$N = 12$]; 99–110 kg [$N = 7$]) and walked at 4.8 km h^{-1} (0% gradient) for five, 15-min stages, separated by 5-min rests. Each stage involved a