LOAD CARRIAGE EXERCISES WITH TWO DIFFERENT LOADS AND THEIR EFFECTS ON SOLDIERS PHYSIOLOGY

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Introduction
Infantry is still a vital part of capabilities of the Finnish Defense Forces, while load carriage ability is one of the most important physical tasks for an infantry soldier. Modern warfare and modern warfare fighting equipment’s have not diminished the need for well-educated infantry soldiers. These soldiers are often well-equipped while the weight of loads depends on specific occupational tasks. Therefore, it is important to study the physiological responses induced by load carriage. The purpose of the present study was to examine metabolic changes in soldiers during a simulated road march with two different loads (29 kg and 45 kg). The results can be used to develop better training methods among conscripts, reservist and professional soldiers’ in the Finnish Defence Forces. In addition, the results can also be used to develop methods how to reduce the burden or strain of the soldiers. When we know how more our soldiers are affected by the burden that they carry we might be able to find solutions to lighten the load or develop new tactics with lesser equipment.

Methods
Eight male soldiers participated in the study (age 20 ±1 yrs., height 1.80±0.10 m, body mass 77.9±12.3 kg, BMI 23.9±2.4, VO2max 51.8± 4.2 ml· kg⁻¹·min⁻¹). Test subjects were chosen from conscripts and soldiers who were volunteers in the Finnish rapid deployment force. All the subjects were voluntary and they had served in the army at least 21 weeks before the tests. Maximal oxygen consumption (VO2max) was determined one week before the first load carriage test, while maximal strength, muscular endurance and body composition a day before the first load carriage test. Between the two tests there was 48 h rest period. The load carriage tests were conducted on a treadmill. The first 45-min of the test was performed at the speed of 4 km·h⁻¹ with inclination of 1.0 deg. Thereafter, the angle and speed was increased by having their highest values of 12 deg and 6 km·h⁻¹ or when the subjects’ voluntary quit the test. Oxygen consumption (VO2), ventilation (VE), heart rate (HR), rating of perceived exertion (RPE) and blood lactate (La) were measured during the test trials.

Results
Submaximal VE and HR were higher with the heavier load compared to the lighter load (p<0.05). Time to exhaustion correlated with absolute VO2max (ml·min⁻¹), (29kg: r=0.80 p≤0.05, 45kg: r=0.92 p≤0.05) but not with relative maximum VO2max (ml·kg⁻¹·min⁻¹). Maximal bench press results also correlated with time to exhaustion in both of the loads (29kg: r=0.75 p≤0.05, 45kg r=0.81 p≤0.05). VO2max and maximal bench press were the only two factors from the pre-load carriage physical fitness tests that were associated with time to exhaustion in the two load carriage tests. Body weight and fat free mass correlated positively only with the heavier load (r=0.72 p≤0.05), (r=0.74 p≤0.05) and standing long jump with the lighter load (r=0.80, p≤0.05). A regression analysis further revealed that height and bench press explained the variance of the load carriage test performance by 79% (p<0.01).

Discussion
The results of this investigation may indicate that upper body strength is a vital characteristic for carrying heavy loads, especially when measured by maximal isometric bench press. In addition, maximal aerobic capacity seems to be important while operating near maximal effort with an
additional load but, however when VO2max was related to body weight, it did not seem to have an important feature any more. Moreover, the load carriage performance of heavier soldiers may not be as hampered as that of lighter soldiers an aerobic strain did not seem to be important factor while marching with submaximal effort level. In conclusion, the present results may suggest that strength training, especially for the upper body, and endurance training are beneficial for soldiers in order to sustain carrying capabilities with heavy loads. The role of body weight, body fat percent and BMI should be taken into account when estimating soldiers’ abilities to carry heavy loads.