

Physiological stress of voluntary soldiers in military load carriage

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Many evidence based reports imply that infantry soldiers suffering from an unprecedented number of ankle and spinal injuries due to the incredible weights they have to carry. Since the last century, total loads carried by marching or combat soldiers have progressively increased. These heavy loads usually contain the basic sustainment and survivability kit, as well as “lethality” equipment, including weapon, ammunition, hand grenades, etc.

Loads recommended by the U.S. Army Infantry schools are 33 kg for an approach march load (45% of body weight) and 22 kg for a combat load (30% of body weight). Methods of reducing loads include the use of lightweight technology, load tailoring, auxiliary transport systems, and physical training.

The specific muscle groups involved in load carriage have been examined in some studies using correlational approaches, EMG analysis and strength changes after marching. These studies suggest that most of the functional muscle groups of the lower body (hip extensors, knee flexors and extensors, ankle plantar flexors), are involved in load carriage performance.

Energy cost increases progressively with an increase in the speed of marching, the load or the grade. March velocity decreases in a linear manner with load.

Lower extremity injuries are those most commonly experienced in load carriage. These include blisters, tendonitis, and stress fractures. Rucksack paralysis is most often seen in recruits but can occur in experienced soldiers.

Marching with loads in combination with other military training appears to increase VO₂ max as well as energy expenditure. The soldiers may therefore be exposed to more stress when carrying heavier load. According the statistics the lower limb (extremity) injuries are those most commonly experienced in load carriage. To avoid the development of musculoskeletal complaints and injuries, ergonomic interventions and utilization of appropriate methodology on load carriage performance (shown in following figure) as well as interval training should be implemented. For example, depending on the bearing technique the energy cost of load carriage could be minimized if the load is placed as close to the center of mass of the body as possible. However, military requirements favor the backpack, which allows more freedom of movement and can be quickly shed.

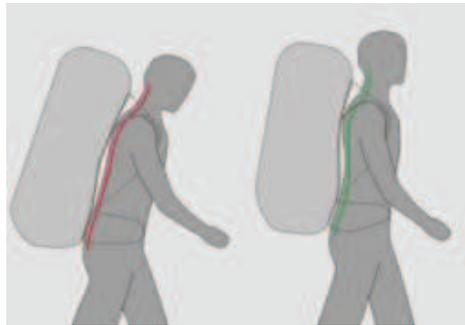


Figure 1. Different technique used in load carriage

The aims of the present research work are:

1. To scrutinize and identify the carriage and handling of loads performed by voluntary soldiers.
2. To investigate the effects of load bearing on the number of injuries as well as motivation and job satisfaction.
3. To find out any job related physiological and psychological exposure as well as musculoskeletal complaints at the work.
4. Just defining the concept of workload is not enough; there must also be a way to measure it. It's therefore important to study and suggest the most relevant and reliable human factors measurement tools which are sensitive to different levels of workload and could accurately measure workload and determine what levels of workload are excessive.
- 5.

There are generally three main classifications for measurement of workload: physiological, subjective and performance-based measures. Physiological measurement of workload is a factually based concept that relies on evidence that increased mental demands lead to increased physical response from the body. Physiological measures use the physical reactions of the body to objectively measure the amount of mental work a person is experiencing. It would seem an objective measurement would be the most exact and therefore the best way to find workload because it does not require a direct response from the person, unlike subjective measures. More important than how workload is measured is how the measurement is used.

The following methods which are considered as a fairly reliable indicator of workload suggested to be discussed in our Workshop:

- Initial observation
- Multiple Resources Questionnaire (MRQ) which can be used to demonstrate the subjective feeling of workload under and after performing the task
- Interview
- Objective measurements:
 - ✓ Cardiac monitoring (heart rate variability, HRV)
 - ✓ Respiratory activity (VO₂ max)
 - ✓ Blood pressure (BP)
 - ✓

It is hypothesized that modification on load characteristics and using an appropriate method on manual handling of the instrument which is supposed to be on line with optimization of education would decrease the amount of injuries (troops' misery).

These modifications would have even more positive impacts on novice soldiers who possibly are not well physically and mentally prepared and are therefore in higher risk zone regarding injuries.

The above brief description has thought to bring up for a comprehensive discussion regarding this issues.