

Abstract

When observing the gait associated with the transportation of backpacks by children and adults, there were differences in posture and gait when compared to gait without back overload.

Using a backpack type double backpack, studies suggest its performance is better than traditional transport.

It is expected to confirm the advantages of using double backpack by the civilian population for the transport of high loads minimizing possible future injuries.

Introduction

The backpack type double backpacks (front and back: double pouch or double backpack) and bilateral backpacks (supported on both shoulders) are ergonomically superior compared to simple backpacks (unilaterals) charged only with one shoulder.

Adults in professions such as the military, firefighting, and mountain rescue routinely carry packs loaded with 60% body weight. When the subject walks he needs to compensate sideways posture; when using the double-bag (front and back), causes less contraction of the spinal musculature and less cardiovascular effort.

When investigating the effects of using an exoskeleton (EXO), in order to facilitate the transport of high loads on the back, in metabolic cost during gait with loads, that in the case of military can reach 57% of body mass.

Gregorczyk concluded that the use of this type of device, increases the metabolic cost, not being metabolically sustainable for more than brief periods even in physically fit young people, thus opening an important window relevant for study with "double backpack".



Figure 1. Single backpack overload.



Figure 2. Double Backpack Front and rear.

Methods and Materials

To perform and obtain the collection of the required data it will be used various techniques. Some systems on the market use "inertial measurement units" (IMUs), resorting to the use of accelerometers and gyroscopes and recent techniques based on flexible optical motion capture systems, enable high speed and are reliable, based on the capture of marker positions.

Another technique is the **electromyography** that is used in many areas from medical clinic, rehabilitation and anatomy to biomechanics. The Electromyography refers to the study of neuromuscular activity through the graphical representation of the electrical activity of the muscle that indicates the neurological stimulation sent to a muscular system.

Oxygen consumption (VO₂) of an individual with a gait speed of 4 to 5 km/h is around 100 milliliters per kilogram of body weight per minute. Gait efficiency can be defined as the energy cost per distance traveled, the lowest value is considered maximum efficiency, i.e., the highest efficiency is achieved when it is required minimal energy per distance unit. The measurement of VO₂, during gait, reflects the efficiency of the movement pattern.

The **thermography** can be used in clinical trials measuring the skin temperature changes in response to physiological state of an individual. The temperature difference (ΔT) is a measure of the temperature difference between similar body locations and a difference of more than 1 °C is accepted as an abnormal. This technique enables real-time analysis, dynamic observation of the reactions of the locomotor system to provocative tests of painful syndromes and evidence of stress and efforts.

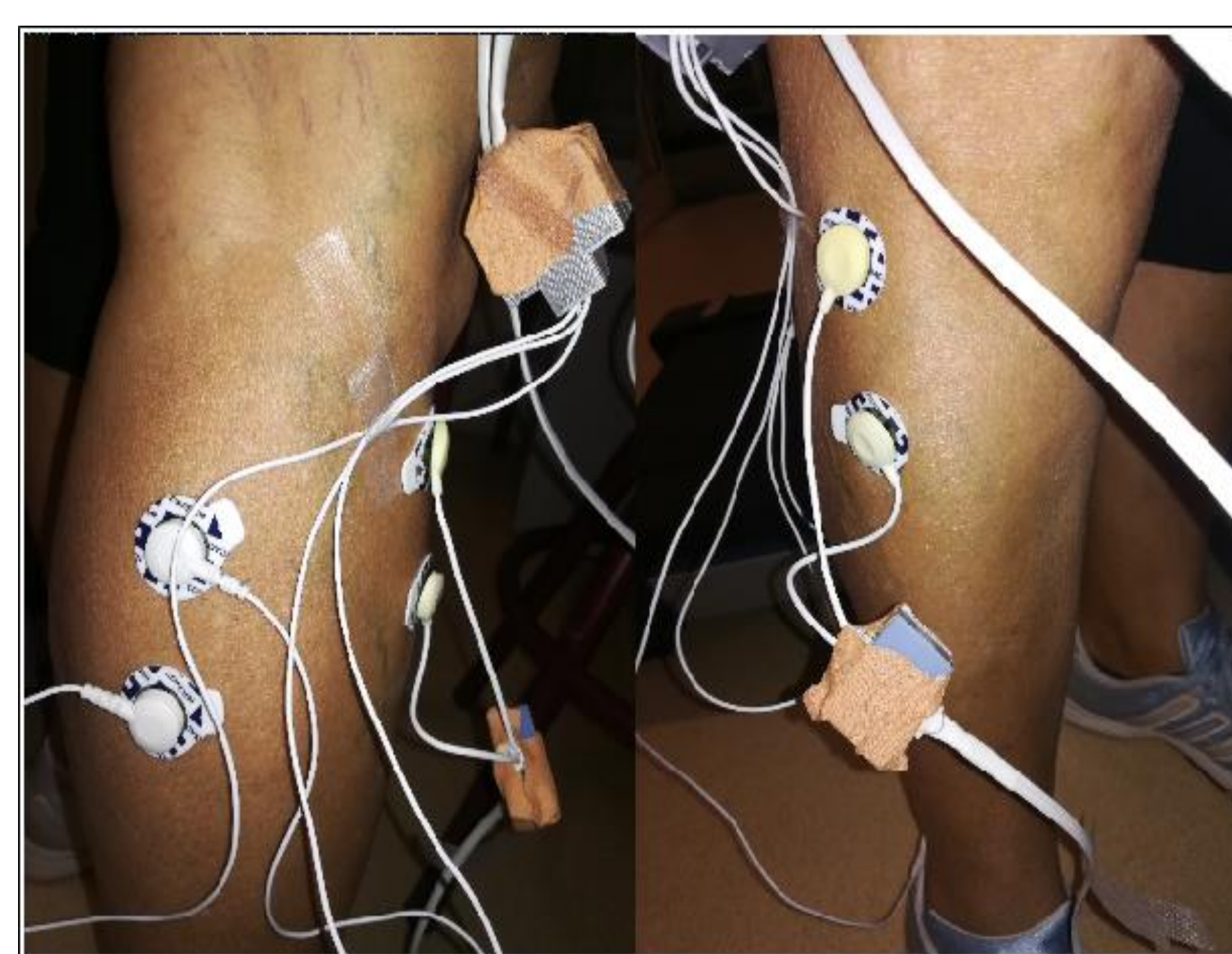


Figure 3. Electromyography test example in progress

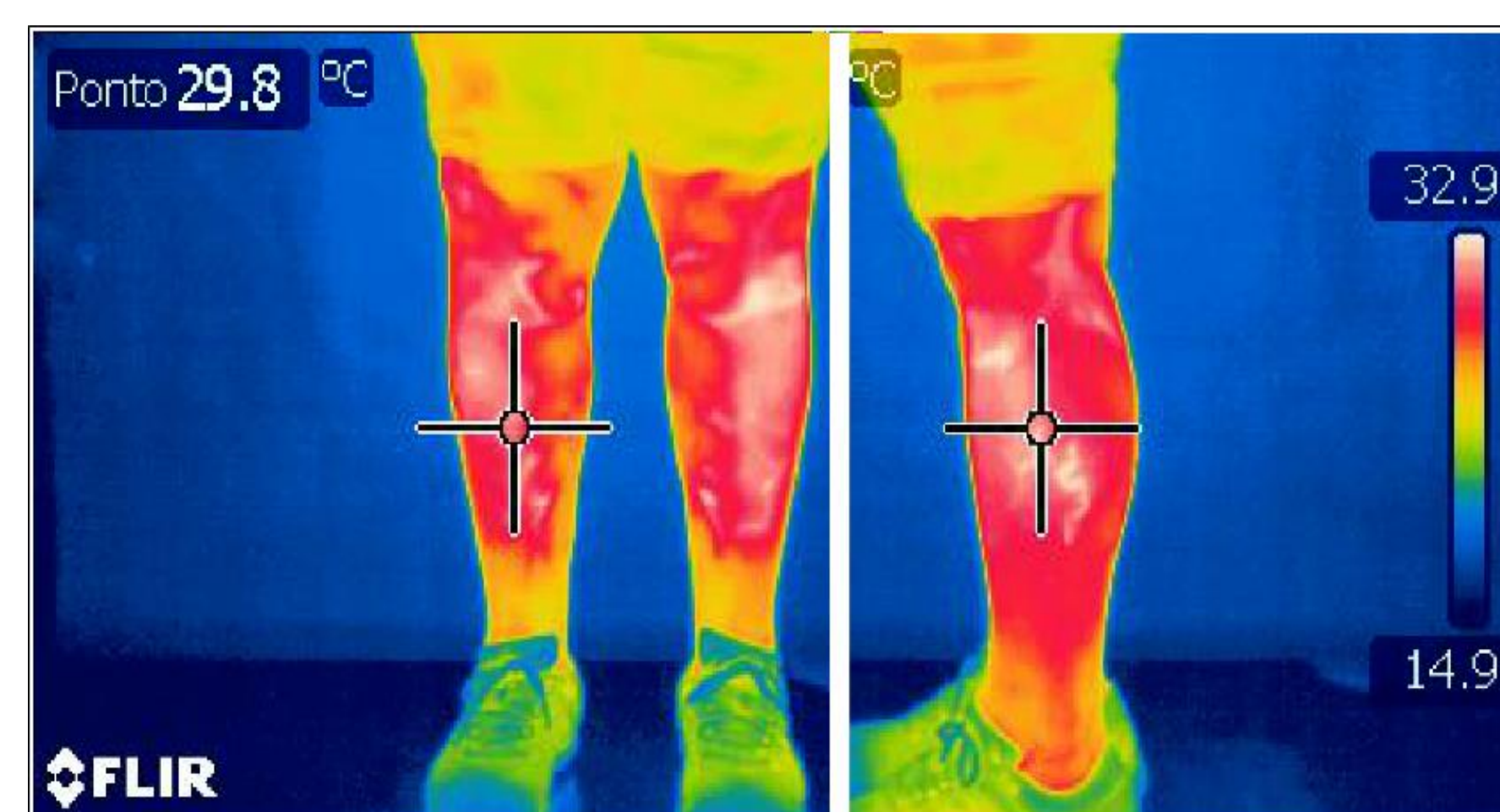


Figure 4. Thermography of legs image being taken after 5 minutes of gait overload.

Selection criteria

To sample it will be studied young adults between late adolescence **18 and 30 years old**. The main reason is due to the fact that in this age occur transporting larger loads concerning the weights, excluding carriage in academic environment.

To mislead reading errors or health problems, an initial screening will be performed so that we can select only individuals **with low or normal body fat** (important to the measurement of the thermography technique) and **no relevant health history** that may adulterate the intended measurement values, **like asthma, other kind of allergies or any other kind of limiting movement**. Thus it will be accept only healthy young adults to perform the tests on this gait study.



Figure 5. Example of measuring oxygen consumption (VO₂)

Preliminary study

As a preliminary study we perform an open inquiry to verify the accuracy of the data we pretend to study.

After we treated the data according to the 71 answers that were achieved and validated, we conclude that 54% of the activities made by civilian population are made in occasional Short Walks (less than 15km) and the majority of the answers given (34%) were from ages understood between 21-30 years old. As we expected, there is a gap on this range of population that is necessary to focus this study.

we can also understand that there is a high academic level in the answers collected, which allows us to better determine the type of double backpack that can be developed for these population.

