

You are here: [Home](#) > [UFRGS](#) > [News and Information](#) > Research analyzes how the weight carried in backpacks affects the performance of adventure racers

Research analyzes how the weight carried in backpacks affects the performance of

Results are believed to contribute to the training and preparation of athletes

by Camila Raposo

A research conducted at the School of Physical Education, Physiotherapy and Dance (ESEFID, in Portuguese) of the Federal University of Rio Grande do Sul (UFRGS), analyzed the influence of the weight carried in backpacks on the performance of adventure racers. Based on treadmill tests with athletes of the sport, the research was the first to evaluate the relations between load weight and several physiologic performance markers, including maximal oxygen consumption, energy expenditure, and ventilatory thresholds. The results are believed to contribute to the training and preparation of those who practice adventure racing. The research was part of the master's thesis of Alex de Oliveira Fagundes on Human Movement Sciences, and its results were published in the journal Plos One.

Adventure racing is a multimodality competition, either played solo or by teams, which takes place in the wilderness and includes, aside from trekking, several other disciplines, such as mountain biking, paddling and even ballooning. Race length varies from hours to days (as in the case with *El Cruce*, one of the main adventure races in the world, in which racers cross 100 kilometers of the Andes mountains). Athletes need to carry equipment, food and water, among other supplies, in order to sustain themselves through the race. "I intended to check whether the weight in the backpacks would interfere with their performance. The longer the race, the heavier the weight they have to carry. We expected there would be some interference, but we did not know exactly what it would be," comments Fagundes.

Laboratory tests were conducted with 12 adventure racers from Rio Grande do Sul – all male. The participants visited the laboratory five times and data was collected. The first visit was reserved for the familiarization of the athletes with the loads, the equipment, and with the research protocols, as well as for the collection of important research data such as the participants' muscle proportion, body fat percentage, weight, age, and time training the sport. The three visits which followed were reserved for the maximal tests – one day with no weight, one day with the equivalent to 7% of the body mass, and one day with 15%, chosen randomly.

For the maximal tests, participants ran on a treadmill while wearing a gas analyzer. The starting speed was 6km/h, and it was increased by 1km/h every minute, until the athlete was exhausted. Data including oxygen consumption, cardiac rate, and the quantity of carbon dioxide expelled were collected and the ventilatory thresholds – turning points for the metabolism, which can be used for setting the limits of a training session – were identified. As the athlete puts increased effort on a physical activity (such as running faster on a treadmill), changes take place in his or her organism. The athlete's heart speeds up, as does the breathing. But other changes are less evident – chemical reactions provoked by muscle contraction and the need for more energy, including the increase in blood acidity and a higher concentration of carbon dioxide in the air expelled. In this research, the turning points were calculated based on the information obtained with the gas analyzer.

Finally, on the last visit, participants were tested again with the same three different loads, except that the speeds were 10% lower than that in which they had reached at their second ventilatory threshold. Each athlete had a different speed determined for every weight carried. Each of the final tests lasted for 6 minutes, and, in between them, racers rested until their breathing and heart rates were back to normal.

Researchers observed that neither the ventilatory thresholds nor the maximal oxygen consumption (the highest volume of oxygen the body can carry and metabolize while performing a physical activity) were significantly changed by the different weights carried. However, there was



Research was based on lab testing of athletes. – Photo credit: UFRGS

a considerable impact on the participant's running economy, a term related to the quantity of metabolic energy used for performing the activity in a certain speed or distance. "This is a factor athletes should pay attention to. When they set out for the adventure race, nutrition is a great challenge they have to face, for they need to balance their food intake so they can sustain themselves throughout the race, and manage how much energy they use to carry that food. If they carry too much weight, they pay the price. The kilometers run will take more from them. This was a very important message from the research", explains ESEFID professor Leonardo Tartaruga, who supervised Fagundes on his master's thesis. Adventure racing traditionally demands a lot from its competitors, who may, during longer races, end by losing fat and muscle protein for the production of energy.

The collected data points to an inversely proportional relation between the weight carried and the recommended running speed. In order to maintain the same use of energy, a person must reduce the speed in the same proportion he or she increases backpack weight. For every 1% added to someone's body mass, the runner must reduce in 1% the speed he or she would run at without any extra weight. In other words, if a racer who weighs 80kg is used to running at 10km/h, when wearing an 8kg backpack (10% of one's body mass), he or she should then run at 9km/h (10% of the original speed).

As both researchers pointed out, this turned to be practical information both athletes and coaches can use for training and planning essential race logistics. "Knowing the effects of the weight carried by individuals, one can calculate specific training plans for every athlete," reinforces Fagundes.

Source:

FAGUNDES, A. de O. et al. (2017) Effects of load carriage on physiological determinants in adventure racers. Plos One. v. 12, n. 12.

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