GEORGE EMIL PALADE UNIVERSITY OF MEDICINE, PHARMACY, SCIENCE, AND TECHNOLOGY OF TARGU MURES

SCHOOL OF DOCTORAL STUDIES

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SUMMARY OF THE DOCTORAL THESIS

Increasing exercise capacity by scientifically directing sports training in cross-country and biathlon skiing

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Introduction

Through research studies important changes are observed in the elite athlete exercise capacity. The contribution of specialized science and specific medical activities is often discussed in terms of increasing the athletes working capacity during the training stages. However, in cross country skiing, the use of cardio-pulmonary assessments nationwide, is insignificant. Lack of data regarding both monitorization and training periodization could be much more related to the recent national and international performances.

Therefore, our hypothesis is that under both low and high intensity exercise training, physical effort can increase aerobic power, under both speed and resistance, while improving oxygen consumption and increasing VT_1 and VT_2 ratio.

Study Methodology

The doctoral thesis is founded on multiple observational studies, which consisted of several physiological test, anthropometric measurements and tracking during training conditions in order to test the existing hypothesis. The studies were conducted during the 2017 and 2018 cross-country skiing and biathlon training season. The study sample consisted of 13 international competitive athletes, members of the national cross-country and biathlon teams. The study group (n=13) was separated into two sub groups (n=2). Group 1 was also called G_1 while group 2 was referred to as G_2. G_1 group was composed of cross country skiing athletes (n=6), compared to G_2 group (n=7), formed of biathlon athletes.

Study protocol

The study protocol was applied over 270 days, involving several effort capacity and resting metabolic rate measurements by using Cosmed Quark CPET equipment, while tracking the training outcomes over the predefined training periods. The general training phase was referred to as stage I (f_{1-3}), representing the first training stage. The specific training stage, namely stage II, the pre competition stage, stage III and the competition phase, stage IV represented the main training stages during the study period. Over the predefined period, we conducted three physiological exercise tests (n=3), abbreviated as T_{1-3}, which measured exercise capacity by assessing the VO_{2max} value. Three resting metabolic rate (RMR) measurements (n = 3) abbreviated as R_{1-3}, were conducted at 30 - 40 days apart. Secondly, but of particular importance, daily training monitoring along with anthropometric and baseline functional analysis, consisting of heart rate and blood pressure measurements were conducted as well.

Results

Comparative analysis over exercise capacity assement

No statistically significant differences ($p > 0.05$) were obtained between G_1 and G_2 groups regarding both the oxygen volume and the VE (3723 vs. 4004 ml / min; 98.7 vs. 97.4 l / min). However, significant statistical differences were obtained on Rf (44.7

vs. 37.5 c / min), with a statistically significant relationship over the tidal volume (2.24 vs. 2.45) ($p = 0.01$). Between the two groups, the carbon dioxide removal ratio (3478 vs. 3779 ml / min) did not differ statistically ($p > 0.05$). Thus, CO_2 equivalent (29.09 vs. 27.4) ($p = 0.0089$) along with the respiratory exchange ratio (1.17 vs. 1.13) were significantly different as seen through $p = 0.0391$. Further on, O_2 equivalent (25.8 vs. 24.79), VO_2/HR, along with $PetO_2$ and $PetCO_2$ failed to be significantly different over the study groups ($p > 0.05$).

The two study groups illustrate lack of differences regarding VT_1 and VT_2 ventilatory thresholds, determined by VE, VE/VO_2, VE/VCO_2 use. Thus, VT_1 for G_1 and G_2, through 80 vs. 79.59% of HR_{max} does not differ statistically from T_2 ($p>0.05$). Respiratory exchange ratio and CO_2 equivalent imposed differences in energy metabolism. Thus, the energy density (17.63 vs. 19.77 kcal / min), along with fat (32.79 vs. 24.5%) and the carbohydrate (67.2 vs. 75.4%) ratio were significantly different ($p<0.01$). Significant statistical differences are identified during the T_2 evaluation between the two groups, regarding both effort capacity and physiological adaptations.

Conclusions

Conducting training by using individual adaptations and progress related data, can improve exercise capacity. The main results suggested that a progressive exercise intensity will positively influence oxygen consumption, along with both VT_1 and VT_2 values. Starting from this point an individual progress profile, following training volume and effort intensity during several stages, led to important results and the following main partial conclusion:

Individual adaptations can be assesed during medium term periods by measuring the resting metabolic rate, while monitoring the body weight changes and the energy balance. Although no significant differences were seen in the RMR values, the respiratory exchange ratio was correlated with the training characteristics. The individual progress and improvements in the exercise capacity, were enhanced through aerobic training, as see in G_2 unlike G_1 group during the general training phase. Further on, 95 and 98% of the total exercise volume was conducted in aerobic training stages (45 - 80% of VO_{2max}), whereas an increased effort intensity (>80% of VO_{2max}) did not exceed between 2 and 5% of the assigned volume. As against G_2 results, higher exercise intensity increased VT_1 in G_1, without any changes in VO_{2max} values.