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Aerobic and Anaerobic Physiological Characteristics of Brazilian Army Military Orienteers

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ABSTRACT

Redkva PE, Paes MR, Esmanhotto SA, Vargas LM, Cantorani JRH, Ferreira SS, Alves RC, Da Silva SG. Aerobic and Anaerobic Physiological Characteristics of Brazilian Army Military Orienteers. **JEP**online 2015;18(2):78-84. The purpose of this study was to present the physiological profile, VO_2 max, and anaerobic power of athletes in the Brazilian Army Sports Commission. Orienteering is a sport in which individual practitioners cover a path in rural area. It is a complex sport that requires skills spanning beyond the physical aspects, correct map reading, evaluating and choosing the best route, use of the compass, concentration and, maybe the most important of all, to be able to make quick decisions. During the orientation, metabolism was predominantly aerobic. However, there are intensity variations along the path that required the occurrence of strenuous anaerobic work. The VO_2 max, PMax, and PMed were 50.4 ± 4.2 $mL \cdot kg^{-1} \cdot min^{-1}$, 7.44 ± 1.1 $W \cdot kg^{-1}$, and 6.29 ± 0.8 $W \cdot kg^{-1}$, respectively. Interestingly, the VO_2 max values of the subjects were far below the values of elite athletes from traditional countries in this sport.

Key Words: Orienteering, Physiologic Profile, Army Athletes

INTRODUCTION

Orienteering is a sport of which the athletes cover a path in rural ground running. They must go through orientation control sites (previously determined by race organizers) in a number of points scored on the ground in the shortest time, aided only by a map and a compass. The route, defined by the location of the control points is revealed to the athletes just minutes before the start of the race (8).

It is a complex sport that requires a variety of skills beyond the physical aspects of running, correct map reading, evaluating and choosing the best route, use of the compass, concentration and, perhaps, most important of all the making of very quick decisions (4,6). In addition, the local competitions seems to be another factor that influences performance, because they are conducted in rural and rough terrain, which makes it a form of high physical demand (19,23).

Maximal aerobic power (VO_2 max), anaerobic power, flexibility, and agility are important in the success of orienteers (5). Thus, as a result, it is important that athletes and trainers understand the role of each in their training and competitive performance. This is particularly relevant among athletes who train hard to increase their aerobic capacity while appreciating the need to engage in extremely strenuous and difficult anaerobic work (2,17).

Understandably, orienteering is not presently recognized as a popular sport (5). Part of the reason may be due to the fact that not many studies have looked at the athletes' characteristics and physiological responses to orienteering. This seems true whether it is at the national or international level. To help clarify this thinking, the purpose of this study was to present the physiological profile (i.e., VO_2 max and anaerobic power) of the Brazilian Army Sports Commission Team's athletes.

METHODS

Subjects

This study consisted of 8 male subjects (i.e., orienteers) who were ranked nationally by the Brazilian Army Sports Commission. The anthropometric characteristics of the subjects are presented in Table 1. All the subjects participated in military competitions at the national level, and all subjects participated in a weekly training routine of 6 $d \cdot wk^{-1}$ with a volume of ~80 $km \cdot wk^{-1}$ of running. Each subject was informed about the methodological aspects as well as the risks and benefits of the study. An informed signed consent was obtained from all subjects. The research procedures were approved by the local Ethics Committee.

Procedures

The subjects were instructed to maintain the same standard ingestion of food with no alcohol intake or exercise during the test period. All procedures were performed in the morning with similar environmental conditions of 22 to 24°C at a relative humidity of 60 to 65%.

Measurements

Antropometry

Height (cm; Filizola, Sao Paulo, Brazil) and body mass (kg; Sanny stadiometer, Sao Paulo, Brazil) were determined according to anthropometric standards. Percent body fat (%BF) was determined using the BIA brand Maltron® BF-906 in accordance with the recommendations by Heyward and Stolarczyk (7). The subjects were asked to meet the following requirements of the BIA test: (a) avoid caffeine and alcohol 24 hrs before the assessment; (b) no physical activity or heavy meal at

least 4 hrs before; and (c) all diuretic medication must be suspended 24 hrs before evaluation (if appropriate). All data were collected individually, which was subsequently tabulated in a spreadsheet using the free software BrOficce.org Calc. All measurements were performed at a separate site to respect the privacy of the athletes.

Table 1. Descriptive Values (mean ± SD) of Anthropometric Characteristics of Orienteers.

Methods	Maximum (n = 8)
Age (yrs)	25.86 ± 6.84
Body Weight (kg)	69.1 ± 6.2
Height (cm)	179 ± 10
Body Fat (%)	12.07 ± 0.7
BMI ($kg \cdot m^{-2}$)	21 ± 0.6

Determination of VO_2 max

All subjects performed 5 min of warm-up at a moderate intensity (8 $km \cdot h^{-1}$) before starting the test, which was followed by a 5-min passive recovery. Then, the subjects performed a maximal incremental test on a treadmill (ATL Imbramed Millennium®). The initial velocity was 12 $km \cdot h^{-1}$ with increments of 1 $km \cdot h^{-1}$ every 3 min at a constant inclination of 1% (JONES, 1996) to determine maximal oxygen uptake (VO_2 max) velocity associated with VO_2 max (vVO_2 max). Cardiorespiratory parameters were measured breath-by-breath using the gas analyzer K4® (Cosmed, Italy). The equipment was calibrated with known gas samples containing 3.98% CO_2 and 16.02% O_2. The ventilation flow was calibrated using a syringe with a volume of 3 L (Hans Hudolf, USA). Strong verbal encouragement was used to keep each subject motivated to perform a maximum effort to voluntary exhaustion.

The values obtained by the breath-by-breath VO_2 assessment were reduced to a 15-sec average after the removal of outliers. Maximal oxygen consumption (VO_2 max) was considered as the highest average during the last 30 sec of exercise with at least 2 of the following 3 criteria obtained: (a) HR = maximal age-predicted HR (220 – age); (b) respiratory gas exchange ratio (RER) = 1.10; and (c) plateau (variations = 2.1 $mL \cdot kg^{-1} \cdot min^{-1}$ between the last 2 exercise stages.

Anaerobic Power Field Assessment

Assessment of anaerobic power was carried out using the Running Anaerobic Sprint Test (RAST) (22). The test consists of 6 x 35 m running in the shortest possible time with a recovery of 10 sec between each race. Maximum power (PMax), average power (PMed), minimum power (PMin), and fatigue index (IF) were determined using the following equations: (a) Power (w) = [Weight (kg) x distance 2 (m)] ÷ time 3 (sec); and (b) Fatigue index = [Maximum power – minimum power x 100] ÷ maximum power.

The best time, average time, and the worst time during the six efforts of the subjects were used to calculate the maximum, mean and minimum power. Time was recorded by digital timers (Timex, TI5G811® Manaus, Brazil).

RESULTS

The Saphiro-Wilk test was used to determine the normality of the data. Table 2 presents the average physiological values for the athletes in the Brazilian Army Sports Commission.

Table 2. VO_2 Max, Maximum Power (Pmax), Average Power (PMed), and Fatigue Index (IF) of the Orienteers (Mean ± SD).

Methods	Maximum (n = 7)
VO_2 Max ($mL \cdot kg^{-1} \cdot min^{-1}$)	50.4 ± 4.2
PMax ($W \cdot kg^{-1}$)	7.44 ± 1.1
PMed ($W \cdot kg^{-1}$)	6.29 ± 0.8
IF (W)	4.73 ± 2.3

DISCUSSION

When compared to the British (1), the Americans (15), and the Finnish (16) athletes, the anthropometric measures of the Brazilian athletes were found to be consistent in the body mass and height standards (Table 1). However, although the BMI of 21 ± 0.6 falls within the appropriate range as recommended by the World Health Organization (20) standard, it is higher than expected (but so is the BF% of 12.07 ± 0.7%). This was a surprise, given that excess adipose tissue acts as "dead weight" in activities such as running and jumping where body mass must be sustained repeatedly against gravity (3). Thus, the BF% of the military athletes is relatively high compared to the Danish athletes (top 40 national ranking) with a value of 10.4 ± 1.9 BF% (10). On the other hand, the Brazilian athletes is still well below the levels of the American (15) and Finnish (16) athletes of 16.3 ± 1.9% and 16.8 ± 0.9 BF%, respectively.

As Creagh and Reilly (5) pointed out, VO_2 max and anaerobic power are important physiological variables that define the physical fitness of the orienteers. Interestingly, the mean VO_2 max value for the military athletes of 50.4 ± 4.2 $mL \cdot kg^{-1} \cdot min^{-1}$ is well below the average maximum values for the elite Swedish athletes of ~70 $mL \cdot kg^{-1} \cdot min^{-1}$ (11), members of the national team of Denmark in 1992 of 74.3 ± 3.5 $mL \cdot kg^{-1} \cdot min^{-1}$ (10), and the Swiss orienteers of 69.6 ± 3.7 $mL \cdot kg^{-1} \cdot min^{-1}$ (18).

Physical performance is affected by a number of physiological variables, including anaerobic power (5). Among several tests reported to measure anaerobic power, the RAST (21) is a reliable and simple field test that reflects the maximal anaerobic power of a subject (14). The test results

indicate that the Brazilian Army Military Orienteers were well below the values described by Kaminagakura et al. (13) with military runners (average distance) of the same nationality. Another study using the RAST in Brazilian military nonathletes (22) showed higher values of PMax and PMed to those found in the present study. A probable explanation for the low value of anaerobic power may be related to the low demand for the sport in Brazil, especially since the most important issues are related to map reading and compass use rather than physical aspects.

CONCLUSIONS

Orienteering is a sport with complex features. The athletes must have the physical and athletic skills to perform a task in the shortest period of time. To increase the success of the athletes, it is important to understand the physiological requirements (particularly, the energy demands and physical training required to perform well in the race). The findings indicate that the mean VO_2 max value of the Brazilian Army Military Orienteers is well below the elite athletes from traditional countries in this sport. It is our recommendation that additional studies should be carried out to better characterize the physiologic profile of the military orienteers. Such studies may encourage new methodologies and analysis of physiological variables to improve the training that is required of the sport.

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