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Can disordered eating behaviors reduce maximum oxygen consumption in road cyclists?

Comportamentos de risco para os transtornos alimentares pode reduzir o consumo máximo de oxigênio em ciclistas de estrada?

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Abstract – The aim of this study was to compare the maximum oxygen consumption (VO_2max) between road cyclists with and without risk for eating disorders. The sample was composed of 43 cyclists aged 18-25 years, participants of the road cycling championship of the State of Pernambuco. VO_2max was measured by a computerized metabolic analyzer during an incremental test in cycleergometer. The initial test load was 50 W, with increments of 25 W every minute until volitional exhaustion or inability to maintain the current load. To evaluate disordered eating behaviors (DEB), the Eating Attitudes Test was used (EAT-26). Univariate analysis of covariance (ANCOVA) was used to compare the VO_2max between cyclists with (EAT-26 ≥ 21) and without (EAT-26 < 21) risk for eating disorders. The findings showed statistically significant VO_2max difference between cyclists with and without risk to eating disorders ($F_{(2, 41)}$=28.44; p=0.01), indicating moderate effect size (d = 0.6). It was concluded that DEB was related to cyclists with lower VO_2max.

Key words: Cycling; Physical endurance; Sport medicine.

Resumo – *O objetivo da pesquisa foi comparar o consumo máximo de oxigênio (VO_2máx) entre ciclistas de estrada com e sem risco para o desencadeamento de transtornos alimentares. A amostra foi composta por 43 ciclistas com idade entre 18 e 25 anos, participantes do campeonato pernambucano de ciclismo de estrada. O VO_2máx foi mensurado por um analisador metabólico computadorizado no decorrer de um teste incremental realizado em cicloergômetro. A carga inicial do teste foi 50 W, com incrementos de 25 W a cada minuto até atingir a exaustão voluntária ou impossibilidade de manter a carga atual. Para avaliar os comportamentos de risco para os transtornos alimentares (CRTA) foi utilizado o Eating Attitudes Test (EAT-26). Conduziu-se a análise univariada de covariância (ANCOVA) para comparar o VO_2máx entre ciclistas com (EAT-26≥21) e sem riscos (EAT-26<21) para os transtornos alimentares. Os achados revelaram diferença estatisticamente significante do VO_2máx entre ciclistas com e sem risco para os transtornos alimentares ($F_{(2, 41)}$=28,44; p=0,01), indicando moderado tamanho do efeito (d=0,6). Concluiu-se que os CRTA estiveram relacionados aos ciclistas com menor VO_2máx.*

Palavras-chave: *Ciclismo; Medicina esportiva; Resistência física.*

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INTRODUCTION

Road cycling is a cycling sport modality with endurance characteristics, usually performed outdoors, in which long distances are traveled on a bicycle (~ 250km). According to Skorski et al.[1], movement economy, alactic anaerobic power, anaerobic resistance and maximum oxygen consumption (VO_2max) are the main performance indicators in road cycling.

VO_2max refers to the body's maximum ability to uptake, transport and use oxygen and is expressed in absolute (1/min) or relative terms (ml/kg/min)[2]. Studies have indicated that VO_2max is closely related to aerobic and anaerobic capacity[3-4]. In this sense, VO_2max is considered of extreme importance for athletes of cyclic endurance sports, such as road cycling, to support long competitive distances, as it ensures high energy performance throughout the cycling stage and favors rapid removal of metabolic acidosis accumulated among high-intensity muscular actions[5].

Therefore, it is considered inevitable to identify aspects that can affect VO_2max in cyclists, both positively and negatively. On the one hand, long-term continuous exercises and/or moderate intensity interval exercises are used in training to improve VO_2max[2], while, on the other hand, disordered eating behaviors (DEB) may attenuate it in athletes[6-7].

DEB are considered inadequate methods for reducing body mass[8]. Long periods without food intake, use of laxatives/diuretics/appetite suppressants, use of plastic clothes to generate dehydration during physical training sessions and self-induced vomiting are pointed out as the main DEB among athletes[9]. According to Bratland-Sanda and Sundgot-Borgen[6], the pressure of coaches for better athletic performance is the main explanation for the athletes' adoption of DEB. Findings have demonstrated that about 25% of male endurance sports athletes adopt DEB as a measure to maximize athletic performance[10-12], since coaches often associate body mass attenuation with improved athletic performance[13].

It seems that DEB can lead to VO_2max reduction in athletes[6]. According to Chapman and Woodman[9], DEB generate dehydration, which in turn can induce increased blood viscosity and, consequently, cardiovascular overload. Thus, considering that cardiovascular overload is closely related to the decrease in aerobic performance[14,15], it could be concluded that DEB can generate VO_2max attenuation. However, it is noteworthy that, to the best of our knowledge, no scientific research has sought to analyze whether, in fact, DEB induces VO_2max reduction in athletes, which justifies the accomplishment of the present study.

In summary, the following question is made: is there a negative relationship of DEB with VO_2max in road cyclists? If this relationship is true, follow-up and/or psychological intervention programs may be indicated for road cyclists with the premise of inhibiting the adoption of DEB. From the practical point of view, this type of research may contribute to the field of sports sciences, as it is fundamental to identify the intervening factors in the VO_2max of athletes. In view of the above, the aim of the present study was to compare VO_2max values between road cyclists with and without risk for the onset of eating disorders. Then, based on the assertions of some researchers[6-8], a hypothesis was formulated for the present investigation: 1) road cyclists with higher DEB frequency present lower VO_2max compared to cyclists with lower DEB frequency.

METHODOLOGICAL PROCEDURES

Participants

This is a research developed with male road cycling athletes. The sample consisted of 48 cyclists aged 18-25 years participating in the road cycling championship of Pernambuco. Cyclists trained on average 2 hours a day five times a week. To be included in the survey, athletes should: a) be a road cycling athlete for at least one year; b) train road cycle for at least 6 hours per week; c) be enrolled in the state championship organized by the Cycling Federation of Pernambuco and; d) be willing to answer a questionnaire, participate in anthropometric measurements and perform the performance test (incremental test).

However, 5 athletes were excluded because they did not present the fully answered questionnaire or did not participate in the performance test. Thus, the survey had a final sample of 43 road cycling athletes.

Participants signed the informed consent form, agreeing to participate in the methodological procedures of the investigation. The procedures adopted in this study complied with the norms of Resolution 466/12 of the National Health Council for research on humans. The project was approved by the Ethics Research Committee on Humans of the Federal University of Pernambuco (CAE - 46978515.6.0000.5208).

Procedures

The researchers contacted some cyclists participating in the road cycling championship of Pernambuco. The "snowball" method was adopted with the premise of recruiting more volunteers for the research. The "snowball" method is a non-probabilistic sampling technique in which the subjects selected to be investigated invite new participants from their network of contacts[8]. Then, a meeting was held with cyclists to clarify all the ethical procedures of the investigation. All athletes signed the informed consent form agreeing to their voluntary participation in the survey.

Data were collected in two laboratory visits (Figure 1). The first visit was made with the intention of familiarizing cyclist with the incremental test in cycloergometer in order to avoid the learning effect[16]. On the second visit, conducted between 72 and 96 hours after the first visit, volunteers participated in two stages. In the first stage, athletes answered the EAT-26 questionnaire and then participated in the anthropometric measurements (body mass, height and skinfolds). It should be emphasized that athletes received verbal guidance and any doubts were clarified. The questionnaire also included written guidelines on completing it. In the second stage of the second laboratory visit, athletes performed the incremental test in cycloergometer with electromagnetic braking (Cateye, Japan). Cyclists were recommended to keep their daily diets and not perform physical exercises in the 24 hours prior to the incremental test.

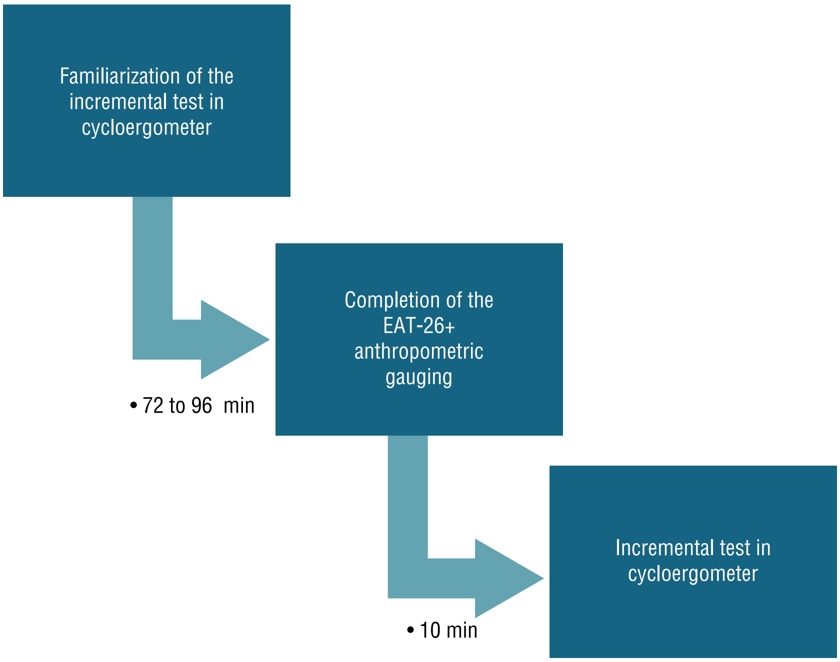

Figure 1 - Procedural design of the investigation.

Measures

VO_2max was measured by a computerized metabolic analyzer (CPX/D Cortex, Germany) during an incremental test performed on cycloergometer with electromagnetic braking (Cateye, Japan). The test was preceded by warm-up exercises developed in the same cycloergometer for 3 minutes adopting load of 25 W. The participant rested for 2 minutes prior to the start of the incremental test. The cyclists adjusted the height of the seat according to their height. The cyclists remained seated during the incremental test. Volunteers were instructed to perform the test under as much effort as possible. Verbal encouragement was provided throughout the entire test. The initial load was 50 W, with increments of 25 W every minute until participant reached voluntary exhaustion or impossibility to maintain current load. Heart rate (HR) was continuously monitored by a cardiofrequency meter (S810i, Polar). Respiratory variables were uninterruptedly measured and recorded every 20 seconds. The test was interrupted when one of the following situations occurred: 1) plateau or VO_2 reduction with increasing load; 2) respiratory coefficient greater than or equal to 1.1 and; 3) 95% of maximum HR predicted for age (220 - age), as recommended by Astrand et al.[17]. The highest VO_2 value before test interruption was adopted as the VO_2max.

To evaluate DEB, the Eating Attitudes Test (EAT-26), validated for the Portuguese language by Bighetti et al.[18] in non-athlete women, was applied. The questionnaire consists of 26 questions distributed in three subscales: 1) diet - refers to the pathological refusal to food with high caloric content and concern with physical appearance; 2) bulimia and concern with food - refers to episodes of binge eating, followed by purgative behaviors for body weight loss / control and; 3) oral self-control - refers to self-control in relation to food and evaluates the environmental and social forces that stimulate food intake. In each EAT-26 item, volunteers have six response options ranging from 0 (seldom, almost never and never) to 3 (always). The only question that presents reverse order score is question 25. The EAT-26 score is made by adding up its items. The higher the score, the greater the risk for eating disorders. It is also possible to classify respondents as for the risk for eating disorders, i.e., scores equal to or greater than 21 in the EAT-26 indicate risk for the onset of eating disorders. In the validation study, Bighetti et al.[18] indicated internal consistency of 0.82. For the present sample, internal consistency value of 0.88 was found, evaluated by Cronbach's alpha. It is noteworthy that EAT-26 was also used as an instrument for screening eating disorders in other investigations with male athletes[10-11].

Portable scale (Tanita®) and stadiometer (Welmy®) were used to determine body mass and height, respectively. Body mass index (BMI) was calculated from the following formula: BMI = body mass (kg)/height (m)^2.

Body density was determined with the technique of skinfold thickness using a Lange© caliper (USA) to measure triceps, pectoral and subscapular skinfolds, adopting the protocol of Jackson and Pollock[19]. For the measurements of skinfolds, standardizations of the International Society for Advancement for Kineanthropometry[20] were used. Body fat percentage (BF%) was determined by means of the Siri equation[21].

Data analysis

The Shapiro Wilk test was conducted to evaluate data distribution. The Levene test was used to test homocedasticity, whereas data sphericity was verified by the Mauchly test. When this last assumption was violated, the Greenhouse-Geisser correction was adopted, taking into account Cohen's notes[22]. Measurements of central tendency (mean) and dispersion (standard deviation and standard error) were used to describe the research variables. Univariate covariance analysis (ANCOVA) was applied to compare VO_2max between cyclists with (EAT-26≥21) and without risk (EAT-26 <21) for eating disorders. It is noteworthy that age was statistically controlled. In addition, the Cohen's effect size[22] represented by the abbreviation "*d*" was used to indicate differences from the practical point of view, as adopted by other scientific investigations[2,10,12]. The following criteria were adopted, according to Cohen's notes[22]: d <0.4 = low effect size, 0.4 ≤ d> 0.8 = moderate effect size and d ≥ 0.8 = large effect size. All data were processed in SPSS 21.0 software, adopting significance level of 5%.

RESULTS

Descriptive data [VO_2max, EAT-26, BMI, BF%, age and training regime (weekly training frequency x hours of daily training)] can be seen in Table 1.

The research findings indicated that 25% of cyclists revealed risks for the onset of eating disorders according to EAT-26 scores (≥21).

Table 1. Descriptive values (mean / standard deviation) of the research variables.

Variables	No risk (EAT-26<21) (n = 32)	Risk (EAT-26≥21) (n = 11)	p
	Mean (±SD)	Mean (±SD)	
VO_2max (ml/kg/min)	58.80 ±2.41[a]	54.75 ±2.56	0.01
EAT-26	11.97 ±8.62[a]	24.14 ±4.36	0.01
BMI (kg/m²)	21.61 ±1.43	21.80 ±1.52	0.29
BF%	20.17 ±6.42	21.04 ±8.19	0.21
Age (years)	21.33 ±1.84	21.49 ±1.75	0.35
TR (weekly hours)	10.23 ±1.12	10.26 ±1.07	0.26

SD = standard deviation; VO_2max = maximum O_2 consumption; EAT-26 = Eating Attitudes Test; BMI = body mass index; BF% = body fat percentage; TR = Training regime; [a]p <0.05 compared to the "risk" group.

The ANCOVA results revealed a statistically significant difference in VO_2max between cyclists with and without risk for eating disorders ($F_{(2, 41)}$ = 28.44, p = 0.01), indicating a moderate effect size (d = 0.6). It should be noted that age did not show collinearity with VO_2max ($F_{(2, 41)}$ = 2.62, p = 0.21).

DISCUSSION

The present investigation aimed to compare VO_2max between road cyclists with and without risk for the onset of eating disorders. The results of the present study indicated lower VO_2max for cyclists at risk for eating disorders compared to those with no risk, confirming the initial hypotheses.

Scientific investigations have revealed that approximately 25% of endurance sports athletes adopt DEB with the premise of attenuating body mass[6-12], corroborating the findings of the present study. It appears that approximately 1/4 of endurance sports athletes are vulnerable to the onset of eating disorders. According to Fortes et al.[11], the main explanation for this fact is the pressure of coaches in the yearning for better results. Considering that athletes usually associate body mass reduction with the maximization of performance in competitions[8], some athletes may adopt DEB aiming at optimizing competitive results.

The findings of the present study demonstrated lower VO_2max in cyclists at risk for the development of eating disorders compared to those with no risk. It is noteworthy that the results showed moderate effect size, which indicates a reasonable probability of cyclists adopting DEB to attenuate VO_2max. Considering the energy metabolism, the performance in the incremental test due to its duration (~ 13 minutes) came mainly from muscle glycogen metabolism[23,24]. Studies have indicated that athletes who adopt restrictive dietary diets and/or medications (laxatives, diuretics, thermogenics and appetite suppressants) expecting fast weight loss may decrease muscle glycogen stores[6,7], which may lead to a reduction in sports performance[13]. In this sense, it seems that the adoption of DEB can generate negative changes in the aerobic energy pathways. According to Chapman and Woodman[9], DEB increase blood viscosity, which may reduce cardiac output due to cardiovascular overload[25]. Therefore, it is possible to assume that DEB results in the attenuation of energy release in medium intensity exercises, thus explaining the VO_2max results between cyclists with and without risk for the onset of eating disorders.

Although the experimental design of this research is unprecedented with cycling athletes, the results should be analyzed with caution, since the research has limitations. A questionnaire was used to measure DEB frequency. Since responses are subjective, athletes may not have indicated total truthfulness in their responses. In addition, it is known that EAT-26, although presenting acceptable reference values for the Brazilian male population[26], is not specific for athletes. In the study by Fortes et al.[26], the same instrument validated by Bighetti et al.[18] was adopted, with no change in semantic equivalence. The difference among studies was the psychometric properties revealed. Fortes et al.[26] demonstrate that the EAT-26 items divided into three factors explained more than 45% of their variance, in addition to pointing to excellent concurrent validity, discriminatory power and reproducibility. In this sense, EAT-26 can also be used for the screening of eating disorders in male subjects. Another limitation that should be mentioned was the use of a double indirect method to evaluate BF%.

CONCLUSION

The findings of the present study led us to conclude that DEB was related to cyclists with lower VO_2max. In other words, cyclists with higher DEB frequency demonstrated lower VO_2max compared to cyclists with lower DEB frequency.

Further prospective studies with road cycling athletes should be carried out in order to investigate the possible influence of DEB on physical performance (VO_2max, alactic anaerobic power, anaerobic capacity, etc).

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