DOI: 10.4025/jphyseduc.v28i1.2828

**Original Article**

# DOES DISORDERED EATING IMPAIR THE PERFORMANCE OF FEMALE SWIMMERS IN 100M AND 200M FREESTYLE RACES?

## O COMPORTAMENTO DE RISCO PARA TRANSTORNOS ALIMENTARES ATENUA O DESEMPENHO NAS PROVAS DOS 100M E 200M LIVRE EM NADADORAS?

**Leonardo de Sousa Fortes**[1], **Saulo Fernandes Melo de Oliveira**[1], **Tony Meireles dos Santos**[1], **Sebastião de Sousa Almeida**[2] and **Maria Elisa Caputo Ferreira**[3]

[1]Universidade Federal de Pernambuco, Recife-PE, Brasil.
[2]Universidade de São Paulo, Ribeirão Preto-SP, Brasil.
[3]Universidade Federal de Juiz de Fora, Juiz de Fora-MG, Brasil.

**RESUMO**

O objetivo do estudo foi comparar o desempenho (melhor tempo em segundos) nas provas dos 100m e 200m livre de nadadoras em razão dos comportamentos de risco para os transtornos alimentares (CRTA). Participaram 84 nadadoras das categorias infantil, juvenil ou júnior. O *Eating Attitudes Test* (EAT-26) foi utilizado para avaliar os CRTA. Utilizou-se o melhor tempo em segundos para determinar o desempenho nas provas de 100m e 200m livre. O percentual de gordura corporal foi estimado a partir da mensuração de dobras cutâneas. Conduziu-se a análise multivariada de covariância (MANCOVA) para comparar o desempenho (tempo em segundos) nas provas de 100m e 200m livre entre nadadoras com (EAT-26≥21) e sem risco (EAT-26<21) para transtornos alimentares. Os achados apontaram diferença de desempenho nas provas dos 100m ($F_{(2, 82)}$=12,86; $p$=0,01; $d$=0,5) e 200m livre ($F_{(2, 82)}$=11,72; $p$=0,02; $d$=0,5) entre os grupos com e sem risco para os transtornos alimentares. Concluiu-se que as nadadoras com maior frequência de uso de CRTA demonstraram menor desempenho nas provas dos 100m e 200m livre.
**Palavras-chave:** Transtornos alimentares. Atletas. Natação.

**ABSTRACT**

The aim of this study was to compare the performance (best time in seconds) in 100m and 200m freestyle of swimmers according to disordered eating behaviors (DE). 84 women swimmers in infant, youth or junior classes were participants. The Eating Attitudes Test (EAT-26) was used to assess the DE. We used the best time in seconds to determine the performance in 100m and 200m freestyle. The body fat percentage was estimated considering the skinfolds thickness. We utilized multivariate analysis of covariance (MANCOVA) to compare the performance (time in seconds) in 100m and 200m freestyle between swimmers with (EAT-26≥21) and without (EAT-26 <21) DE. Findings indicated performance difference in 100m ($F_{(2, 82)}$=12,86; $p$=0,01; $d$=0,5) and 200m freestyle ($F_{(2, 82)}$=11,72; $p$=0,02; $d$=0,5) between groups with and without DE. It was concluded that the young women swimmers with greater DE frequency showed lower performance in 100m and 200m freestyle.
**Keywords:** Eating disorders. Athletes. Swimming.

## Introduction

Athletes are subjected to physical training routines in order to maximize performance in competitions[1]. In this sense, their performance needs to be frequently monitored. Although it is expected that an athlete's performance improves linearly, results in competitions may not reach the expected magnitude. Thus, it is important to detect early possible factors that determine decrease in performance.

More specifically, in swimming, there is frequent use of tethered swimming (peak anaerobic power), OBLA (speed referring to a 4 mmol concentration of blood lactate) and/or best time in competitions (50m, 100m, 200m, 400m, 800m and/or 1,500m) as performance indicators[2]. In 50m, 100m, 200m and 400m races the main energy substrate used is muscle glycogen, while in 800m and 1,500m races blood glucose predominates, although muscle glycogen is also used, but in smaller proportions[3]. Considering 100m and 200m freestyle competitions, though both depend on muscle glycogen as energy substrate[3], it is worth noting that a lower reserve of the respective substrate may compromise performance in a greater magnitude in 200m freestyle compared to 100m freestyle races[4]. Evidence indicates that poor energy recovery after training sessions may, in the long run, impair an athlete's performance in the course of competitive events[5]. Thus, researchers highlight the possibility that athletes who engage in risk behaviors for disordered eating (DE) have their sports performance decreased[6,7].

Risk behaviors for DE are: dietary restriction for long periods, use of medications (laxatives, diuretics and appetite suppressants) for rapid weight loss, self-induced vomiting, and strenuous physical exercise[8]. Studies point out that approximately 30% of female athletes adopt risk behaviors for DE as a means to lose or maintain body weight throughout competitive seasons[7,9]. It has been highlighted that engagement in risk behaviors for DE is closely related to body dissatisfaction[10]. In this sense, the level of body dissatisfaction should be statistically controlled in investigations concerning risk behaviors for DE in athletes[9]. It is also worth noting that risk behaviors for DE can decrease sports performance[6], mainly due to a possible reduction of energy substrate reserves[5]. Fortes et al.[11] found decrease of anaerobic capacity in male road cyclists that adopted risk behaviors for DE. Durguerian et al.[12] showed that the 5% reduction in body mass resulting from the adoption of risk behaviors for DE in male Olympic weightlifting athletes was not a good strategy to boost sports performance.

However, as far as we know, no scientific research has sought to analyze the relationship between sports performance and risk behaviors for DE in female athletes to date, which justifies the importance of the present study. In this sense, the objective of this research was to compare the performance (best time in seconds) of female swimmers in 100m and 200m freestyle races as a consequence of risk behaviors for DE.

Therefore, some hypotheses were formulated based on notes from two systematic reviews[6,8]: a) female swimmers that frequently adopt risk behaviors for DE have worse performance in 100m and 200m freestyle races; and b) food restriction, compulsive eating behaviors and purgatives are negatively related to performance in 100m and 200m freestyle races in female swimmers.

## Methods

*Participants*

This is a cross-sectional investigation developed with female swimmers. The sample was selected by convenience, being composed of 92 volunteers aged between 12 and 18 years old, participating in state championships [Minas Gerais (n=11), Paraíba (n=5), Pernambuco (n=14), Rio de Janeiro (n=26), Rio Grande do Sul (n=5) and São Paulo (n=23)], from infant, junior or youth categories. The female swimmers trained on average 3 hours a day, five times a week. To be included in the research, the athletes should: a) be a swimming athlete for at least two years; b) systematically train swimming for at least 6 hours a week; c) qualify for the state championship in 100m and 200m freestyle races, organized by their state's Swimming Federation and; d) be available to answer questionnaires and participate in anthropometric measurements.

However, 8 athletes were excluded for not returning some of the questionnaires fully answered or not participating in anthropometric measurements. Therefore, the investigation counted with a final sample of 84 female swimmers.

After receiving information on the procedures to which they would be subjected, the participants signed a consent form. The guardians of athletes under the age of 18 signed an informed and free consent form agreeing to the methodological procedures of the investigation. The procedures adopted in this study complied with all norms of Resolution 466/12 of the National Health Council for research involving human beings. The project was approved by the Ethics Committee on Research with Human Beings of the School of Philosophy, Sciences and Language of Ribeirão Preto (CAE - 05166712.8.0000.5407).

*Instruments*

To assess risk behaviors for DE, the Eating Attitudes Test (EAT-26) validated for the Portuguese language by Bighetti et al.[13] was applied. The questionnaire consists of 26 questions distributed into three factors: 1) diet – referring to pathological refusal to foods with high caloric content and concern with physical appearance; 2) bulimia and concern with food - referring to episodes of binge eating, followed by purgative behaviors for body weight loss/control and; 3) oral self-control – it reflects self-control in relation to food and assesses environmental and social forces that stimulate food intake. For each item of the EAT-26, the volunteers had six answer options ranging from 0 (few times, hardly and never) to 3 (always). The only question with reverse scoring is No 25. Scoring on the EAT-26 was calculated by summing its items. The higher the score, the greater the risk for DE. It is also possible to classify respondents as to risk for DE, that is, scores equal to or greater than 21 on the EAT-26 indicate risk for DE. In the validation study, Bighetti et al.[13] evidenced internal consistency of 0.82. For the present sample, a value of 0.88 was found for internal consistency, assessed by Cronbach's alpha.

The Body Shape Questionnaire (BSQ) in its validated version for the Brazilian young population[14] was employed to assess body dissatisfaction. The instrument presents good internal consistency (Cronbach's alpha [$\alpha$] = 0.96). For the sample of the present study, the $\alpha$ value found was 0.94, meaning good consistency of the instrument. The self-report questionnaire is composed of 34 Likert-type questions related to concern with weight and physical appearance, specifically with amount of body fat. The assessed subjects indicated how often, in the last four weeks, they experienced the events proposed by the alternatives, and the final score is given by the total sum of the items. The higher the score, the greater their body dissatisfaction. Considering that body dissatisfaction is closely related to risk behaviors for DE in female athletes[15,16], this study chose to control BSQ scores in the statistical analyses.

The best time in seconds was used to determine performance in 100m and 200m freestyle races. For instance, the time of 1'10"00 in 100m freestyle was converted to 70 seconds. Likewise, the time of 2'20"00 in 200m freestyle was converted to 140 seconds. These data were made available by the Brazilian Confederation of Water Sports [*Confederação Brasileira de Esportes Aquáticos*] (CBDA), after consultation to the official spreadsheets of said events.

Body density was determined through the skinfold thickness technique, using a Lange© compass (USA); tricipital, suprailiac and abdominal skinfolds were measured in athletes aged 18 years and over, as per protocol by Jackson and Pollock[17]. Tricipital and subscapular folds were measured for swimmers aged between 12 and 17 years old, as per protocol by Slaughter et al.[18], which considers the assessed subjects' ethnicity (white or black) and maturational stage as a function of their chronological age (pre-pubertal – seven to 10 years old, pubertal – 11 to 12 years old, and post-pubertal – 13 to 17 years old). In this sense, ethnicity was determined by self-assessment. For skinfold measurements, the standardizations of the International Society for the Advancement of Kineanthropometry were adopted[19]. Body fat percentage (F%) was determined using the Siri equation[20]. Due to scientific investigations indicating influence of F% on risk behaviors for DE[15,16], this study decided to control this variable in the statistical analyses.

Demographic data (age, ethnicity, weekly training frequency and daily training hours) were assessed by means of a questionnaire prepared by the researchers themselves.

*Procedures*

First, the researchers contacted the CBDA. The procedures, as well as the objectives of the study were duly explained, and authorization was requested to collect data during the competitive events organized by the states' swimming federations.

Afterwards, a meeting was held with the female swimmers in order to clarify all ethical procedures of the investigation. At that meeting, the informed and free consent form was also handed over to their respective coaches for consent to the participation of their athletes. All athletes signed the consent form, agreeing to their voluntary participation in the investigation.

Data collection was carried out in two different moments at the competition venue (water park). At the first meeting, the athletes answered the questionnaires (EAT-26 and BSQ) and, at the second one, anthropometric measurements (skinfolds) were performed. Thus, the athletes received the same verbal orientation, and any doubts were clarified. The questionnaires also contained written guidelines on how to fill it. Application was collective and answered individually, lasting 20 minutes on average.

*Statistical analysis*

The Kolmogorov-Smirnov test was conducted with the Lilliefors correction to assess data distribution. The Levene test was employed to test homecedasticity, whereas data sphericity was verified by the Mauchly test. When this last assumption was violated, the Greenhouse-Geisser correction was adopted. Mean and standard deviation were used to describe: EAT-26, BSQ, performance (time in seconds) in 100m and 200m freestyle races, F%, age and training regime (weekly training frequency x daily training hours). Multivariate analysis of covariance (MANCOVA) was conducted to compare performance (time in seconds) in 100m and 200m freestyle races between female swimmers with (EAT-26≥21) and without risk (EAT-26<21) for DE. It should be noted that BSQ, F% and age scores were statistically controlled. In addition, the size of the Cohen effect, represented by the initial "d", was used to show differences from a practical point of view. The following criteria were adopted, according to Rhea[21] notes: $d$ <0.35 = trivial, 0.35 ≤ $d$ > 0.80 = small effect size, 0.80 ≤ $d$ > 1.5 = moderate effect size and, $d$ ≥ 1.5 = large effect size. Hierarchical linear regression was used to assess the relationship between risk behaviors for DE (EAT-26 scores) and performance (time in seconds) in 100m and 200m freestyle races, inserting EAT-26 subscales into blocks 1 (diet), 2 (bulimia and concern with food) and 3 (oral self-control). All data were treated on SPSS 20.0, adopting a significance level of 5%.

## Results

Descriptive data (EAT-26, BSQ, performance (time in seconds) in 100m and 200m freestyle races, F%, age and training regime (weekly training frequency x daily training hours)] can be seen in Table 1.

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

| Variables | Mean | SD | K-S test (*p* value) |
|---|---|---|---|
| *EAT-26* | 14.48 | 10.26 | 0.12 |
| *BSQ* | 64.54 | 30.35 | 0.09 |
| *100m freestyle (seconds)* | 69.77 | 5.81 | 0.23 |
| *200m freestyle (seconds)* | 142.03 | 8.50 | 0.21 |
| *F%* | 23.67 | 5.14 | 0.17 |
| *Age (years)* | 13.63 | 1.60 | 0.39 |
| *Training regime (hours)* | 14.73 | 7.65 | 0.52 |

Note. SD = standard deviation; K-S = Kolmogorov-Smirnov; EAT-26 = Eating Attitudes Test; BSQ = Body Shape Questionnaire; F% = body fat percentage.
Source: The authors.

Concerning comparisons of performance (time in seconds) in 100m and 200m freestyle races by risks for DE (EAT-26 score), MANCOVA showed results worth being highlighted (Table 2): a) there was difference of performance in the 100m freestyle race (F $_{(2, 82)}$=12.86; *p*=0.01; *d*=0.5); b) there was statistically significant difference for the 200m freestyle race (F $_{(2, 82)}$=11.72, *p*=0.02, *d*=0.5) between the groups with and without risk for DE and; c) only F% ($F_{(1, 83)}$=17.53; *p*=0.01) and age ($F_{(1, 83)}$=22.08; *p*=0.02) showed collinearity with performance in 100m and 200m freestyle races, while BSQ scores (F $_{(1, 83)}$=2.87, *p* = 0.16) did not.

**Table 2.** Mean and standard error of performance (time in seconds) in 100m and 200m freestyle races by risk for disordered eating in female swimmers

| Group | Sample size (%) | 100m freestyle | 200m freestyle |
|---|---|---|---|
| | | Mean (SE) | Mean (SE) |
| *No risk (EAT-26 < 21)* | 56 (66.7%) | 67.34 (1.49) | 140.69 (2.84) |
| *Risk (EAT-26 ≥ 21)* | 28 (33.3%) | 71.98 (1.77)[a] | 145.02 (2.21)[b] |

Note: EAT-26 = Eating Attitudes test; SE = standard error; [a]p<0.05 in relation to the "no risk" group in the 100m freestyle; [b]p<0.05 in relation to the "no-risk" group in the 200m freestyle.
Source: The authors.

The multiple regression model that used time in the 100m freestyle as dependent variable can be seen in Table 3. The findings indicated a statistically significant correlation of the "Diet" subscale (F $_{(1, 83)}$=18.19, $R^2$=0.13, *p*=0.001 ), inserted in block 1. The magnitude of the correlation in block 2 increased when the "Bulimia and Concern with Food" subscale was inserted in the model (F $_{(2, 82)}$=20.03, $R^2$=0.02, *p*=0.02); however, no statistically significant correlation was found between the "Oral Self-Control" subscale and performance in the 100m freestyle (F $_{(3, 81)}$=11.32, $R^2$=-0.07, *p*=0.11).

**Table 3.** Hierarchical multiple regression analyzing the correlation of the EAT-26 subscale with performance variance in the 100m freestyle (time in seconds)

| EAT-26 Subscale | Block | *B* | R | R² | R²* | *p* value |
|---|---|---|---|---|---|---|
| *Diet* | 1 | 0.18 | 0.36 | 0.13 | 0.12 | 0.001 |
| *B&CF* | 2 | 0.19 | 0.39 | 0.15 | 0.13 | 0.02 |
| *Self-control* | 3 | 0.14 | 0.29 | 0.08 | 0.06 | 0.11 |

Note. EAT-26 = Eating Attitudes test; BSQ = R² * = adjusted R²; B&CF = Bulimia and Concern with Food subscale; Self-control = Oral Self-Control subscale.
Source: The authors.

The multiple regression model that used time in the free 200m freestyle as dependent variable can be seen in Table 4. Results indicated a statistically significant correlation of the "Diet" subscale ($F_{(1, 83)}$=16.80, $R^2$=0.10, $p$=0.01), inserted in block 1. The magnitude of the correlation in block 2 increased when the "Bulimia and Concern with Food" subscale was inserted in the model ($F_{(2, 82)}$=19.46, $R^2$=0.03, $p$=0.04). In contrast, no statistically significant correlation was found between the "Oral Self-Control" subscale and performance in the 200m freestyle ($F_{(3, 81)}$=8.74, $R^2$=-0.08, $p$=0.14).

**Table 4.** Hierarchical multiple regression analyzing the correlation of the EAT-26 subscale with performance variance in the 200m freestyle (time in seconds)

| EAT-26 Subscale | Block | *B* | R | R² | R²* | *p* value |
|---|---|---|---|---|---|---|
| *Diet* | 1 | 0.16 | 0.32 | 0.10 | 0.09 | 0.01 |
| *B&CF* | 2 | 0.18 | 0.36 | 0.13 | 0.11 | 0.04 |
| *Self-control* | 3 | 0.12 | 0.23 | 0.05 | 0.04 | 0.14 |

Note. EAT-26 = Eating Attitudes test; R²* = adjusted R²; B&CF = Bulimia and Concern with Food subscale; Self-control = Oral Self-Control subscale.
Source: The authors.

## Discussion

The study sought to compare the performance (best time in seconds) of female swimmers in 100m and 200m freestyle races as a consequence of the presence of risk behaviors for DE. Although there is yet no scientific evidence on the relationship between sports performance and risk behaviors for DE with female athletes, some researchers suggest that athletes who adopt risk behaviors for DE as a means to reduce body weight may have their performance decreased in competitions[1,10]. Broadly speaking, the findings of the present study confirmed these hypotheses for young female Brazilian swimmers.

Considering only energy metabolism, performance in the 100m and 200m freestyle races, due to their duration (between 1 and 3 minutes), depends mainly on lactic anaerobic metabolism, more specifically on muscle glycogen[4]. Studies indicate that athletes who adopt restrictive diets and/or use medications (laxatives, diuretics and appetite suppressants) for rapid weight loss may decrease muscle glycogen reserves[1,6], which reduces sports performance[22]. The findings of the present study corroborate such evidence. Female swimmers with scores of 21 or higher on the EAT-26 (risk for DE) showed lower performance in 100m and 200m freestyle races compared to those without risk for DE. It is also worth stressing that the results pointed a small effect size, which indicates a small probability of this phenomenon being true for young female swimmers with characteristics similar to those of the present investigation. In other words, some swimmers who engaged in food restriction, use of laxatives/diuretics and/or purgative methods (induced vomiting and strenuous physical exercise) to reduce/maintain body weight may have had their performance decreased in high intensity races lasting between 1 and 3 minutes.

About MANCOVA, results revealed that F% related to performance in 100m and 200m freestyle. In fact, scientific findings show that body fat has a negative association with performance in sports that require one's body displacement[23], as in swimming. In this sense, swimmers with high F% may have their performance reduced.

Likewise, MANCOVA pointed collinearity between swimming performance and chronological age. This finding indicates that the greater the chronological age of the female swimmer, the greater her performance in 100m and 200m freestyle races, corroborating the research findings of Nazario and Vieira[24]. The linear and positive correlation between chronological age and sports performance is no news in the scientific literature. According to Mezzaroba, Papoti and Machado[3], chronologically older athletes normally show greater strength and muscle power compared to chronologically younger ones, which may justify the better sports performance.

On the other hand, MANCOVA findings did not indicate collinearity between body dissatisfaction (BSQ) and performance in 100m and 200m freestyle. Although no scientific research has yet sought to analyze correlations between body dissatisfaction and performance, it is assumed that body dissatisfaction leads to reduced performance in athletes of decision-making sports who wear uniforms that highlight body shape, such as volleyball and tennis. Fortes et al.[7] emphasize that decreased attention and sports perception in athletes that play decision-making sports may be closely related to body dissatisfaction. However, it is worth noting that performance in 100m and 200m freestyle races depends more on physiological and biomechanical abilities[25], which indicates that body dissatisfaction may not affect results in these swimming races, justifying, to a certain extent, the results revealed in the present investigation.

According to Melin et al.[26], restrictive-type eating behavior may be closely related to sports performance, corroborating the findings of block 1 of the first and second hierarchical regression models. Results indicated that 13% and 10% of performance variance in 100m and 200m freestyle races, respectively, were explained by the "Diet" subscale of the EAT-26.

Concerning block 2 of both hierarchical regression models, the findings indicated that compulsive and purgative eating behaviors related to performance in 100m and 200m freestyle races, raising the magnitude of the correlation. Thus, 2% and 3% of the performance variance in 100m and 200m freestyle, respectively, were explained by the "Bulimia and Concern with Food" subscale of the EAT-26. According to Fortes, Almeida and Ferreira[16], athletes in sports that demand anaerobic endurance and/or aerobic power (swimming, rowing and track and field), who use laxatives, diuretics, appetite suppressants and/or strenuous physical exercise, may have their performance decreased in competitions, which, relatively, justifies such results.

Block 3 of both hierarchical regression models, in turn, showed no statistical correlation with performance in 100m and 200m freestyle races. This finding indicates that self-control over food, and the environmental and social forces that stimulate food intake are not related to the female swimmers' performance in 100m and 200m freestyle races. Corroborating these results, Rosendahl et al.[27] stress that social influences on diet (coaches, friends and parents) may have no correlation with sports performance.

Although this study shows new and important results, it has limitations that deserve attention. Self-report instruments were used for assessment. Thus, its results may not reflect the context analyzed because the answers were subjective. However, authors suggest self-report instruments in studies with large samples. The doubly indirect method (skinfolds) to assess fat percentage stands out as another limitation as well. Nevertheless, the use of sophisticated equipment (DXA and electrical bioimpedance) is not feasible to assess body composition in investigations with large samples due to their high financial expenditure. Another limitation is the design of the present investigation (cross-sectional), which does not characterize real cause and effect relations between variables. Finally, another limitation was using the best time in 100m and 200m freestyle races as performance indicator. Although application of objective tests (25m power or OBLA) are recommended to assess performance in swimming athletes, it is important to highlight that it is not possible to conduct such tests in the course of competitive events. Therefore, the findings should be treated with caution. Despite the limitations, it is believed that the results of this research are extremely important for professionals working in the sports field.

## Conclusions

Finally, it can be concluded that the female swimmers who adopted risk behaviors for DE more frequently showed poorer performance in 100m and 200m freestyle races. Thus, risk behaviors for DE may negatively affect performance in short-length swimming races in young female athletes.

Further research should be conducted with athletes in order to confirm the findings of this study, with the addition of more reliable and accurate assessment methods. Moreover, research with athletes of other sports should be carried out as well.

## References

1. Papathomas A, Petrie T. Editorial: Towards a more sophisticated approach to eating disorders in sport research. Psychol Sport Exercise 2014;15:675-679.
2. Matos CC, Barbosa AC, Castro FAS. The use of hand paddles and Fins in front crawl: biomechanical and physiological responses. Rev Bras Cineantropom Desemp Hum 2013;15(3): 382-392.
3. Mezzaroba PV, Papoti M, Machado FA. Gender and distance influence performance predictors in young swimmers. Motriz rev educ fis 2013;19(4):730-736.
4. Spriet LL New insights into the interaction of carbohydrate and fat metabolism during exercise. Sports Med 2014;44(1):87–96.
5. Garthe I, Raastad T, Refsnes PE, Koivisto A, Sundgot-Borgen J. Effect of two different weight-loss rates on body composition and strength and power-related performance in elite athletes. Int J Sport Nutr Exercise Metabolism 2011;1(1): 97-104.
6. El Ghoch M, Soave F, Cafugi S, Grave D. Eating disorders, physical fitness and sport performance: A systematic review. Nutrients 2013;5(5):5140-5160.
7. Fortes LS, Kakeshita IS, Almeida SS, Gomes AR, Ferreira, MEC. Eating behaviours in youths: A comparison between female and male athletes and non-athletes. Scand J Med S Sports 2014;24:e62-e68.
8. Bratland-Sanda S, Sundgot-Borgen J. Eating disorders in athletes: Overview of prevalence risk factors and recommendations for prevention and treatment. Eur J Sport Sci 2012;1(1):1-10.
9. Krentz TM, Warschburger P. A longitudinal study investigation of sports-related risk factors for disordered eating in aesthetic sports. Scand J Med S Sports 23(3):303-310.
10. Fortes LS, Ferreira MEC, Oliveira SMF, Cyrino ES, Almeida SS. A socio-sports model of disordered eating among Brazilian male athletes. Appetite 2015;92:29-35.
11. Fortes LS, Mendonça LCV, Paes PP, Vianna JM, Diefenthaeler F. Can power and anaerobic capacity reduce according to disordered eating behaviors in cyclists? Motriz rev educ fis 2017;23(1):60-64.
12. Durguerian A, Bougard C, Drogou C, Sauvet F, Chennaoul M, Filaire E. Weight loss, performance and psychological related states in high-level weighlifters. Int J Sports Med 2016;37(3):230-238.
13. Bighetti F, Santos CB, Santos JE, Ribeiro RPP. Tradução e avaliação do eating attitudes test em adolescentes do sexo feminino de Ribeirão Preto, São Paulo. J Bras Psiq 2004;53(6):339-46.

14. Conti MA, Cordás TA, Latorre MRDO. Estudo de validade e confiabilidade da versão brasileira do body shape questionnaire (bsq) para adolescentes. Rev Bras Saúde Materna Infant 2009;9(3):331-338.
15. Fortes LS, Almeida SS, Ferreira MEC. Anthropometric indicators of body dissatisfaction and inappropriate eating behaviors in young athletes. Rev Bras Med Esporte 2013;19(1):35-39.
16. Fortes LS, Almeida SS, Ferreira MEC. Influência da periodização do treinamento sobre os comportamentos de risco para transtornos alimentares em nadadoras. J Phys Education 2014;25(1):127-134.
17. Jackson AS, Pollock ML. Generalized equations for predicting body density of men. Br J Nutr 1978;40(4):497-504.
18. Slaughter MH, Lohman TG, Boileau R, Hoswill CA, Stillman RJ, Yanloan MD. Skinfold equations for estimation of body fatness in children and youth. Hum Biology 1988;60(3):709-723.
19. The Internacional Society for Advancement for Kineanthropometry [Internet]. Australia: National Library of Australia. [acesso em Jul 2013]. Disponivel em: http://www.isakonline.com.
20. Siri WE. The gross composition of the body. In: Tobias CA, Lawrence JH, editors. Advances in biological and medical physics. New York: Academic Press, 1956. p. 239-80.
21. Rhea MR. Determining the magnitude of treatment effects in strength training research through the use of the effect size. J Strength Cond Res 2004;18(6):918-920.
22. Lima-Silva AE, Fernandes TC, Oliveira FR, Nakamura FY, Gevaerd MS. Metabolismo do glicogênio muscular durante o exercício físico: mecanismos de regulação. Rev Nutr 2007;20(4):417-429.
23. Guilherme JPLF, Tritto ACC, North KN, Lancha-Júnior AH, Artioli GG. Genetics and sport performance: current challenges and directions to the future. Rev Bras Educação Fís Esporte 2014;28(1):177-193.
24. Nazario PF, Vieira JLL. Sport context and the motor development of children. Rev Bras Cineantropom Desemp Hum 2014;16(1):86-95.
25. Matos CC, Barbosa AC, Castro FAS. The use of hand paddles and Fins in front crawl: biomechanical and physiological responses. Rev Bras Cineantropom Desempenho Hum 2013;15(3):382-392.
26. Melin AM, Torstveit M, Burke L, Marks S, Sundgot-Borgen J. Disordered eating and eating disorders in aquatic sports. Int J Sport Nutr Exercise Metabol 2014;24(3):450-459.
27. Rosendahl J, Bormann B, Aschenbrener K, Strauss B. Dieting and disorders eating in German high school athletes and nonathletes. Scand J Med Sci Sports 2009;19(3):731-739.

Received on Feb, 26, 2015.
Reviewed on Mar, 15, 2017.
Accepted on Apr, 06, 2017.

**Author address**: Leonardo de Sousa Fortes. Rua Clóvis Beviláqua, 163/1003, bairro Madalena, Recife/PE, CEP 50710330.
E-mail: leodesousafortes@hotmail.com