







Anxiety, sleep quality and eating disorders in rhythmic gymnasts of the Brazilian Youth Team

Ansiedade, qualidade de sono e transtornos alimentares em ginastas rítmicas da Seleção Brasileira Juvenil

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ABSTRACT

Introduction: The high training load associated with the aesthetic standards required by rhythmic gymnastics (RG) has been considered a stressor for high-performance athletes, which may culminate in anxiety, poor sleep quality and risk for developing eating disorders. **Objectives:** To evaluate the state of anxiety, sleep quality and the risk of eating disorders, and their possible correlations, in high-performance rhythmic gymnasts looking for a place in the Brazilian youth team. **Methods:** Twenty-one female gymnasts (13.4 ± 0.5 years, 1.56 ± 0.1 m, 45.6 ± 6.1 kg) were evaluated. The gymnasts answered three questionnaires: the Competitive Anxiety State Inventory (CSAI-2) to assess cognitive and somatic anxiety as well as self-confidence, the Pittsburgh Sleep Quality Index (PSQI), and the Eating Attitudes Test (EAT -26) to assess the risk of eating disorders. **Results:** Gymnasts predominantly presented low somatic and cognitive anxiety, and high self-confidence. However, 23.8% of rhythm gymnasts were at risk for eating disorders, and 23.8% had poor sleep quality. There was a statistically significant correlation between sleep quality and somatic anxiety, but eating disorders did not correlate with anxiety or sleep quality. **Conclusion:** The high-performance juvenile rhythmic gymnasts evaluated in this study presented high frequencies for risk of eating disorders and poor sleep quality, and monitoring by a multidisciplinary team was indicated.

Keywords: gymnastic; feeding behavior; adolescent; anxiety; sleep wake disorders.

RESUMO

Introdução: A elevada carga de treinamento associada ao padrão estético exigido pela ginástica rítmica (GR) tem sido considerada um fator estressor para as atletas de alto rendimento, podendo culminar em ansiedade, má qualidade de sono e risco para desenvolvimento de transtornos alimentares. **Objetivos:** Avaliar o estado de ansiedade, a qualidade do sono e o risco de transtorno alimentar, e suas possíveis correlações, em ginastas rítmicas de alto rendimento em busca de uma vaga na seleção brasileira juvenil. **Métodos:** Foram avaliadas 21 ginastas do gênero feminino ($13,4 \pm 0,5$ anos, $1,56 \pm 0,1$ m, $45,6 \pm 6,1$ kg). As ginastas responderam a três questionários: o Inventário do Estado de Ansiedade Competitiva (CSAI-2) para avaliar ansiedade cognitiva e somática como também a autoconfiança, o Índice de Qualidade do Sono de Pittsburgh (PSQI), e o Teste de Atitudes Alimentares (EAT-26) para avaliar o risco de transtornos alimentares. **Resultados:** As ginastas apresentaram predominantemente baixa ansiedade cognitiva e somática, e elevada autoconfiança. No entanto, 23,8% das ginastas rítmicas apresentaram risco para transtornos alimentares, e 23,8% apresentaram má qualidade de sono. Houve correlação estatística significativa entre qualidade de sono e ansiedade somática, porém os transtornos alimentares não se correlacionaram com ansiedade ou qualidade de sono. **Conclusão:** As ginastas rítmicas juvenis de alto rendimento avaliadas neste estudo apresentaram altas frequências para risco de transtorno alimentar e má qualidade de sono, sendo indicado monitoramento por equipe multidisciplinar.

Palavras-chave: ginástica; comportamento alimentar; adolescência; ansiedade; transtornos do sono.

Received: September 29, 2021; Accepted: November 24, 2021.

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Introduction

Rhythmic gymnastics (RG) is a prominent sport in Eastern Europe, with a focus on the execution of harmonious and graceful series, through the combination of body dynamics with the handling of official equipment such as balls, clubs, ribbons, bows, and ropes [1,2]. As it is a combination of extremely difficult body movements, with high skill in handling devices, in coordination with musical accompaniment, RG requires high levels of flexibility, power, coordination, and technical perfection. Therefore, rhythmic gymnasts have a high training load, and in some cases, inadequate periods for recovery [3,4], which has been considered a source of mental and physical stress, capable of impairing the quality of sleep of athletes, and consequently, their sporting performance [5,6].

Parallel to the demand for physical performance imposed by RG, there is a requirement related to the aesthetic standard of this modality, described as a slender body with long limbs, according to the international standard of high-level gymnasts who won Olympic medals [7]. Additionally, performance in high-performance acrobatic modalities can benefit from reduced body weight, as leaner athletes seem to have biomechanical advantages [8]. Thus, whether for aesthetic appeal or the biomechanical advantages, the search for weight reduction has been frequently reported in studies that evaluate rhythmic gymnasts [7] and, for this reason, athletes of this modality may present a higher risk of developing eating disorders and, consequently, harm to health [9].

The demands inherent to performance, the perfection of movements, and the thin biotype imposed on rhythmic gymnasts have been considered stressors in their routine and can be linked to anxiety, poor sleep quality, and eating disorders [3,5,6], which suggests the possibility of correlation between these variables.

In an attempt to assess the correlation between eating disorders and anxiety in athletes, some studies were carried out with team sports such as basketball and volleyball [10,11], combat sports such as judo [12], and aesthetic modalities such as artistic gymnastics [13], still, the results are controversial. However, to date, our searches have not found studies that have assessed the correlation between anxiety, sleep quality, and eating disorders in rhythmic gymnasts. Therefore, the present study aimed to evaluate the state of anxiety, sleep quality, and the risk of eating disorders, and their possible correlations, in rhythmic gymnasts undergoing an evaluation process to compose the 2020-21 Brazilian Youth Team.

Methods

Experimental design

This is a cross-sectional observational study. A week before the study was carried out, the rhythm gymnasts and their guardians participated in remote meetings through digital platforms to be guided regarding the objectives and procedu-

res inherent to the study. At this same stage, the Informed Consent Form (ICF) was sent for those responsible for the athletes to sign. Still, in the week before the 2nd National Rhythmic Gymnastics Internship, the athletes who agreed to participate in this study and had the ICF signed by their guardians carried out food records for three non-consecutive days so that the dietary characterization of the studied group could be performed. After the first phase of clarification and food records in remote mode, the gymnasts arrived in Aracaju, SE to participate in the event. On the first day, another stage of characterization of the participants was carried out through the body composition assessment. On the second day, the gymnasts answered two questionnaires to assess the quality of sleep and the state of anxiety, about 40 minutes before starting the physical training in which they would be evaluated to make up the Brazilian team. On the third day, the gymnasts filled out a questionnaire to assess the risk of eating disorders and continued training for another four days to compete for the seven places available to make up the Brazilian Youth Rhythmic Gymnastics Team in 2021.

Sample

Twenty-one juvenile rhythmic gymnasts, female, aged between 13 and 14 (13.4 ± 0.5 years) participated in the study, invited to the 2nd National Rhythmic Gymnastics Internship, organized by the Brazilian Gymnastics Confederation, held in December 2020, in Aracaju, SE, whose objective was to select seven athletes to compose the Brazilian Youth Team in the year 2021. The call criterion for the Internship, and, therefore, the inclusion criterion for this study, was that the gymnast stood out (first to third place in the classification) in the 2019 Brazilian Championships. The exclusion criteria were: a) the use of drug therapy for anxiety disorders treatment, sleep disorders, and eating disorders; b) absence at any stage of the assessments inherent to the study.

Sample characterization, body composition and dietary assessment, body composition assessment

For body composition assessment, body weight, height, and skinfold measurements were taken in triplicate; and later used to estimate the percentage of fat mass through the Slaughter *et al.* equation [14]. Weight and height were measured on an analog scale, with a coupled stadiometer (Toledo®), with a precision scale of 100 g and 1.0 cm, respectively. For estimating the percentage of body fat (%FM), the triceps and subscapular skinfolds were measured with a scientific adipometer (Sanny®), with a precision of 0.1 mm.

For data collection, safety protocols were adopted to prevent contamination by SARS-CoV-2, such as the negative RT-PCR test presentation by athletes and the team of professionals involved in the collection, masks, 70% alcohol hand sanitizer, open and ventilated environments.

Dietary assessment

A food record of three alternate days [15] was adopted, with subsequent adoption of the Dietpro software to estimate caloric intake and nutrients such as vitamin C, Calcium, Iron, Selenium, Zinc, and Magnesium.

Anxiety state assessment

The Competitive State Anxiety Inventory (CSAI-2) translated version was adopted [16]. The assessment consists of the 27 questions analysis distributed over 3 subscales, with 9 items each, namely cognitive anxiety, somatic anxiety, and self-confidence. According to Paludo *et al.* [17], cognitive anxiety is defined as the mental aspect of competitive anxiety, characterized by pessimistic expectations and negative self-assessments about one's performance. On the other hand, somatic anxiety is defined as the affective and physiological component of anxiety, compromising the autonomic nervous system. Finally, self-confidence anxiety is defined as the opposite state of cognitive anxiety, that is, the individual's belief in their abilities to achieve positive performance. Each item was scored according to the answer (none = 1 point; something = 2 points; moderate = 3 points; a lot = 4 points) [16,17]. For the analysis of cognitive, somatic, and self-confidence anxiety, the following scores were considered: low = 9 to 18 points, average = 19 to 27 points, high = 28 to 36 points [16,18].

Sleep quality assessment

The Pittsburgh Sleep Quality Index (PSQI) translated version was adopted to assess sleep quality [19,20]. This assessment was based on 19 self-classified items present in the questionnaire, combined to form seven "component" scores, each of which ranges from 0 to 3 Points. PSQI scoring ranges vary from 0 (zero) to 21 points. A total score equal to or less than 5 points is associated with good sleep quality, while a total score higher than 5 points is considered an indicator of poor sleep quality [20].

Eating disorder risk assessment

The Eating Attitudes Test (EAT-26) translated version was used to measure symptoms of different eating disorders and assess the risk [21,22]. The questionnaire contains 26 questions with individual scores ranging from 0 to 3 points, depending on the choice (always = 3 points; often = 2 points; sometimes = 1 point; a few times, rarely, and never = 0 points). A final score higher than 21 points indicates a risk of eating disorders [21,22].

Statistical treatment

Normality was verified by the Shapiro-Wilk test. Data are presented as mean and standard deviation. Relative frequency was used in the assessments of the degree of anxiety, sleep quality, and risk of eating disorders. Pearson's correlation coefficient was adopted to identify the relationship between ratings of anxiety, sleep, and eating disorders. All analyzes were performed using SPSS-22.0 software (IBM, SPSS Inc., Chicago, IL, USA). Significance was set at $p < 0.05$.

Ethical aspects

The research was approved by the Ethics and Research Committee, accredited by the National Health Council (CAAE 16452219.5.0000.5546 2020). Those responsible for the participants read and signed the Free and Informed Consent Form before the study was carried out.

Results

Table I presents the characterization data of the participants: age, body composition and energy intake, macronutrients, and micronutrients of interest.

Table I - Characterization of the sample (mean \pm standard deviation) regarding age, RG training experience, body composition, and dietary intake of the evaluated rhythmic gymnasts (n = 21)

Characteristics	Mean \pm standard deviation
Age (years)	13.4 \pm 0.5
Experience in RG (years)	6.3 \pm 0.3
Body weight (kg)	45.6 \pm 6.1
Body mass index (BMI)	18.59 \pm 1.33
% Fat mass	13.18 \pm 2.6
Fat mass (kg)	6.1 \pm 1.6
% Lean mass	86.82 \pm 2.71
Lean body mass (kg)	39.5 \pm 5.0
Height (m)	1.56 \pm 0.1
Energy intake (kcal)	1093 \pm 443.3
Energy intake (kcal/kg)	23.97 \pm 9.71
Protein (g)	61.1 \pm 22.9
Protein (g/kg)	1.4 \pm 0.51
Carbohydrate (g)	135.8 \pm 68.9
Carbohydrate (g/kg)	2.98 \pm 1.51
Total fat (g)	36.9 \pm 16.1
Vitamin C (mg)	155.4 \pm 216.5
Calcium (mg)	465.6 \pm 239
Iron (mg)	6.4 \pm 3.1
Selenium (μ g)	75.9 \pm 50.7
Zinc (mg)	6.7 \pm 3.6
Magnesium	144.5 \pm 64.2

Table II shows that the means obtained in the cognitive and somatic anxiety subscales were less than 18 points (low anxiety) and that the mean obtained in the self-confidence subscale was greater than 28 points (high). The same table shows that the sleep quality index average was less than five points (good sleep quality), and the eating attitudes test average was less than 21 points (no risk of eating disorders).

Table II - Descriptive statistics (mean \pm standard deviation, 95% confidence interval) of scores obtained by rhythmic gymnasts on anxiety scales (CSAI-2), Pittsburgh Sleep Quality Index (PSQI), and Eating Attitudes Test (EAT-26)

Characteristics	Mean \pm standard deviation	95% Confidence interval
Cognitive CSAI	17.5 \pm 5.10	15.2 - 19.8
Somatic CSAI	14.9 \pm 3.75	13.2 - 16.6
Self-confidence CSAI	30.0 \pm 4.62	27.9 - 32.1
PSQI	3.4 \pm 2.67	2.2 - 4.6
EAT-26	16.3 \pm 9.01	12.2 - 20.4

Table III shows the bivariate correlations between all study variables. Only a significant ($p < 0.05$) positive correlation was found between somatic anxiety and PSQI scores, indicating that the sleep quality of rhythmic gymnasts directly correlates with higher levels of somatic anxiety.

Table III - Bivariate correlations between scores obtained by rhythmic gymnasts on anxiety scales (CSAI-2), Pittsburgh Sleep Quality Index (PSQI), and Eating Attitudes Test (EAT-26)

EAT-26		
	r	p
Cognitive CSAI	0.289	0.204
Somatic CSAI	0.140	0.545
Self-confidence CSAI	0.379	0.090
PSQI	0.087	0.709
CSAI cognitiva		
	r	p
Somatic CSAI	0.301	0.186
Self-confidence CSAI	-0.079	0.735
PSQI	0.118	0.610
CSAI somática		
	r	p
Self-confidence CSAI	-0.167	0.468
PSQI	0.552*	0.009
CSAI autoconfiança		
	r	p
PSQI	-0.231	0.314

*Correlation is significant at the 0.05 level (2 extremities)

As shown in figure 1, in the two subscales of anxiety, somatic and cognitive anxiety, there was a predominance of classification as “low anxiety” (81% and 71.4%, respectively). In the self-confidence subscale, the most frequent classification was “high self-confidence”. Figure 2 shows that 23.8% of gymnasts had poor sleep quality, and the same frequency was found for eating disorders risk.

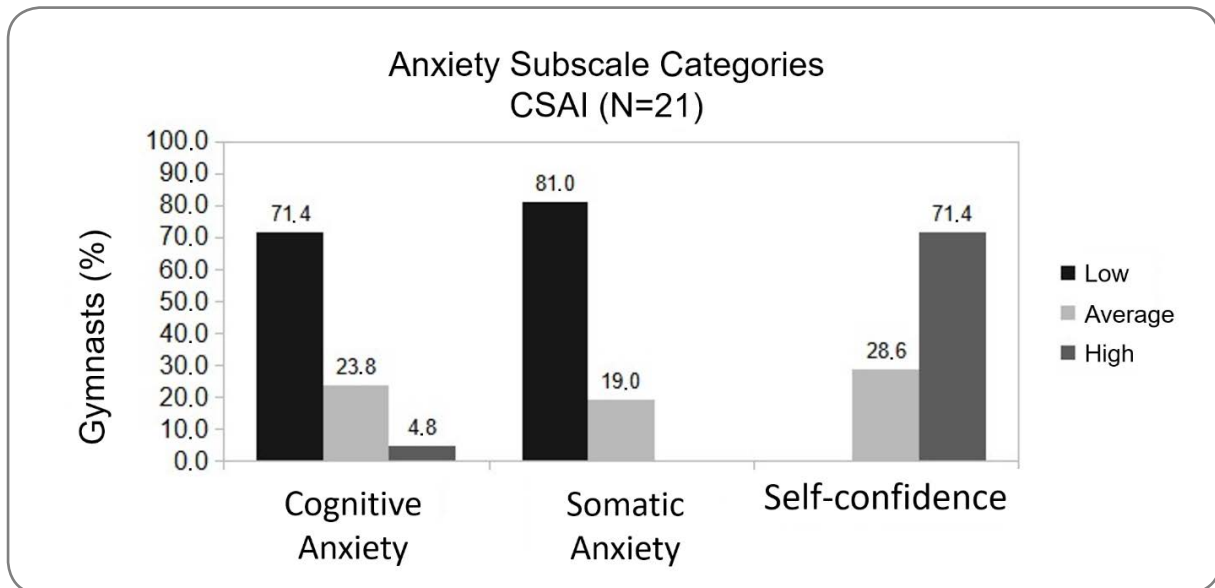


Figure 1 – Distribution of gymnasts according to degrees of cognitive anxiety, self-confidence, and somatic anxiety

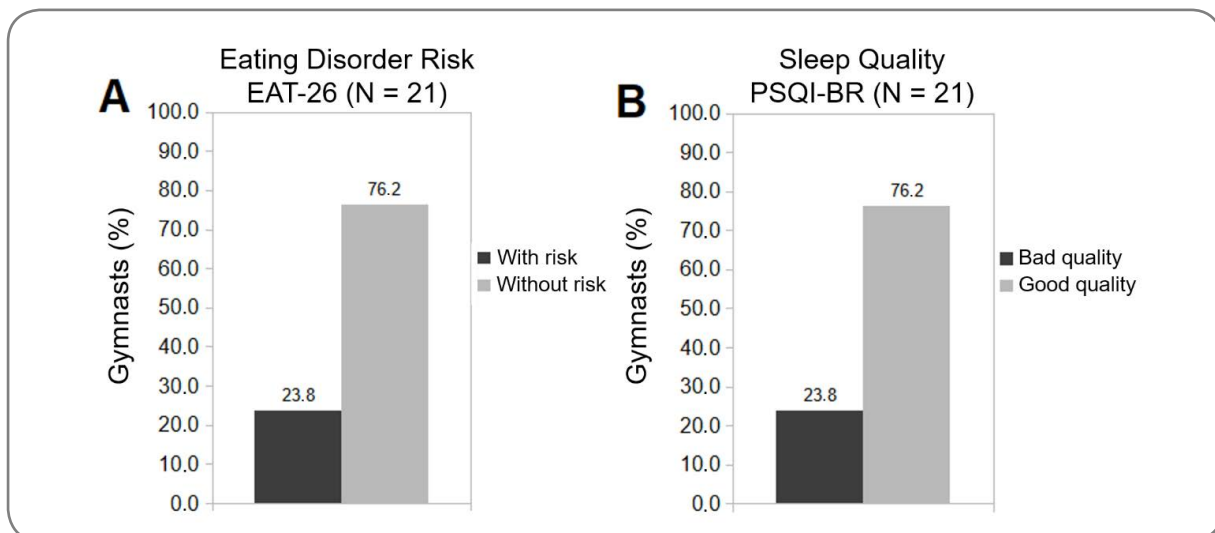


Figure 2 – (A) Frequency of risk behaviors for eating disorders. (B) Distribution of gymnasts according to sleep quality

Discussion

The main findings of the present study show that most athletes had cognitive anxiety and somatic anxiety subscales at low scores and the self-confidence subscale at high scores. Poor sleep quality was found in 23.8% of gymnasts, and the same frequency for risk of eating disorders. There was a significant correlation between somatic anxiety and poor sleep quality. However, none of the variables correlated with the risk of eating disorders.

Bertuol and Valentini [23] reported that a very anxious athlete may have higher energy expenditure due to greater muscle tension, as well as difficulties in coordination, concentration changes, and narrowing of the attention field, which can limit their ability to observe the general competitive context. Such impairments can

lead to a “de-automated” performance of complex movements, making them more rudimentary. Therefore, it is believed that the low frequency of cognitive anxiety and somatic anxiety found in our study may have positively contributed to the performance of the evaluated gymnasts. Similarly, Silva and Paiva [5] evaluated elite Portuguese rhythmic gymnasts and also did not find high levels of anxiety, predominantly moderate.

The association between high self-confidence and low somatic and cognitive anxiety, found in the present study, corroborates the multidimensional theory of anxiety proposed by Martens, Vealey, and Burton (1990) and discussed by Santos *et al.* [24], who infers that cognitive and somatic anxieties are low when indices and self-confidence are high.

According to Souza, Teixeira, and Lobato [18], experience in the competitive environment directly interferes with anxiety scores in athletes, with the youngest and least experienced being those with higher scores for cognitive anxiety and somatic anxiety and the most experienced being those who have greater self-confidence. Although, in our findings, young athletes were evaluated, with an average of 13.4 years old, these gymnasts had an average of 6.3 years of experience in the modality. Additionally, it is relevant to emphasize that the criterion for inclusion in this study was specifically to stand out in national and international championships. Therefore, it is believed that the time and level of experience of rhythmic gymnasts were determinants for the low frequency of cognitive and somatic anxiety. Although the present study has presented new findings for the national literature, it is important to consider evidence that young people may not respond reliably to the assessment instruments. Even though gymnasts are instructed to be trustworthy in their answers, the fact that they are being evaluated at the national level can influence the answers to the questionnaires.

Additionally, it was found that 23.8% of gymnasts had poor sleep quality. According to Vitale *et al.* [25], low quality of sleep may imply changes in neurocognitive, metabolic, immunological, and cardiovascular functions, as well as negatively affect athletic performance. Previous studies carried out with athletes indicated a frequency of poor sleep quality between 28-77% [5,26-28], which is higher than the frequency found in our study. Benjamin *et al.* [26] report that sleep quality can affect athletes of different genders differently, with women being more affected, with significantly higher levels of tension, depression, anger, fatigue, confusion, and total mood disturbance, as well as higher levels of stamina when compared to those with good sleep quality. It is noteworthy that in this study, female athletes were studied, and, therefore, it would be essential to monitor, in the future, the possible implications on their mood.

Although the prevalence of poor sleep quality found here has been lower than that found in similar studies, it is necessary to emphasize that practically a quarter of the evaluated gymnasts had this diagnosis, which may mean a loss of performance for a member of the Brazilian team since a set of RG is composed of five athletes. For

a modality that requires perfection and synchrony between the athletes, any mistake made by an athlete can affect the overall score [1]. Therefore, we believe that these results justify the need for monitoring the athletes by a multidisciplinary team.

Additionally, it was found that somatic anxiety was significantly correlated with poor sleep quality. Somatic anxiety refers to physiological reactions such as muscle tension, tachycardia, discharge, tremors, and sweating, and such physiological changes can negatively influence sleep quality [29], thus justifying our results.

We did not find a correlation between eating disorders and the other variables. Studies carried out with basketball [11] and judo [12] athletes to correlate anxiety with the risk of developing eating disorders did not identify the influence of anxiety on the development of eating disorders, as in the present study. The authors assumed that the feelings of anxiety that athletes usually experience during a competitive season do not explain the variance in risk behaviors for eating disorders. Therefore, other factors may be related to this variable, such as the constant search for the long biotype required in aesthetic modalities, such as synchronized swimming, diving, skating, artistic gymnastics, and rhythmic gymnastics. It is noteworthy that the sample size of our study is small. Therefore, a larger sample would increase the possibility of observing different correlations.

Although our findings did not find a correlation between anxiety or sleep quality and risk behaviors for eating disorders, it is essential to emphasize that practically a quarter of the rhythm gymnasts evaluated were at risk for eating disorders. Recent studies carried out with athletes have indicated a risk frequency for eating disorders between 10-25% [11,12,30].

The prevalence of risk behaviors for eating disorders in aesthetic sports athletes is higher than in other sports [13,31]. Tan *et al.* [9] studied eating disorders in gymnasts and found risk in 19% of those evaluated, this prevalence being lower than that found in this study. The authors compared four different questionnaires, namely the EAT-26, the Eating Disorder Exam Questionnaire Version (EDE-Q6), the Beck Depression Inventory (BDI-II), and the Rosenberg Self-esteem Scale, with a significant correlation between the EAT-26 scores and those of the other instruments.

According to Wells *et al.* [32], one of the main health risks of the athlete with an eating disorder is the potential development of Relative Energy Deficiency in Sport (RED-S), characterized by outcomes such as reduced resting metabolic rate, decreased immunity and of protein synthesis capacity, damage to cardiovascular health, as well as gastrointestinal, hematological, psychological, growth and development alterations [33].

The low body fat and dietary pattern of the participants, whose results indicate insufficient intake of energy (< 50 kcal/kg) and nutrients such as carbohydrates (< 5 g/kg), vitamin C (< 500 mg) [34], iron, calcium, zinc, and magnesium [35–39], corroborate the risk of eating disorders. Therefore, it is possible to show that the studied population is nutritionally vulnerable and should, consequently, be monitored by an interdisciplinary team.

Conclusion

Our findings indicate that the young rhythmic gymnasts evaluated presented low anxiety and high self-confidence. However, there was a high frequency of poor sleep quality and risk for eating disorders.

Conflicts of interest

No author had a financial relationship or any activity outside the present study, which may appear to have influenced the submitted work.

Financing source

There were no external funding sources for this study.

Authors' contribution

Conception and design of the research: Menezes VO, Lourenço MRA, Mendes RR; **Obtaining data:** Menezes VO, Silva RJ, Marques IL; **Data analysis and interpretation:** Menezes VO, Silva RJ, Marques IL, Mendes RR; **Statistical analysis:** Gomes JH; **Obtaining funding:** Lourenço MRA. **Writing the manuscript:** Menezes VO, Mendes RR; **Critical review of the manuscript for important intellectual content:** Mendes RR, Gomes JH.

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