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HIGH-PERFORMANCE ADOLESCENT TENNIS ATHLETES: FOOD INTAKE AND BODY COMPOSITION PROFILES

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ABSTRACT

Tennis is an intermittent sport, with movements of high intensity and duration. The present study aimed to assess nutritional status focusing on food intake and body composition of high-performance adolescent athletes. Observational, cross-sectional study with a quantitative approach conducted with 9 athletes from a tennis school in Campo Grande-MS, of both sexes, aged between 10 and 15 years. Dietary research of specific food frequency for athletes was used, comparing with the nutritional recommendations of the International Society for Sports Nutrition for energy and macronutrients and the Institute of Medicine for micronutrients. Anthropometric measurements of weight, height, arm and waist circumferences and skinfolds were performed to determine body fat (%) and fat-free mass (kg). Regarding adequacy, we observed 77.8% of energy intake, in relation to the recommendations, mean intake of carbohydrates of 6.9 g/kg/day, 2.0 g /kg/day of protein and 1.9 g/kg/day of lipids. Calcium intake was below recommendation in 100% of cases. Mean intake above the recommendation was found for zinc, vitamin E and C. Adequate body fat was observed in only 33.3% of tennis players. We concluded that the majority of athletes presented inadequate intake of proteins and micronutrients, which may be reflected in their body composition.

Key words: Sports nutrition. Tennis. Nutritional assessment. adolescence.

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RESUMO

Atletas tenistas adolescentes de alto rendimento: Perfil de consumo e composição corporal

O tênis é um esporte intermitente, com movimentos de alta intensidade e curta duração. O presente estudo objetivou avaliar o estado nutricional focado no consumo alimentar e composição corporal de atletas adolescentes de alto rendimento. Estudo observacional, transversal, com abordagem quantitativa realizado com 9 atletas de uma escola de tênis de Campo Grande-MS, de ambos os sexos, com idades entre 10 e 15 anos. Utilizou-se inquérito dietético de frequência alimentar específico para atletas, comparando-se com as recomendações nutricionais da International Society of Sports Nutrition de energia e macronutrientes e do Institute of Medicine para micronutrientes. As medidas antropométricas de peso, estatura, circunferências de braço e cintura e dobras cutâneas foram realizadas para a determinação da gordura corporal (%) e da massa livre de gordura (kg). Observou-se consumo energético com 77,8% de adequação em relação as recomendações, carboidratos de 6,9 g/kg/dia, proteína de 2,0 g/kg/dia e lipídios de 1,9 g/kg/dia. A ingestão de cálcio estava abaixo da recomendação em 100% dos casos. A média de ingestão de zinco, vitamina E e C apresentaram inadequações estando superiores às recomendações. O percentual de gordura corporal estava adequado em apenas 33,3% dos tenistas. A maioria dos atletas apresentaram ingestão inadequada de proteínas e micronutrientes, que pode estar refletindo na composição corporal.

Palavras-chave: Nutrição esportiva. Tênis. Avaliação nutricional. Adolescência.

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Revista Brasileira de Nutrição Esportiva
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INTRODUCTION

According to the World Health Organization (WHO, 2013), adolescence is defined by ages between 10 and 19 years and characterized by body changes inherent of this age group (Velho et al., 2014).

This phase is also marked by the increase in nutritional needs, requiring good eating habits to ensure proper growth and development (Vieira et al., 2013).

For athletes who practice not competitive exercises, a balanced diet meeting general population recommendation is sufficient to maintain health. For athletes, energy requirements are higher to cover the energy expenditure of training and competitions (Carvalho, Mara, 2010).

Tennis is an intermittent sport, with high intensity and short duration movements, played as individual or double matches, with an average duration of 90 minutes, reaching up to 5 hours (Kondrick et al., 2013).

According to Sanz, Otegui and Ayuso (2013), the energy systems required for playing tennis can be: alactic anaerobic, lactic anaerobic and aerobic, and pathways variations occur according to the intensity and duration of the game.

The main factors that interfere with tennis performance are related to depletion of glycogen reserves, hypoglycemia, decreased pH, central fatigue, dehydration and hyperthermia (Baker et al., 2015).

Tavio and Domínguez (2014) suggest extra care with dietary-nutritional objectives since energy supply varies according to the athlete's training practices and level.

Therefore, the adjustment of macro and micronutrients through sports nutrition is essential to preserve performance, since insufficient nutrient intake can trigger low performance, injuries, weakened immune system and prone to infections (Quintão et al., 2009).

Given this, like other modalities, there are few studies assessing nutritional status with focus on food intake and body composition of Brazilian high-performance adolescent tennis athletes.

The present study aims to describe these variables at mitigating through the present work.

MATERIALS AND METHODS

Observational, cross-sectional study, with a quantitative approach, based on primary data collection and with a non-probabilistic sample design, with convenience sampling.

Questionnaires were applied with socio-demographic issues, food, training, and maturation age.

The study included 9 athletes from a tennis school, all of them with high performance training, participating in municipal and state competitions, of both sexes, aged between 10 and 15 years old, with regular tennis practice of at least 6 months, at least twice a week, 2 hours each workout, totaling 4 hours a week. All were able to practice physical exercises and did not have chronic non-communicable and neurological diseases, attested by the athletes themselves.

The present study was approved by the Human Research Ethics Committee of the Federal University of Mato Grosso do Sul (UFMS) with opinion number 3176877/2019.

For the evaluation of food intake, a specific food frequency questionnaire was applied to athletes (Godois et al., 2018), for later evaluation of energy, macronutrients and micronutrients (calcium, iron, zinc, vitamin C and vitamin E) content.

Food in homemade measures were converted into grams, using the Table of Referred Measures for Food Consumed in Brazil as a reference (Brazilian Institute of Geography and Statistics, 2011) and the Table for Evaluation of Food Consumption in Home Measures (Pinheiro et al., 2004).

To estimate the percentage of inadequate food intake, reference values of Dietary Reference Intakes (DRI) (Institute of Medicine, 2004) for micronutrients and the International Society of Sports Nutrition (ISSN, 2018) for macronutrients were consiered, according to gender and age.

For estimated energy requirements calculation, the equation referring to the Metabolic Rate of Rest (TMR) (Cunningham, 1991) was used, considering fat-free mass, and calculated by metabolic equivalent of the task (of the acronym in English MET) obtained through of all activities practiced by athletes for 24 hours (Ainsworth et al., 1992).

Assessment of body composition were obtained using body measurements: weight, height, circumferences (arm and waist), % of

Revista Brasileira de Nutrição Esportiva
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Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício

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body fat and lean mass, in addition to indexes calculated from these measures. Curves and tables expressed in percentiles and / or z-scores were used to classify adolescents according to their BMI index by age (World Health Organization, 2006; World Health Organization, 2007).

To measure weight, a Tanita® digital scale was used, and height was obtained using a portable Sanny® stadiometer, accurate to 0.1 cm, with measurements performed as recommended by the World Health Organization (1995).

Body Mass Index (BMI) was calculated using weight and height and values were classified using references for adolescents between ≥ 10 years and <20 years of age (World Health Organization, 2006).

Circumferences were obtained by an anthropometric measuring tape with a precision of 0.1 mm (Cescorf®). Circumference values were classified according to age and gender in percentiles using Freedman et al., (1999) and Frisancho (1990).

For the assessment of body fat composition, a scientific adipometer (0.1 mm) (Cescorf®) was used. Three measurements of each anatomical point were measured on the right side of the body in the rotation system considering the tricipital and subscapular folds, according to the protocol by Slaughter et al., (1988).

Gender, race, sum of the folds and maturation age according to figures of each gender of the Tanner stage (1962) and stated by the athletes themselves were used. Percentage of fat according to age and gender was obtained according to reference values of Deurenberg et al., (1990).

The data were organized and analyzed using SPSS (Statistical Package for the Social Sciences) software version 18.0.

The descriptive analysis was presented as mean, standard deviation and absolute and relative frequency.

RESULTS

Study sample was composed of 88.9% of male participants with mean age of 11.11 ± 1.53 years.

The average duration of training for both sexes was 2 hours per week, with a frequency of 2 days per week.

According to data presented in Table 1, 66% of the athletes did not use a supplement, and among those who used 33% drank a supplement containing carbohydrates and electrolytes.

Table 1 - Characterization of high performance teenage tennis players.

Variable	Mean ± SD	n (%)
Gender		
Female		1 (11.1)
Male		8 (88.9)
Scholarity		
Incomplete elementary school		8 (88.9)
Incomplete high school		1 (11.1)
Time in years of sports practice	4.00 ± 1.66	
Training phase		
In preparation (pre-competition)		4 (44.4)
In rest (vacation)		5 (55.6)

Revista Brasileira de Nutrição Esportiva
ISSN 1981-9927 ***versão eletrônica***

Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício

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Sleeping hours	8.22 ± 0.83	
Fatigue in training		
Yes		4 (44.4)
No		5 (55.6)
Pre-training meal		
Yes		6 (66.7)
No		3 (33.3)
Use of supplements		
Yes		3 (33.3)
No		6 (66.7)
Supplement type		
Carbohydrates and electrolytes		3 (33.3)
None		6 (66.7)

The results of the evaluation of food intake are described in Tables 2 and 3.

The average total energy value (VET) was 2021.47 kcal/day, meaning lower than absolute value fot total energy consumption (Kcal/day), but adequate when compared with energy intake in relation to body weight (Kcal / kg / day).

It was observed that 77.78 % of the athletes presented adequate energy intake according to the recommendations of the International Society of Sports Nutrition (2018).

Table 2 - Energy requirements, energy and macronutrients intake of high performance teenage tennis players.

Nutrients	Mean±SD	n (%)	Recommendation*
MET	1.79±0.1		
MRR	1120.16±188.81		
TEV	2021.47±441.62		
Energy (kcal/day)	2344.70±685.06		
Energy (kcal/kg/day)	52.35±16.37		40 - 70 Kcal/kg
Energy adequacy			
Low		1 (11.11)	
Adequate		7 (77.78)	

Revista Brasileira de Nutrição Esportiva
ISSN 1981-9927 *versão eletrônica*

Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício

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High		1 (11.11)	
Protein(g/kg/day)	2.01±1.13		1.2 - 2.0 g/kg
Protein adequacy			
Low		3 (33.33)	
Adequate		1 (11.11)	
High		5 (55.56)	
Lipids (g/kg/day)	1.94±0.80		-
Lipids (%TEV)	33.78±9.21		30 - 50% TEV
Lipids adequacy			
Low		2 (22.22)	
Adequate		7 (77.78)	
Carbohydrates (g/kg/day)	6.86±2.57		5 - 8 g/kg
Carbohydrates (%TEV)	55.07±11.50		-
Carbohydrates adequacy			
Low		2 (22.22)	
Adequate		5 (55.56)	
High		2 (22.22)	

Legenda: MET (Metabolic Equivalent of the Task); MRR (Metabolic Rest Rate); TEV (Total Energy Value); SD (standard deviation).

Table 3 - Micronutrients intake of high-performance teenage tennis players.

Nutrients	Mean±SD	n (%)	Recommendation*
Calcium (mg/day)	354.02±315.74		1300**
Calcium adequacy			
Low		9 (100)	
Iron (mg/day)	12.69±16.45		8 and 15**
Iron adequacy			
Low		1 (11.11)	

Revista Brasileira de Nutrição Esportiva
ISSN 1981-9927 ***versão eletrônica***

Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício

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Adequate		1 (11.11)	
High		7 (77.80)	
Zinc (mg/day)	10.97±16.26		8 and 9**
Zinc adequacy			
Low		3 (33.30)	
High		6 (66.70)	
Vitamin C (mg/day)	249.45±236.10		45 and 65**
Vitamin C adequacy			
Adequate		1 (11.10)	
High		8 (88.90)	
Vitamin E (mg/day)	20.34±22.17		11 and 15**
Vitamin E adequacy			
Low		2 (22.22)	
Adequate		1 (11.11)	
High		(66.70)	

Legenda: *IOM (2005); ** Recommendation for men aged 9-13 years and women aged 14-18 years respectively; SD (Standard Deviation).

When analyzing Table 3, daily intake of all micronutrients was inadequate. Calcium inadequacy was observed in 100% of athletes, while other evaluated nutrients presented inadequacies above 65% according to the DRI (Institute of Medicine, 2005).

Body composition assessment data is described in Table 4 and Figure 1.

Table 4 - Body composition of high-performance teenage tennis players.

Variable	Mean ± SD	n (%)
Weight (kg)	48.26 ±16.14	
Height (m)	1.51 ±0.11	
Arm circumference (cm)	24.86 ±5.59	
AC classification (%)		
Energy deficit		1 (11.1)
Energy deficit risk		2 (22.2)
Adequate		3 (33.3)

Revista Brasileira de Nutrição Esportiva
ISSN 1981-9927 versão eletrônica
Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício
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Excessive energy		3 (33.3)
Waist circumference (cm) WC classification	69.44 ±12.46	
Without excess adiposity		8 (88.9)
Excessive adiposity		1 (11.1)
BMI (kg/m^2)	20.25 ±6.25	
BMI classification		
Eutrophy		6 (66.7)
Obesity		2 (22.2)
Severe obesity		1 (11.1)
Arm Muscle Circumference (cm) AMC classification (%)	19.60 ±3.21	
Lean mass deficit		1 (11.1)
Adequate		6 (66.7)
Developed muscle mass		2 (22.2)
CAMA (cm)	21.30 ±10.20	
CAMA classification (%)		
Lean mass deficit		4 (44.4)
Adequate		5 (55.6)
Body fat (%)	25.78 ±9.22	
%BF classification		
Adequate		3 (33.3)
Moderately high		2 (22.2)
High		2 (22.2)
Excessively high		2 (22.2)
Fat mass (kg)	13.53 ±8.46	
Free fat mass (kg)	34.73 ±8.74	

Legenda: SD (Standard Deviation); AC (Arm Circumference); WC (Waist Circumference); BMI (Body Mass Index); AMC (Arm Muscle Circumference); CAMA (Corrected Arm Muscle Area); BF (Body Fat).

Revista Brasileira de Nutrição Esportiva
ISSN 1981-9927 ***versão eletrônica***
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It was found that the majority of high-performance tennis players had satisfactory body composition according to the parameters of waist circumference (88% without excess adiposity), body mass index (66% eutrophic), muscle circumference of the arm (66, 7% adequate) and corrected arm muscle area (55.6% adequate).

However, for the percentage of body fat, only 33.3% were classified as adequate and 66.7% presented excess body fat.

Observing Figure 1, it was seen that among the variables used to assess body composition, percentages of arm circumference (AC) and body fat (BF) were the ones that most showed inadequacies (66%) in teenage high-performance tennis athletes.

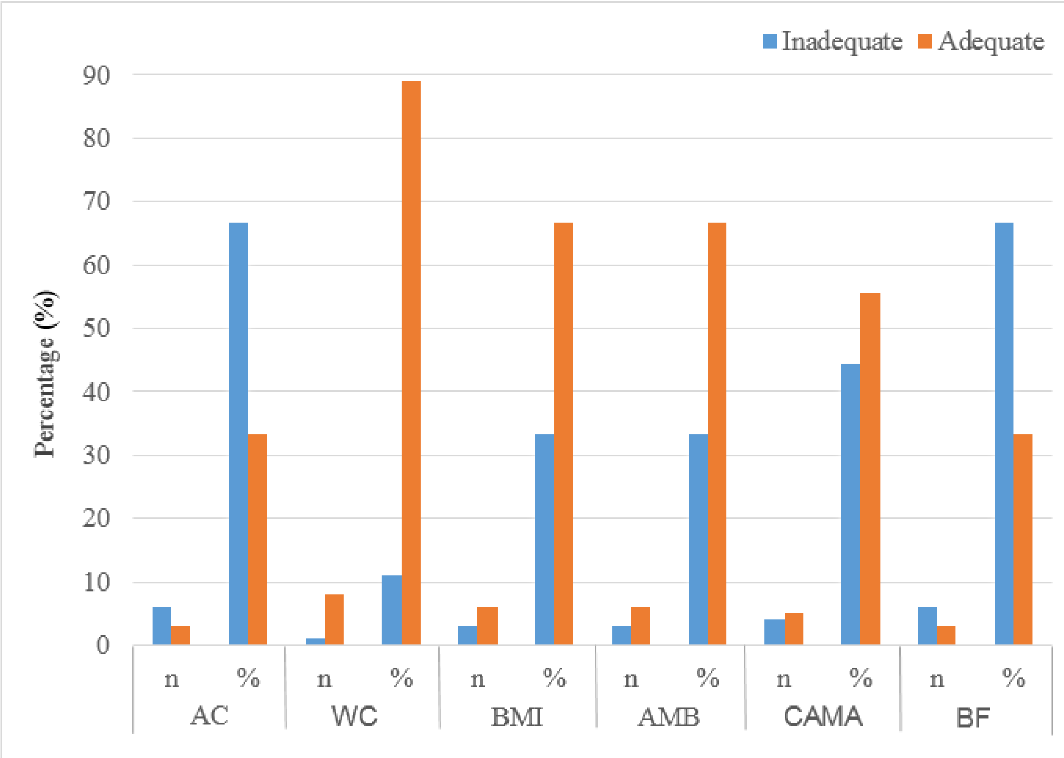

Figure 1 - Number (n) and percentage (%) of body composition adequacy of high-performance adolescent tennis players (n = 9). AC (Arm Circumference); WC (Waist Circumference); BMI (Body Mass Index); AMB (Arm Muscle Circumference); CAMA (Corrected Arm Muscle Area); BF (Body Fat).

DISCUSSION

In comparison to other modalities, our results differed in relation to energy intake. Studies with adolescent football players (youth category), with a minimum training of 5 times a week, from 45 to 60 minutes, showed that, after applying the 24-hour recall, athletes obtained an average intake of 1330.43 ± 483.102 kcal, lower than energy requirement proposed by the DRI formulas (Institute of Medicine, 2002) of 3,937.45 ± 516.3 kcal / day (Wondracek et al., 2017).

Similar to aforementioned study, Welicz et al., (2016) found that in basketball adolescent athletes aged between 16 and 17 years old, inadequacy was also observed regarding energy intake, with an average of 32.7 kcal/kg below recommendation of the Brazilian Society of Sports Medicine (2009) of 37 to 41 kcal/kg/day.

In comparison with the International Society of Sports Nutrition recommendations (ISSN, 2018) of 40 to 70 Kcal/kg for moderate intensity modalities (2 to 3 hours per day), it is noted that both studies presented results below recommendations, different from data obtained in the present work.

Revista Brasileira de Nutrição Esportiva
ISSN 1981-9927 ***versão eletrônica***

Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício

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Adolescent athletes have an increased energy demand due to their stage of life and competitive sports practice (IOM, 2000).

It is noted that, in general, an adequate intake for athletes in this age group, can result in benefits such as: maintaining health, promoting growth and adequate sexual maturation and meeting energy expenditure for exercises and intellectual activities (IOM, 2005).

Although the assessment of food intake provides important information to identify inappropriate habits and/or excessive intake of foods with poor nutritional content, the heterogeneity of methods raises doubts about the most appropriate assessment tools for use in daily practice (Fisberg et al., 2009).

Regarding macronutrients results, protein intake was inadequate for most athletes (88.89%) above the upper limit of 2.0g/kg/day of the ISSN recommendation (2018).

In a study carried out with adult professional tennis players in São Paulo, protein intake averaged 1.79 ± 0.80 g/kg/day, also above the recommendations proposed by SBME (2009) of 1.2 to 1.7 g/kg/day (Smaili, 2018), but within the range of ISSN (2018) for adults and below the value found in the present study. Research about protein intake in adolescents was not found.

Protein requirements in adolescence is greater than in adulthood due to growth and new tissue generation demands. Furthermore, adequate protein intake is essential for tissue recovery and muscle maintenance during exercise practice.

However, when protein intake is too high, it does not increase muscle mass, which can result in urinary calcium losses, making it necessary to monitor water replacement (Kerksick et al., 2008).

Regarding lipids intake, 22.22% presented intake below the recommended. When compared to professional adolescent swimming athletes aged between 12 and 17 years in Rio Grande do Sul, who were participating in state, national and international competitions, lipids intake was 10.86 ± 6.84% (Costa et al., 2017), values below the results of the present study and recommended by Dietary Reference Intakes (2005) (from 25 to 30% of total energy intake) and ISSN (2018) (from 30 to 50% of total energy intake).

The contribution of this macronutrient to metabolism depends on several factors, such as intensity and physical effort. Non-essential lipids provide thermal insulation and store metabolic energy that might be used as an energy substrate during prolonged exercise, when carbohydrate reserve is depleted. Therefore, lipids intake should be monitored, as low intake does hold performance benefits, and it might alter the absorption of fat-soluble vitamins and the adequate supply of essential fatty acids (Oliveira, Marins, 2008).

Regarding carbohydrate intake, we observed an average intake of 6.86 ± 2.57g/kg/day, Also, 44.44% of the athletes presented inadequate carbohydrate intake, being 22.22% with low intake. The average intake found in our study are within the recommendation of the ISSN (2018) of 5 to 8 g/kg for moderate intensity exercises, with duration of 2 to 3 hours/day.

A study with 129 adolescents from prominent teams of tennis players, swimming, rhythmic gymnastics and judo from the state of Aracaju-Brazil, participating at regional and national competitions, showed, through food frequency questionnaire (FFQ), that the athletes presented an average intake of 8.43 g/kg of carbohydrates (Reinaldo et al., 2016), meaning high carbohydrates intake according to the recommendation of 5 to 7 g / kg by Burke et al., (2011), above ISSN recommendation range (ISSN, 2018) and above the value found in the present study.

Adequate intake of carbohydrates in high intensity exercises preserves tissue proteins preventing their oxidation as an energy source and is essential to maintain blood glucose stock and to promote glycogen recovery, delaying fatigue onset (Kerksick, 2008).

Considering that tennis is a sport with an average duration of 60 to 300 minutes using mixed metabolic system (anaerobic and aerobic), carbohydrates are an important energy source, both in moments of explosion, which depend on the degradation of muscle glycogen, as well as maintaining blood glucose in the long term (Hirschubruch, 2014).

Still comparing the findings of the study with athletes from different modalities of Reinaldo et al., (2016), we observed in the present study that micronutrients intake, tennis players presented high average intake for vitamin E and zinc, based on the recommendations of the DRI (Institute of Medicine, 2005).

Revista Brasileira de Nutrição Esportiva
ISSN 1981-9927 *versão eletrônica*

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Regarding insufficient average intake, it was observed fot vitamin C (5.4 mg/day), iron (4.9 mg/day) and calcium (74.55 mg/day). Calcium intake was low for all athletes. It is noteworthy that even though vitamin E and zinc represented high intake in comparison to recommendations, none of them were exceeded the Tolerable Upper Intake Level (UL), meaning the maximum tolerable intake level for micronutrients that prevents different health risks.

During adolescence, daily calcium requirement is increased due to bone demands and for preventing fractures risk and osteoporosis during adulthood. In sports, calcium is essential for blood clotting, platelet aggregation, transmission of neural impulses, activation of enzymes, synthesis of vitamin D and especially in muscle contraction. Its deficiency can lead to a decrease in this contraction, in addition to accelerated loss of bone mass and the development of future osteoporosis (Bucci et al., 2005).

Iron is essential in adolescence due its role in growth. Iron requirements for both genders are increased, helping to gain muscle mass, increase blood volume and respiratory enzymes. In athletes with intense training, iron demand becomes even greater, due to the additional loss of iron through sweat, urine, gastrointestinal tract and menstruation (Vitolo, 2008).

During acute exercise such as in tennis, both aerobic and anaerobic activity can result in increased production of free radicals and may be responsible for muscle damage after physical activity. Both vitamin C and vitamin E have antioxidant effects, contributing to the protection of cell membranes against oxidative destruction and accelerating muscle recovery (Ju et al., 2010).

Regarding body composition and measurements, a previous study assessed arm circumference of 30 judo athletes, from the state of Espírito Santo, aged between 10 and 19 years old, participating in competitions at the state, national or international level, being 15 male and 15 females, authors noted that among the 15 male athetes, 12 (80%) presented adequate results.

Among 15 female athletes, 10 (66.66%) presented adequacy (Mognol, Paixão, 2017). In comparison to the present study, we observed that the inadequacy remains higher in adolescent tennis players.

Arm circumference is a measure that represents a reserve index of fat and muscle mass. One hypothesis for our findings could be that tennis players with longer practice may present higher arm muscle due to increase in the triceps brachii, as observed by Ireland et al., (2013).

A study carried out with 24 amateur tennis players from a school club in the city of São Paulo, training once a week, aged between 10 and 15 years and in different training volumes, showed an average fat percentage of 21.2 ± 9.3% for the group with 2 hours of training and 10.2 ± 8.2% for the group with 3 hours of training per week (Miranda et al., 2019).

These results show that the average percentage of body fat found in the present study with high-performance tennis players from Campo Grande-MS would be higher compared to the study.

According to Deurenberg et al., (1990), fat percentage in athletes aged 7 to 18 years, must be between 10.01 and 20% for males and 15.01 and 25% for females. In the present study, only one female tennis player was studied with a fat percentage of 26.54%, and the average for male athletes was 25.68 ± 9.85%, meaning results above the recommendation.

Tennis is a sport with many physical actions performed during the game, in a fast, varied and precise way, where weight control ends up being an important factor for a better performance. However, although body composition can affect performance, this should not be the only goal for young athletes, in a growing period, since low weight and fat percentage can cause decreased height and puberty delay, increasing the risk for development of eating disorders, damage to bone health, nutrient deficiency and menstrual irregularities, or even amenorrhea (Muniz et al., 2014).

According to Siervogel et al., (2003), adolescents with excess adiposity may need a deposit of body fat for the pubertal spike that occurs in both genders.

However, it is necessary to emphasize that no factor should be evaluated in isolation to better understand the nutritional status.

Factors such as autonomy and power to choose foods may be linked to inadequate feeding, with excessive energy intake from simple sugars and fats, directly contributing to weight gain in this group (Reinaldo et al., 2016).

Revista Brasileira de Nutrição Esportiva
ISSN 1981-9927 *versão eletrônica*
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CONCLUSIONS

Most high-performance tennis adolescents presented adequate intake of energy, carbohydrates and lipids and inadequate intake of proteins and micronutrients, which may be reflected in their body composition.

In this sense, we highlight the importance of nutrition follow-up, to ensure appropriate behaviors that lead to health and good sports performance, in partnership with a multidisciplinary team.

We highlight the limited sample size of high-performance teenage tennis players in Campo Grande-MS and the importance of conducting new studies with a greater number of adolescent athletes, including amateurs to expand and compare our findings.

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