DOI: 10.4025/jphyseduc.v27i1.2758

Original Article

NUTRIENT AND FOOD INADEQUACIES AMONG ATHLETES: GENDER COMPARISONS

INADEQUAÇÕES DIETÉTICAS EM ATLETAS: UMA COMPARAÇÃO ENTRE HOMENS E MULHERES

Marcus Vinicius Santos do Nascimento[1], Tiago Marcel Santos Villa-Nova[1], Danielle Góes da Silva[1], Vitor Teixeira Nascimento[1] e Raquel Simões Mendes-Netto[1]

[1]Universidade Federal de Sergipe, São Cristovão-SE, Brasil.

RESUMO
O objetivo do estudo foi comparar e avaliar o perfil nutricional entre atletas de ambos os sexos. Participaram do trabalho 80 atletas, sendo 43 do sexo masculino (58,8%). Para avaliar a alimentação dos atletas, foi aplicado recordatório de 24 horas. Ambos os grupos apresentaram uma baixa ingestão calórica. Os homens estavam mais inadequados (pelo excesso) quanto à ingestão de proteína e gordura saturada. Com relação aos micronutrientes, ambos os grupos apresentaram uma elevada inadequação na ingestão de vitamina A, E, D e cálcio. As mulheres apresentaram maior inadequação em vitamina B12, B3, magnésio, folato, fósforo, além de terem uma maior probabilidade de inadequação em ferro. As mulheres também apresentaram maior inadequação na ingestão de frutas, carnes, e ingestão hídrica. Atletas de ambos os gêneros apresentarem inadequações na alimentação, entretanto, essas foram maiores, entre as mulheres.
Palavras-chave: Comportamento alimentar. Atletas. Exercício físico.

ABSTRACT
The present study aimed to evaluate and compare the dietary intake between male and female athletes. The study included 80 high performance athletes, including 43 male and 37 female. The athletes dietary intake was evaluated by a 24-hour recall. Both groups showed a low caloric intake. Men were more inadequate in protein and saturated fat intake. Both groups showed a high inadequacy in vitamin A, E, D and calcium intake. Women had a higher inadequacy in vitamin B12, B3, magnesium, folate, phosphorus, and five times more probability of inadequate iron intake. Women had a more inadequate intake of fruit, meat. Athletes of both sexes present inadequacies on dietary intake, however, these were higher among women.
Keywords: Feeding Behavior. Athletes. Exercise physical.

Introduction

To excel in sport, besides having an exhaustive training routine, adoptions of food habits that are related to exercise are paramount to their athletic demands. Athletes have elevated nutritional needs because of the high physical attritions that are caused by training. These activities can put them in situations of nutritional risk, increasing the incidence of infections, lesions and muscular fatigue[1].

Studies have evaluated athletes from different nationalities and at different competition levels, aiming to detect food errors that might hinder their sports performances or by compromising their health[2,3]. Since men and women may have different nutritional profiles, therefore, a comparison of the food practices between the genders is of great relevance[4].

The literature suggests that female athletes suffer a greater social pressure in order to acquire a lean physique, leading them to adopt energy restriction practices that put them at a higher risk of nutritional deficiencies, especially in sports of aerobic resistance and combat, or those that appreciate the esthetics of movement (e.g., artistic gymnastics) [5,6]. However, despite an elevated number of studies involving female athletes, these types of conclusions come from those studies that have evaluated the female gender in isolated situations[5,6]. Besides, these energy restrictions have also been observed in male athletes within similar modalities[2].

Male athletes show a higher mean energy intake than do their female counterparts[7]. Nevertheless, even when an energy intake is adequate, that does not necessarily mean adequate nutrient intakes for an athlete. Nogueira and Da Costa[3] evaluated 38 adolescent triathletes. They noticed that even though there was an energy intake adequacy, the participants had food practices that were based on low-nutritional value foods, with an insufficient consumption of fruit and vegetables. This was reflected in their vitamin and mineral intake inadequacies. These results have highlighted the importance of food intake analyzes, in conjunction with a nutrient intake identification of food errors. However, to our knowledge, few studies have compared the food practices between athletes of both sexes and considered their consumption of the various food groups[3,8].

Those few studies that have compared the dietetic ingestions between athletes of both genders still show results with difficult interpretations. They have uniquely used a mean intake as the evaluating measure[7,8] which might have clouded those differences in the nutrient adequacies or inadequacies between the athletes[9]. Besides, the use of RDA values as a parameter, in order to assess the micronutrient intakes[10], might have overestimated the prevalences of inadequacy[11].

Since athletes usually show problems in their food practices[2,3,8,10], a comparison of the nutritional profiles between the two sexes might have helped in the characterization and the elaboration of specific nutritional intervention strategies for these populations, and thus, aiming to improve their sports performances. Hence, the objective of the present study was to evaluate and to compare the dietetic intakes between male and female athletes.

Materials and Methods

Population and Study Setting

The study was conducted with the athletes receiving financial aid from the municipal government's program *Bolsa Atleta* in the city of Aracaju, Brazil, during the years of 2012 and 2013. This government program promotes a monthly financial aid to athletes who have aced in regional, national, or international competitions. Within this program, it is possible to identify the best athletes in different modalities performing in the municipality.

The inclusion criterion was to receive aid from the program, with no restrictions on age or gender. Athletes with lesions who were not engaged in regular training were excluded.

Annually, 80 athletes are granted this financial aid: 5 of them at the Gold category (those who have aced in international level competitions), 25 at the Silver category (those who have aced in national level competitions) and 50 at the Bronze category (those who have aced in regional level competitions. When corrected for the number of athletes who renewed their grants for the second year of the program, a total of 110 athletes participated in the program during 2012 and 2013. This number represented the maximum number of athletes who could have been evaluated.

The eighty athletes were engaged in the study from different modalities: Combat Sports (Boxing, Taekwondo, Karate, Jujitsu, Capoeira, Freestyle Wrestling, Kick Boxing n=33), Water Sports (Water Polo, Swimming, Surfing, Rowing, Sailing, n=18), Team Sports (Futsal, Handball, n=2), Racket Sports (Tennis, Table Tennis, Badminton, n=6), Athletics (n=6), Cycling (n=3), Triathlon (n=3), Rhythmic Gymnastics (n=6) and Beach Volleyball (n=3).

The sample was composed of 47 male athletes (58.8%). Of those, 29 were adolescents (61.7%) and 18 were adults (38.3%). There were 33 female athletes (41.2%). Of those, 29 were adolescents (87.9%) and 4 were adults (12.1%). The data was analyzed with and without the adults. Since the presence of these two groups did not alter any results, they were all included in the final analyzes. The men and the women showed median weekly training hours of 8 (IQR: 3-12) and 10 (IQR: 5-15), respectively.

Study Design

This study consisted of a transversal study, aiming to assess and compare the dietetic intakes between the male and female athletes who were granted the program's financial aid.

For such, cooperation was established between the Federal University of Sergipe and the Department of Youth and Sports from the municipal government of the city of Aracaju, Brazil. First of all, a meeting with the athletes was held so that they were informed about the study's objectives and its implications. Those athletes who were interested in being engaged in the study then received a Consent Form so that they could confirm their participation. For the under 18 year old athletes, the same Consent Form was sent to their guardians for them to sign.

The study was conducted following the regulations of the Declaration of Helsinki and the project was approved by the Ethics and Research Committee from the University Hospital/UFS (C.A.A.E. 08574213.4.0000.5546).

Anthropometrics

One trained researcher performed the anthropometrics, following the techniques as proposed by Lohman, Roche and Martorell[12]. During the assessments, their body weight (kg) was measured once on an electronic platform scale (LIDER®) with 100g graduations and a maximum capacity of 200 kg. For their height, a stadiometer (ALTURA EXATA®) with 0.1 cm graduations was used. The participants were asked to remove their shoes and to only use a minimum amount of clothing for their measurements and to keep their heels, buttocks and the back of their necks, in touch with the stadiometer.

Dietetic Assessments

In order to collect their dietetic information, a 24-hour dietary recall interview was applied. A photographic album was used in order to help the participants to remember the portion sizes of the consumed foods, and thus, increasing the reliability of the information. This album was composed of food drawings showing their normal dimensions (small medium, large), with utensils and standard sized portions. Different images were presented, aimed at getting a larger compilation of photo options of the usually eaten foods[13].

From this dietetic information in the 24-hour dietary recall interview, a coding to estimate their food consumption, their energy, their macro and micronutrients, together with their water intake was performed. For such, Version 2011 of the Nutrition Data System for Research (NDSR) Software was used. After the coding, consistency analyzes were performed, following the method as proposed by Fisberg & Marchioni[14]. These analyzes were intended to correct the micronutrient nutritional values, since NDSR is American Software and shows foods with different fortification politics from the ones that are applied in Brazil. Hence, the percentages of agreement for all of the micronutrients were calculated by using the Table of Nutritional Composition of Foods Consumed in Brazil[15]. The corrections were performed for those micronutrients that showed percentages of agreement outside of the range of 80%-120%, as are displayed in the Brazilian Table.

Nutrient Assessments and Food Portions

The Basal Metabolic Rate (BMR) was estimated with the Schofield et al.[16]equation. The activity levels were estimated according to the number of training hours[11]. The energy needs were calculated by multiplying the BMR with the Activity Level Factor. The energy balance was calculated by subtracting the Energy Intake from the Energy Expenditure.

The proportions of the Energy Intake and the Basal Metabolic Rate (EI:BMR) were compared with the Goldberg method cutoff points[17], aiming to assess the underreporting magnitudes.

The energy and nutrient intake classifications were performed after a comparison with the specific population recommendations (Table 1).

Table 1. Nutritional Recommendations

Nutrients	Recommendation	Reference
Carbohydrate	5 to 7 g /kg or 6 to 10g/kg	Burke et al.[18]
Protein	1.2 to 2g/kg	Churchward_Venne, Burd, Phillips[19]
Total Fat	20 to 30% of EI	WHO[20]
Monounsaturated Fat	> 10% of EI	WHO[20]
Polyunsaturated Fat	6-10% of EI	
Saturated Fat	<10% of EI	
Cholesterol	<300mg	WHO[20]
Fiber	Adolescents: Chronological Age + 5g Adults: 25 to 35g	Williams et al.[21]
Micronutrients	Differences according to Age and Gender	Otten, PitziHelliwigand, Meyers[11]

EI = Energy Intake
Source: The authors

For energy, the inadequacy percentages were considered as being the prevalences of those individuals who did not reach the recommended values. For the macronutrients, whose recommendations have minimum and maximum recommended values, the following criteria were adopted (taking into account the risks that are caused by the inadequacy of these intakes and the prevalences of those individuals who had not attained adequate levels): carbohydrates, polyunsaturated fats and fibers. Those individuals with intakes under the recommended values were considered inadequate. Concerning the fats and protein, those who consumed more than the recommended intake were considered inadequate.

Regarding the micronutrients, their intake was classified following the Dietetic Reference Intakes (DRI). According to the American Institute of Medicine[11], the intakes of vitamins and minerals that are advised under the Estimated Average Requirement (EAR) are considered to be inadequate. Since the mean intake of sodium in Brazil is elevated[22], values for the Upper Level of Intake (UL) were used instead, in order to determine the prevalences of those individuals with an inadequate intake of this particular nutrient.

Given the fact that the distribution of iron needs is not symmetrical among childbearing aged women, this particular nutrient does not fit into the criterion of EAR classifications. Thus, in order to estimate the prevalences of an iron intake inadequacy, a manually determined probabilistic approach[11] was used.

The consumption of food portions was compared to the recommendations as proposed by the Brazilian Food Pyramid and this has been adapted for the athletes[3]. The percentages of inadequacy were calculated from the prevalences of those individuals who were under the proposed recommendations, except for oils, fats, sugars, and sweets. For these groups, the inadequacy percentages were obtained from the prevalences of those individuals who were over the recommended portion numbers.

Frequency and Meal Omissions

From the 24-hour dietary recall interview, the number of meals per day was obtained, which was then compared against the recommendations for athletes[23]. The characterization of each meal was defined according to its timing, following the methodology as adopted by Burke et al. [23]

Any food and beverage consumption within a 30-minute time frame was considered as being a "Meal". A morning snack, an afternoon snack, and supper, were grouped into one category, named "Snacks", whilst breakfast, lunch, and dinner, were considered as being "Main Meals". Hence, it was possible to estimate the prevalences of meal omissions. Besides, the pre-exercise and post-exercise meal times were analyzed according to the recommendations as proposed by Aragon and Shoenfeld[24], where the interval between the pre-exercise and the post-exercise meal times must be between 3 and 4 hours.

Statistical Analyzes

The Software SPSS Version 17.0 (SPSS Inc., Chicago, IL, USA) was used for the statistical analyzes. The Kolmogorov-Smirnov test was performed in order to verify the data's normality. The variables with a normal distribution have been presented as mean and standard deviations (SD), whilst the ones with non-normal distributions have been presented as medians and with an interquartile range (IQR). For the categorical data, absolute and relative prevalences were used.

The numerical variables for the men and the women were compared with each other by the Independent Samples t-test. The data with non-normal distributions was compared by the Mann-Whitney non-parametric test, while the categorical variables were compared by using Pearson's Chi-Square test.

Results

The mean ages of the men and the women were 19 (SD: 6) years and 16 (SD: 4) years, respectively ($p<0.05$). When comparing the genders, the athletes showed a body mass and a height that were significantly different (men: 64.7 (SD: 12.6) kg and 1.71 (SD: 1) m; women: 54.7 (SD: 12.5) kg and 1.60 (SD: 0.7) m)

Figure 1 presents the number of inadequate meals, the pre-exercise and post-exercise meal adequacy, together with the prevalences of omitted meals. The men showed a higher prevalence of individuals who were adequate according to the recommendations for the pre-exercise and post-exercise meals. However, approximately half of the athletes were inadequate concerning their number of meals, with snacks as the most omitted meal. There were no omissions of lunch for any of the athletes. So therefore, this variable has not been presented.

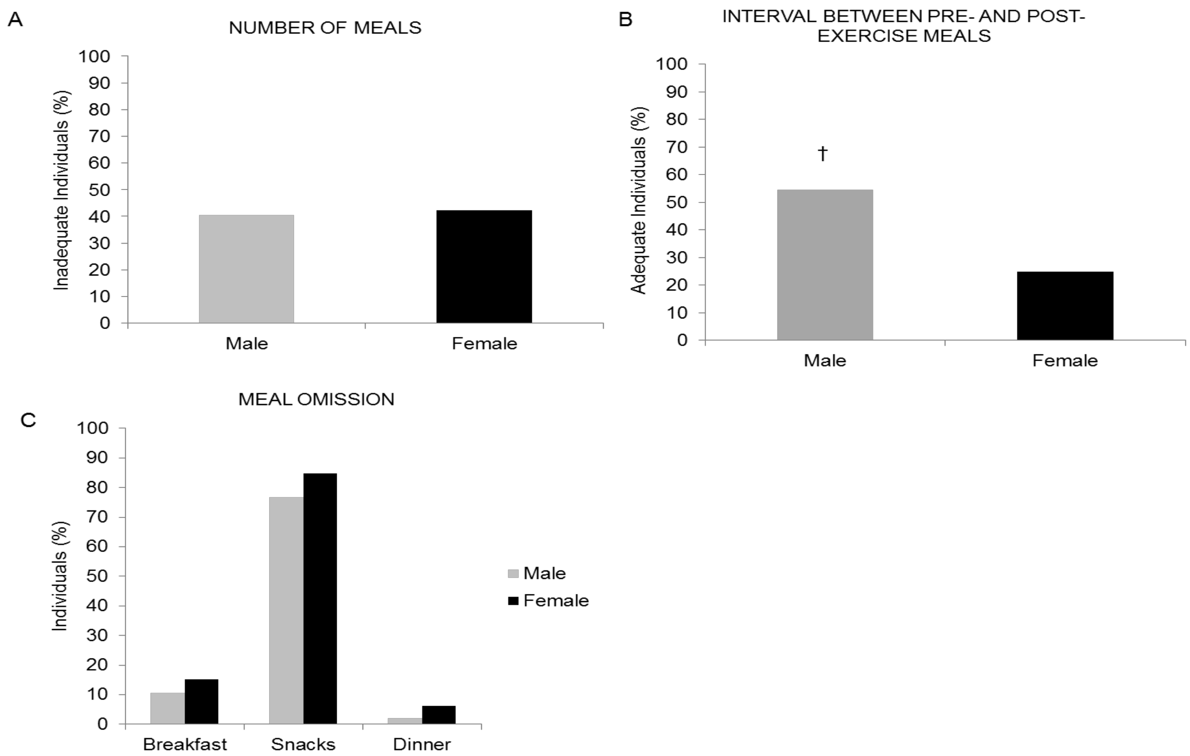

Figure 1. The number of individuals whose meals were inadequate (A), the interval between pre-exercise and post-exercise adequacy (B) and the prevalence of omitted meals (C).
†p<0.05 by Pearson's Chi-Square test (p=0.016)
Source: the authors

Table 2 shows the percentages of inadequacy and the food group consumptions. The study observed high percentages of inadequacy for certain food groups, such as cereals, vegetables, dairy produce, oils, fats, sugars, and sweets, in both the men and the women. However, the women showed higher prevalences of inadequacy in their consumptions of fruit, meat and eggs.

Table 2. Percentages of inadequacy and the medians (interquartile range) of consumption for the food group portions by the athletes.

Groups	Recommended (Portions)	Median (IQR)	Inadequacy n (%)	Median (IQR)	Inadequacy n (%)
		Males (n=47)		Females (n=33)	
Cereals	7-13	6(4-9)*	22(46.8)	4(2.5-6.7)	22(66.7)
Fruit	4-7	4.5(1-7)*	19(40.4)	2.2(0.5-3.9)	24(72.7)†
Vegetables	5-7	0.8(0-1.6)*	44(93.6)	0.2(0-0.5)	33(100)
Meat and Eggs	1.5-3	2.3(1.5-3.3)*	10(21.3)	1.1(0.5-2)	19(57.6)†
Dairy Produce	3-4	1.7(0.7-4)	30(63.8)	1(0.2-3.4)	23(69.7)
Beans	1-2	2(1-3.5)	10(21.3)	1.8(0-2)	13(39.4)
Oils and Fats	1-2	1.5(0.5-3)	33(70.2)	1(0.4-2)	19(57.6)
Sugars and Sweets	1-2	2.7(1.2-5)	27(57.4)	2.7(0.5-5)	18(54.5)

*p<0.05 between the genders by the Mann-Whitney non-parametric test.† p<0.05 between the genders by Pearson's Chi-Square test
Source: The authors

The male athletes had greater food consumptions, energy intakes and energy needs (Table 3). There were no significant differences between the energy balance medians for the men and the women, which were 761 (IQR: -1287 to 265) kcal and 822 (IQR: -1591 to 147) kcal, respectively.

It was observed that there were higher inadequacy percentages for protein and saturated fat intakes in the men and higher inadequacy percentages for monounsaturated fats in the women. In addition, an elevated prevalence of athletes with inadequate intakes of energy, carbohydrate, polyunsaturated fat, and fiber, was noticed in both groups.

Table 3. Food consumption, energy needs, intakes, and the percentages of inadequacy, for energy and the macronutrients in the athletes.

Variables	Males (n=47)	Females (n=33)
	Median (DP)	Median (DP)
Food Consumption (g)	2190 (832)*	1548 (702)
Energy Needs (kcal)	3424 (472)*	2748 (357)
Energy (kcal)	2872(1085)*	2042(897)
Energy (Kcal/kg)	46(20)	39(20)
Carbohydrate (g)	423(151)*	323(157)
g/kg	6.8(3)	6(3.5)
% EI	58.7(8)	61.2(9)
Protein (g)	117.7(64.5)*	73.7(40.3)
g/kg	1.86(0.8)*	1.38(0.7)
% EI	16.8(5.1)	15.2(4.7)
Total Fat (g)	83.4(44)*	54(27.6)
% EI	25.6(6.8)	24(6.3)
Saturated Fat (% EI)	11.5(9)*	7.3(4)
Polyunsaturated Fat (% EI)	6.1(3.0)*	4.5(2.3)
Monounsaturated Fat (% EI)	9(3.6)*	6.5(3.1)
Cholesterol (mg)	302(160)*	218(159)
Total Fiber (g)	26.4(13.3)*	17(7)
% of Inadequacy	n (%)	n(%)
Energy	29(61.7)	22(66.7)
Carbohydrate	18(38.3)	15(45.5)
Protein	20(42.6)†	4(12)
Total Fat	11(23.4)	7(21.2)
Saturated Fat	20(42.6)†	6(18.2)
Polyunsaturated Fat	29(61.7)	25(75.8)
Monounsaturated Fat	30(63.8)	29(87.9)†
Cholesterol	18(38.3)	9(27.3)
Total Fiber	35(74.5)	25(75.8)

% EI= Percentages of energy intake
*p<0.05 between the genders by the Independent Samples t-test
†p<0.05 between the genders by Pearson's Chi-Square test
Source: the authors

Regarding the micronutrients, the men showed higher intakes of B vitamins, magnesium, calcium, zinc, iron, sodium and phosphorus. On the other hand, a higher inadequacy of vitamin C and sodium was found among the males (Table 4). The women showed higher inadequacy rates for vitamin B12, folate, niacin, magnesium, and phosphorus, together with higher probabilities for an iron intake inadequacy. Both of the genders exhibited high prevalences for inadequacies of vitamin A, vitamin D, vitamin E and calcium.

Table 4. Percentages of inadequacy and the medians (interquartile range) for the men and women athlete's vitamin and mineral intakes.

Nutrients	Males (n=47)		Females (n=33)	
	Median (IQR)	Inadequacy n (%)	Median (IQR)	Inadequacy n (%)
Vit. A (μg/d)	326(147-460)	37(78.7)	261(150-352)	28(84.8)
Vit. C (mg/d)	145(77-332)	24(51.1)†	128(57-278)	8(24.2)
Vit. B1 (mg/d)	2(1.4-2.8)*	5(10.6)	1.2(0.9-2.3)	8(24.2)
Vit. B2 (mg/d)	3.1(2-4.2)*	4(8.5)	1.7(1.3-3.1)	3(9.1)
Vit. B6 (mg/d)	4.3(2.3-7)*	3(6.4)	2.8(1.2-4.6)	7(21.2)
Vit. B12 (mg/d)	4(2.5-5.7)*	7(14.9)	2.2(1.4-4.0)	15(45.5)†
Folate (μg/d)	533(415-747)*	4(8.5)	404 (259-544)	13(39.4)†
Niacin (mg/d)	26.3(17-34)*	3(6.4)	16(9.6-24)	9(27.3)†
Vit. D (mg/d)	3(2-6)	40(85.1)	2.4(1-4.6)	32(97)
Vit. E (μg/d)	6.1(3.7-9)	38(80.9)	6(3.6-8)	29(87.9)
Magnesium (mg/d)	362(258-517)*	21(44.7)	220(157-338)	25(75.8)†
Calcium (mg/d)	776(549-1491)*	30(63.8)	685(269-1032)	25(75.8)
Zinc (mg/d)	15(10-19)*	11(23.4)	8.2(5.5-12.7)	11(33.3)
Iron (mg/d)	13.5(9-18)*	8.9[a]	8(5-15)	56.6[a]
Sodium (mg/d)	3294(2400-5081)*	37(78.7)†	1994(1194-3057)	11(33.3)
Phosphorus(mg/d)	1342(995-2128)*	7(14.9)	866(618-1363)	17(51.5)†

[a] Estimated by the probabilistic method
*p<0.05 between the genders by the Independent Samples t-test
†p<0.05 between the genders by Pearson's Chi-Square test
Source: The authors

Discussion

The findings have shown that the athletes from the program presented nutritional inadequacies; nevertheless, most of these inadequacies were found among the women.

Besides the 24-hour dietary assessment interviews, analyzes of their food practices during those periods close to the trainings sessions, such as the timings for their pre-exercise and post-exercise meals, together with their water intake during the sessions, were conducted. It was noted that the women exhibited higher inadequacies of these variables when they were compared to the men.

The various studies that have analyzed nutrient intakes during training sessions have shown that a meal could promote favorable adaptions towards better performances. Recently, Mori[25]observed that carbohydrate and protein intakes, immediately after the exercise sessions, were capable of pushing the nitrogen balance to a more positive state, than if the ingestions were made 2 hours after the training sessions. Hence, even though the pre-exercise and post-exercise meal compositions were not assessed, the lack of a dietary intake during these critical periods may be considered to be a flaw that was present in the food practices of most of the female athletes in this study.

The dietary assessments were supplemented by the calculations of the percentages of inadequacy in the athletes. These methods have allowed for a detailed identification of how much the athletes followed the nutritional recommendations, since the use of a mean, although useful in order to quantitatively compare the nutrient intakes between the groups, may cause false interpretations in the adequacy evaluations[9]. For example, when comparing the mean intakes of protein (g/kg) and carbohydrates (g/kg), it was possible to conclude that both of the groups would have adequate intakes concerning the recommendations of 1.2 to 2 grams of protein/kg and 6 to 10 grams of carbohydrate/kg. Conversely, following the results of the percentages of inadequacy, it was observed that there was a higher prevalence of men with an excessive protein intake and that approximately 40% of the athletes from both of the groups had a deficient carbohydrate intake.

Low carbohydrate diets may limit physical performances. Couto et al.[26] noticed better performances in the runners during a 10 km run when they were supplemented with a carbohydrate-rich diet (70% of EI) rather than with a low-carbohydrate diet (25% of EI). Similar results were found by Skein et al.[27] when they compared the effects of a diet with 7g of carbohydrate/kg with a diet of 2g of carbohydrate/kg over the physical performances in intermittent exercises.

Despite the importance of carbohydrates in sports performances, substitutions of this nutrient by proteins, is a usual practice among athletes[2,7]. This is since proteins are commonly associated with lean mass gains and an excessive intake among the men may be explained by the differences in the body image patterns that affect the genders. Although athletes from some modalities suffer from a high social pressure to acquire a low body fat percentage, males rather than females are more concerned with muscle mass. This way, they exhibit a higher intake of protein foods and supplements[28].

The athletes from both of the groups also showed a low intake of fibers and a low-quality of fat intake. These findings may be related to the greater prevalence of athletes to a higher consumption of sweets, oils and fats. The male athletes showed higher energy intakes. However, 60% of the athletes from both of the groups exhibited energy intakes that were under the recommendations. The observed energy restrictions might have been related to the greater prevalence of athletes in the aerobic resistance modalities and the combat sports, who benefit from this kind of a program (70% of men and 84% of women, $p>0.05$). Those athletes from these modalities tend to adopt to dietary restriction strategies that are aimed at maintaining an ideal bodyweight, acquiring a lower body fat percentage, and being more agile[5,6].

During the present study, the caloric deficits in both of the groups were approximately 800 kcal. There were no significant differences between the groups for the percentages of energy deficits according to their energy needs. Nevertheless, even with similar training volumes, the women, because of their lower body weight, height and lean mass (important predictors of energy expenditures), exhibited lower energy needs. Thus, the same energy restrictions limited the food consumption and the caloric intakes to a greater degree in the women rather than in the men.

It is worth mentioning that analyzes of food consumption through the dietary assessment methods were subject to underreporting when related to the perceptive, the emotional, and the cognitive aspects. In the current study, an underreporting magnitude of 23.8% was observed. This was a similar result to other studies with athletes, where this parameter was assessed by more sophisticated methods in these other studies[29]. There were no differences in the underreporting magnitudes between the men and the women.

Despite the lack of studies that have evaluated the effects of energy restrictions in males, it has been estimated that it can be more detrimental for females. An energy deficiency may lead to reductions in estrogen and progesterone, causing menstrual dysfunctions and reductions in the bone mineral densities in women[30].

The men showed a higher macronutrient intake, but there were no differences in the nutrient densities between the groups. These results have demonstrated that the better adequacies of the males against the women did not happened as a result of having a better quality of diet, but because they consumed more food, and therefore, more calories.

Other studies that have compared the micronutrient intakes of male and female athletes did not show any differences in the adequacies between the genders[10,31]. Our hypothesis is that these types of analyzes may have hindered their data interpretations, seeing that these studies compared vitamin and mineral intakes with the RDA, which might have overestimated the inadequacy prevalences in both of the groups[9].

During the physical exercises, a variety of factors may have contributed to a reduction of the body levels of iron, such as hemolyses, by the physical impacts, the free radicals, gastrointestinal bleeding, and the secretion of inflammatory cytokines, all increasing the risks of iron depletion. These deficits, most of the times, were caused by intakes under the recommended values. [32].

The women showed probabilities of having inadequate iron intakes seven times higher than the men. A lack of iron may negatively affect aerobic metabolism, because of a reduction in the hemoglobin levels, together with the enzymes that are involved in oxidative stress procedures[32].

The greater iron inadequacy among female athletes has already been previously reported[8]. This deficiency is partially due to the higher needs required for females because of their losses by menstruation. Besides the energy deficits, a lower consumption of animal foods might also have contributed to the inadequacies of an iron intake, as well as deficiencies for the vitamin B12. The female athletes may also avoid consuming various meat dishes, due to the associations of these products with dietary fats[32]. However, because these dishes are the main sources of heme iron, it is possible to speculate that besides an insufficient iron intake, the nutrients also have a low bioavailability.

The results have pointed out the importance to analyze, besides the nutrients, the food groups lying behind these nutrients and aiming to obtain details from their dietary intakes. Following the detection of food errors, the elaboration of studies that aim to evaluate the effects of nutritional interventions on these types of athletes would be of great relevance.

In this context, an application of strategies, such as increasing the number of meals, might ease the adherence to a greater variety of food groups. The adequacies of an energy intake through a larger carbohydrate intake, coming from the substitutions of sugars and sweets, for fruit and whole grains, together with the consumption of protein sources with lower saturated fat contents (e.g. skimmed dairy products), ingestions of vegetables, and increasing the water intake, may be considered as practical measures to reach an athlete's nutritional needs.

Despite the relevance of the results in this study, some methodological limitations need to be taken into consideration. A dietary assessment by only one 24-hour dietary recall interview was a limiting factor, because of the in-person variability. Nevertheless, it was necessary to use this methodology, because of the operational difficulties related to meeting the same athlete twice, since they would train at different facilities and so, they needed to be absent from their routine for their data collection. According to Magkos and Yannankolia[33], the 24-hour recall application interview on regular training days is an alternative for when it is not possible to apply it more than once. Other studies have also used this method[34,35] .

Conclusion

The findings of the current study have shown that athletes from both of the groups showed nutritional inadequacies, characterizing a low-quality diet. However, because of the lower energy intakes, the inadequacies were higher among the women.

References

1. Rodriguez NR, DiMarco NM, Langley S. Position of the American dietetic association, dietitians of Canada, and the American college of sports medicine: nutrition and athletic performance. J Am Diet Assoc 2009;109(3):509-527.
2. Drenowatz C, Eisenmann JC, Carlson JJ, Pfeiffer KA, Pivarnik JM. Energy expenditure and dietary intake during high-volume and low-volume training periods among male endurance athletes. ApplPhysiolNutr and Metab 2012;37(2):199-205.
3. Nogueira J, Da Costa T. Nutrient intake and eating habits of triathletes on a Brazilian diet. Int J Sport NutrExercMetab 2004;14(6):684-697.
4. Arganini C, Saba A, Comitatto R, Virgili F, Turrini A. Gender Differences in Food Choice and Dietary Intake in Modern Western Societies. In: Maddock J., Ed. Public Health—Social and Behavioral Health, InTech; 2012. p.84-95
5. Shriver LH, Betts NM, Wollenberg G. Dietary intakes and eating habits of college athletes: are female college athletes following the current sports nutrition standards? J Am Coll Health 2013;61(1):10-16.
6. DellaValle D, Rousseau D, Wadsten S, Haas J. Examining the Relationships Between Dietary Intake, Iron Status, and Physical Performance in Female Collegiate Rowers. FASEB J 2015;29(1).
7. Bogdanis GC, Veligekas P, Selima E, Christofi E, Pafili Z. Elite high jumpers exhibit inadequate nutrient intakes. J PhysEduc Sport 2013;13(3):330-337.
8. Hinton PS, Sanford TC, Davidson MM, Yakushko OF, Beck NC. Nutrient intakes and dietary behaviors of male and female collegiate athletes. Int J Sport NutrExercMetab 2004;14(4): 389-405.
9. Heaney S, O´Connor H, Gifford J, Naughton G. Comparison of strategies for assessing nutritional adequacy in elite female athletes' dietary intake. Int J Sport Nutr 2010;20(3):245-256.
10. Waititu LM, Mugalavai VK, Serrem, CA. Dietary Intake of College Athletes in Tertiary Institutions in the North Rift Region of Kenya. Afr J SciTechnol 2013;1(3):115-121.
11. Otten J, PitziHelliwig J, Meyers LD. The dietary reference intakes: the essential guide to nutrient requirements. Washington, DC: National Academies Press; 2006.
12. Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign, Illinois: Human Kinetics Books; 1988.
13. Zabotto CB, Vianna RPT, Gil MF. Registro fotográfico para inquéritos dietéticos: utensílios e porções. Goiânia: Unicamp; 1996.
14. Fisberg RM, Marchioni DML. Manual de Avaliação do Consumo Alimentar em estudos populacionais: a experiência do inquérito de saúde em São Paulo (ISA). São Paulo: Grupo de Avaliação de Consumo Alimentar da P/USP; 2012.

15. Brasil. Ministério da Saúde. Pesquisa de orçamentos familiares 2008-2009 : tabelas de composição nutricional dos alimentos consumidos no Brasil. Rio de Janeiro: IBGE; 2011.
16. Schofield WN. Predicting basal metabolic, new standards and review of previous work. Hum NutrClinNutr 1985;39(1):5-41.
17. Goldberg GR. Critical evaluation of energy intake data using fundamental principles of energy physiology: 1. Derivation of cut-off limits to identify under-recording. EurJ ClinNutr 1981;45(12):569-581.
18. Burke LM, Hawley JA, Wong SH, Jeukendrup AE. Carbohydrates for training and competition. J Sports Sci 2011;29(1):17-27.
19. Churchward-Venne, TA, Burd NA, Phillips SM. Nutritional regulation of muscle protein synthesis with resistance exercise: strategies to enhance anabolism. NutrMetab 2012;9(1):40.
20. WHO. Interim summary of conclusions and dietary recommendations on total fat & fatty acids. Genebra: Joint FAO/WHO Expert Consultation on Fats and Fatty Acids in Human Nutrition; 2008.
21. Williams CL, Bollella M, Wynder EL. A new recommendation for dietary fiber in childhood. Pediatrics 1995;96(5):985-988.
22. Sarno F, Claro RM, Levy RB, Bandoni DH, Monteiro CA. Estimated sodium intake by the Brazilian population, 2002-2003. Rev SaúdePúbl 2009;43(2):219-225.
23. Burke LM, Slater G, Broad EM, Haukka J, Modulon S, Hopkins WG. Eating patterns and meal frequency of elite Australian athletes. Int J Sport NutrExercMetab 2003;13(4):521-38.
24. Aragon AA, Schoenfeld BJ. Nutrient timing revisited: is there a post-exercise anabolic window. J IntSoc Sports Nutr 2013;10(1):1-11.
25. Mori H. Effect of timing of protein and carbohydrate intake after resistance exercise on nitrogen balance in trained and untrained young men. J PhysiolAnthropol2014;33(24):2-7.
26. Couto PG, Bertuzzi R, de Souza CC, Lima HM, Kiss MA, de-Oliveira FR et al. High Carbohydrate Diet Induces Faster Final Sprint ad Overall 10,000-m times of young runners. PediatrExercSci 2015;27(3):355-363.
27. Skein M, Duffield R, Kelly BT, Marino FE. The Effects of Carbohydrate Intake and Muscle Glycogen Content on Self-paced Intermittent-sprint Exercise Despite no Knowledge of Carbohydrate Manipulation. Eur J ApplPhysiol 2012:112(8):2850-2870.
28. Baum A. Eating disorders in the male athlete. Sports Med 2006;36(1):1-6.
29. Reed JL, De Souza MJ, Kindler JM, Williams NI. Nutritional practices associated with low energy availability in Division I female soccer players. J Sports Sci 2014;32(16):1499-509.
30. Weimann E. Gender-related differences in elite gymnasts: the female athlete triad. J ApplPhysiol 2012;92(5):2146-2152.
31. Papadopoulou SK, Gouvianaki A, Grammatikopoulou MG, Maraki Z, Pagkalos IG, Malliaropoulos N, et al. Body Composition and Dietary Intake of Elite Cross-country Skiers Members of the Greek National Team. Asian J Sports Med 2012;3(4):257-266.
32. McClung JP, Gaffney-Stomberg E, Lee JJ. Female athletes: A population at risk of vitamin and mineral deficiencies affecting health and performance. J Trace Elem Med Biol 2014; 28(4):388-392.

33. Magkos F, Yannankoulia M. Methodology of dietary assessment in athletes: concepts and pitfalls. CurrOpinClinNutrMetabCare 2003:6(5):539-49.

34. Ribeiro SML, Freitas AMP, Pereira B, Vilalva R, Krinski K, Souza-Júnior TP. Dietary Practices and Anthropometric Profile OF Professional Male Surfers. J Sports Sci 2015;3(2):79-88.

35. Goston JL, Mendes LL. PerfilNutricional de Praticantes de Corrida de Rua de um Club e Esportivo da Cidade de Belo Horizonte, MG, Brasil. RevBrasMed Esporte 2011;17(1):13-17.

Received on Dec, 08, 2015.
Reviwed on Jun, 15, 2016.
Accepted on Jul, 18, 2016.

Author address: Marcus Vinicius Santos do Nascimento. Av. Murilo Dantas, 300 - Farolândia, Aracaju - SE, 49032-490. E-mail: marcusnascimentone@gmail.com