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Applied nutritional investigation

Nutritional profile of the Brazilian Amputee Soccer Team during the precompetition period for the world championship

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Abstract

Objective: The purpose of this study was to determine the dietary and anthropometric profiles of the Brazilian amputee soccer players during the training period before the world soccer amputee championship, according to their positional roles in the game.

Methods: Fifteen male athletes participated in the study. Data on height, weight, skinfold thickness, and circumferences were collected to assess nutritional status. Dietary intake was obtained by using 6-d dietary records, analyzed by a Nutrition Support Program for total energy intake, carbohydrates, proteins, lipids, vitamins, and minerals. One-way analysis of variance was used to identify differences in groups ($P < 0.05$).

Results: Midfield players were heavier than the others, and this difference may have been caused by a large quantity of subcutaneous fat. Dietary data showed a low carbohydrate intake and high protein and fat intakes. No athlete met the recommendations for vitamin E, and forward players did not meet recommendations for calcium.

Conclusion: Amputee athletes need an individualized nutritional orientation and the lack of information about disabled sports and athletes highlights the need for more studies in this area.

Keywords: Soccer; Amputee soccer; Amputee; Nutrition; Dietary assessment; Anthropometric assessment; Body composition

Introduction

Amputation is defined as the absence of a member of the body, or part of it, usually the lower or upper limb or both. It imposes changes in customary walking that becomes inefficient and compels the organism to greater effort in a person's locomotion. Those changes cause a considerable increase in oxygen intake and, as a result, on metabolic demand, which is aggravated by crutch use [1].

Disabled sports have made outstanding progress in Brazil and around the world because of the quality of international competitions and of the results obtained by these athletes. Amputee soccer has existed since 1986 and there are yearly world championships, in which Brazil is a three-time champion.

With regard to elite sports, in which fractions of a second, a final sprint, or a decisive play can make the difference between winning or losing, nutritional aspect plays a fundamental role for a better performance. However, given the vast body of knowledge accumulated concerning dietary influences on the well-being of healthy and diseased individuals and on athletic performance, it is ironic that so few studies have assessed the food consumption of disabled individuals and athletes [2].

Although researchers have demonstrated the importance of nutrition for soccer athletes [3,4] and their food habits [5,6], which are mostly inadequate [5,7], no study has highlighted the nutritional aspects of amputee soccer athletes

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that increase performance and quality of life, considering their altered physical condition.

The principal goal of dietary assessment is to characterize an ideal consumption for a person or a population group, knowing their possible faults and, to promote the necessary alterations [8]. Likewise, dietetic surveys may be used to anticipate dietary deficiencies by assisting in the design of optimal nutritional programs and preventing sequelae associated with diets deficient in essential nutrients or excessive in others [2].

The present study evaluated the nutritional status of the Brazilian Amputee Soccer Team during the 2002 world championship during the precompetition period using dietetic and anthropometric parameters.

Materials and methods

General procedure

The athletes were informed of the procedure and objectives, and they signed a consent form to participate in this study. They were allowed to drop out at any time and thus were excluded from the sample. The present research was approved by the ethics research committee of the Hospital Universitário Clementino Fraga Filho at the Universidade Federal do Rio de Janeiro (UFRJ), State of Rio de Janeiro, Brazil (under no. 143/02), and by the scientific investigation commission of the UFRJ (no. 136/02).

Dietary and anthropometric assessments were performed at the Associação Niteroiense dos Deficientes Físicos (ANDEF), an association for the disabled located in the city of Niterói, Rio de Janeiro, Brazil, during the concentration period, 1 wk before the beginning of the world amputee soccer championship, which took place in Moscow, Russia, in 2002.

Sample

The sample was composed of 15 male amputee soccer athletes (two goalkeepers, four fullbacks, three midfielders, and six forwards) from the Brazilian Amputee Soccer Team (mean age, 32.3 ± 6.3 y). The athletes filled out a questionnaire to obtain information regarding the type and duration of the lesion and sportive training before and during the concentration period.

Anthropometric assessment

Height, body mass, skinfold thickness (tricipital, abdominal, thoracic, and thigh), and upper and lower limb circumferences were assessed. The athletes wore minimal clothing, i.e., only training trunks, during the evaluation. A single trained appraiser performed all measurements.

For height, a portable stadiometer Seca 208 (Seca GmbH & Co., Hamburg, Germany) with an accuracy within millimeters was used. The stadiometer was fixed to the wall with no skirting board and the athlete remained in an orthostatic position and apnea inspiration. The head was positioned with the external angle of the eyes parallel to the ground (Frankfurt Plane). This measurement was performed in duplicate.

Body mass was obtained with a digital scale (Tanita Ultimate Scale, Model 2001 TFW; Tanita Corporation, Tokyo, Japan) with a maximum capacity of 150 kg and an accuracy of 200 g, with the athlete barefoot and in an orthostatic position. Body mass was corrected for the amputation, without considering the absence of the limb. Calculation of the corrected body mass was performed using the formula described by Lee and Nieman [9].

Skinfold thicknesses were measured in the hemibody in which the athlete presented no amputation, and in those athletes who had already been evaluated remained in an orthostatic position with relaxed musculature. A Harpenden adipometer (Holtain Limited, Crosswell, Crymych, Pembs, United Kingdom) was used and measurements were performed in duplicate in each place. When the values obtained showed a range of 1 mm, a third measurement was done. The average value of the two measurements that best represented the skinfold thickness was used as the final score. The sum of three skinfolds (abdominal, thoracic, and thigh) was calculated, and the regression equation of Jackson and Pollock [10] was used to determine the percentage of body fat.

Circumferences (brachial and thigh) were assessed on the side in which the athlete presented no amputation with an inextensible tape measure with an accuracy of tenths of centimeters (millimeters). The arm measurement was performed with the arm relaxed along the body and obtained at the point of highest apparent perimeter. The medial thigh assessment was performed at the mid-distance between the inguinal line and the patella upper edge. The brachial perimeter and the tricipital skinfold were used to determine the nutritional status of athletes through estimation of the arm muscular area, arm muscular circumference, and arm fat area, according to the method of Frisancho [11].

Dietary assessment

To evaluate the dietary intake of athletes during the concentration period, the 6-d dietary records were used. These records were filled out by the athletes after previous orientation from a researcher. All foods and beverages consumed were recorded, including meals at the ANDEF dining hall (breakfast, lunch, snack, and dinner) and those outside the concentration place. Foods were expressed as household measurements. These recordings were collected and reviewed by the responsible researcher and the athlete to ensure total recall on the athlete's part, thus assuring greater reliability of the assessment instrument.

The household measurements were converted into grams and milliliters for the quantitative analysis of energy and nutrients ingested through the Nutrition Support Program (NutWin, Health Information Center, Escola Paulista de Medicina 1.5/2002, Universidade Federal de São Paulo, State of São Paulo, Brazil). Foods and preparations not included in the roll provided by the program were included with the aid of a complementary table or nutritional information presented by the label of industrialized products. Some nutrients in addition to energy were analyzed: carbohydrates (CHO), proteins, lipids, water-soluble vitamin C (ascorbic acid), and fat-soluble vitamin E (α-tocopherol). Among minerals, calcium, iron and zinc were analyzed. The value found for macronutrients was compared with the recommendation of the American College of Sports Medicine [12]. Each micronutrient was compared with the current American recommendations [13–16]. With the 6-d dietary records, it was possible to identify the most frequent meal eaten by the athletes and the amount of energy in meal.

Three athletes did not participate in the dietary sample, so the food consumption of 12 soccer players was analyzed.

Statistical analysis

The results are expressed as mean and standard deviation. To identify whether the variances were homogeneous across groups, Levene's F test was used. One-way analysis of variance was used to identify the differences across averages of anthropometric and dietetic variables in groups (goalkeepers, fullbacks, midfielders, and forwards). When significant differences between at least two group averages were detected with analysis of variance ($P < 0.05$), the least significant difference post hoc test was used to determine between which groups the significant differences existed.

Goalkeepers were excluded from the dietary statistical analysis that compared data across groups. Only one athlete participated in the 6-day dietary records. The results of this athlete are shown individually and in the results of the combined group.

Results

Sample characterization

The soccer players presented an average age of 32.3 ± 6.3 y, with an osteoarticular lesion that lasted as long as 18.6 ± 9.4 y. The upper limb amputation (goalkeepers) was in the forearm. One athlete presented transtibial amputation (below the knee) and 12 presented a transfemoral amputation (above the knee). Thirteen amputations had traumatic causes, one was congenital, and another was caused by cancer.

Five athletes were soccer players before amputation. After amputation, the athletes practiced the modality for 9.9 ±5.2 y, with training periods that lasted about 2.5 h/d, three times a week. During the concentration period for the world championship, the training sessions were held in two shifts (morning and afternoon), with an average duration of 1.5 h for each period. Among the participants, 10 athletes are three-time world champions, and one of them was elected the world best player in the 2001 world championship. Seven athletes were recovering from muscle-articular lesions. No subject used nutritional supplements. One athlete received dietary orientation from a doctor, and three others from a dietitian.

Anthropometric assessment

The descriptive and body composition characteristics of the sample, in relation to the players' positional roles, are listed in Table 1. Mean body mass of the forwards (62.5 kg) was significantly lower than that of the goalkeepers and midfielders (76.5 and 73.9 kg, respectively). However, when body mass was corrected to amputation, according to the method of Lee and Nieman [9], forwards presented significant differences only when compared with midfielders (74.9 and 90.4 kg, respectively).

Midfielders presented a tricipital skinfold that was significantly thicker than that of the other groups, between the 75th and 90th percentiles, according to the method of Frisancho [11]. The sum of skinfold thickness, even being the thickest one, showed no significant differences. Midfielders' thoracic skinfold and thigh circumferences were greater than those of the other groups but presented significant differences only when compared with those of the forwards. The percentage of body fat of the amputee soccer players was, on average, 14.4%. Midfielders presented the highest body fat rate (18.5%), with significant differences in relation to the other groups.

Arm circumference and arm muscular area showed no significant differences between groups. However, the arm circumference of goalkeepers (where they presented amputation) was significantly smaller than that of the midfielders and forwards. The arm fat area of midfielders was significantly larger than that of the other groups, between the 75th and 90th percentiles [11].

Dietary assessment

The average values and standard deviation of energy, macronutrients, and micronutrients resulting from the average of the dietary records of athletes in relation to the positional role, except goalkeepers, are found in Tables 2 and 3, respectively.

Soccer players presented a high mean protein intake (grams per kilogram per day and percentage of daily energy intake), when considering all groups (3.1 ± 0.8 g/kg and 21%) and the positional role, especially that of forward players (3.2 ± 0.9 g/kg and 21%).

A low percentage of CHO was observed (50% in all groups) in relation to the daily energy intake. Fullbacks showed significant differences when compared to the forwards (48% and 53%, respectively). When gramature was

Table 1
Description and anthropometric parameters of the Brazilian Amputee Soccer Team players, with respect to the positional role on the team*

Variables	Positions				
	Goalkeepers (n = 2)	Fullbacks (n = 4)	Midfielders (n = 3)	Forwards (n = 6)	All groups (n = 15)
Age (y)	36.0 ± 14.1	32.3 ± 1.0	32.3 ± 4.7	31.0 ± 7.3	32.3 ± 6.3
Stature (cm)	177.1 ± 5.9	177.0 ± 2.1	172.5 ± 3.9	172.9 ± 5.2	174.5 ± 4.5
Body mass (kg)	76.5 ± 5.0[a]	64.5 ± 3.6	73.9 ± 7.6[b]	62.5 ± 7.5[ab]	67.2 ± 8.1
Corrected body mass (kg)	78.3 ± 5.1	76.4 ± 8.6	90.6 ± 9.4[a]	74.9 ± 9.4[a]	78.9 ± 10.0
Skinfold thickness (mm)					
Tricipital	9.0 ± 0.3[a]	9.7 ± 2.7[b]	16.6 ± 2.7[abc]	11.3 ± 3.6[c]	11.6 ± 3.8
Abdominal	19.8 ± 4.1	20.8 ± 9.4	28.8 ± 6.4	22.0 ± 8.7	22.7 ± 8.0
Thoracic	11.3 ± 0.42	12.7 ± 5.8	19.6 ± 1.5[a]	10.8 ± 4.7[a]	13.1 ± 5.2
Thigh	11.1 ± 6.4	12.2 ± 4.1	14.0 ± 1.7	11.5 ± 3.2	12.0 ± 3.4
Sum skinfold thicknesses	51.2 ± 1.6	55.5 ± 20.6	74.4 ± 4.0	55.6 ± 18.1	58.7 ± 16.7
Body fat (%)	13.5 ± 1.0[a]	14.0 ± 5.5[b]	18.5 ± 2.1[abc]	13.4 ± 4.5[c]	14.4 ± 4.4
Circumference (cm)					
Thigh	56.3 ± 0.5	56.4 ± 2.0	60.9 ± 3.8[a]	55.6 ± 2.9[a]	57.0 ± 3.2
Right arm	31.5 ± 0.7	32.6 ± 1.8	34.3 ± 2.2	31.0 ± 2.4	32.2 ± 2.3
Left arm	26.3 ± 3.8[ab]	30.8 ± 1.4	33.8 ± 1.9[a]	31.1 ± 2.9[b]	30.9 ± 3.1
AMC (mm)	286.7 ± 6.2	295 ± 11	291 ± 30	275 ± 19	285 ± 19
AMA (mm^2)	6547.7 ± 282.3	6950 ± 511	6802 ± 1405	6031 ± 854	6499 ± 881
AFA (mm^2)	1354.6 ± 71.8[a]	1519 ± 470[b]	2610 ± 207[abc]	1668 ± 596[c]	1775 ± 616

AFA, arm fat area; AMA, arm muscle area; AMC, arm muscle circumference
* Mean ± SD. Identical superscript letters on the same line indicate significant differences ($P < 0.05$).

considered, the CHO intake did not show significant differences between groups. According to the recommendation of the American Dietetic Association (ADA) [12], CHO intake was adequate, but near the low limit recommended (6–10 g/kg of body mass). All groups presented an average lipid intake above the ADA recommendation [12], which is 20–25% of daily energy intake. Goalkeepers presented an energy intake of 4232 kcal, in the following macronutrient distribution: 48.0% of CHO, 33.7% of lipids, and 18.3% of protein. As observed in the results of the groups, there was a low percentage of CHO, with the gramature (quantity in grams) (6.5 $g \cdot kg^{-1} \cdot d^{-1}$) in agreement with the recommendations [12], although near the low limit (6–10 $g \cdot kg^{-1} \cdot d^{-1}$). Protein intake was higher than the recommended amount, as was the percentage of lipid in relation to daily energy intake (2.5 $g \cdot kg^{-1} \cdot d^{-1}$ and 33.7%, respectively).

The average values of micronutrient intake (Table 3) indicated that all groups had intakes below the recommended amount for vitamin E, including the goalkeepers (10.3 mg). Fullbacks also presented insufficient intake of calcium, according to current American recommendations [13–16].

Figure 1 shows that the CHO intake in the main meals

Table 2
Energy and macronutrient intake of the Brazilian Amputee Soccer Team players, with respect to the positional role on the team*

Variables	Positions			
	Fullbacks (n = 3)	Midfielders (n = 2)	Forwards (n = 6)	All groups (n = 12)
Energy				
kcal	3384 ± 1128	4294 ± 651	3832 ± 1245	3830 ± 1040
kcal/kg	52.2 ± 19.6	58.0 ± 16.3	61.0 ± 17.8	57.6 ± 15.9
Proteins				
g/d	193.7 ± 6.2	231.9 ± 30.0	200.1 ± 63.1	203.8 ± 53.1
%	23	21	21	21
g/kg	3.0 ± 1.1	3.1 ± 0.8	3.2 ± 0.9	3.1 ± 0.8
Carbohydrates				
g/d	401.8 ± 135.4	515.5 ± 72.5	505.3 ± 156.3	482.4 ± 131.6
%	48[†]	49	53[†]	50
g/kg	6.2 ± 2.4	7.0 ± 1.9	8.1 ± 2.2	7.3 ± 2.1
Lipids (%)	29	30	26	29

* Mean ± SD.
[†] Significant differences ($P < 0.05$).

Table 3
Micronutrient intake of the Brazilian Amputee Soccer Team players, with respect to the positional role on the team*

Variables	Positions			
	Fullbacks (n = 3)	Midfielders (n = 2)	Forwards (n = 6)	All groups (n = 12)
Vitamin C (mg)	152.9 ± 68.1	283.9 ± 11.2	207.6 ± 111.2	196.9 ± 97.3
Vitamin E (mg)	6.9 ± 1.6	9.4 ± 0.9	7.9 ± 2.9	8.1 ± 2.3
Calcium (mg)	876.5 ± 451.8	1164.3 ± 107.6	1056.2 ± 358.5	1058.4 ± 344.4
Iron (mg)	26.8 ± 8.2	31.3 ± 5.5	28.6 ± 11.0	28.7 ± 8.6
Zinc (mg)	19.7 ± 6.2	23.3 ± 2.0	19.3 ± 6.2	19.9 ± 5.3

* Mean ± SD.

was low (<200–300 g of CHO per meal), which is not recommended to optimize muscle glycogen storage after trainings and competitions [12].

Discussion

Despite being considered the best players in the country and being members of the Brazilian team, the small number of athletes makes it impossible to draw conclusions about other groups of amputee soccer players. Further, the lack of studies concerning the body composition assessment of the disabled limits discussion about this parameter in disabled sports.

The corrected amputee athletes' height and body mass (174.5 cm and 7.9 kg, respectively) were not in accordance with those of the top South American non-disabled players [17,18] and those from other countries [19,20] because the disabled athletes studied were shorter and heavier. Studies concerning height and body mass of soccer teams have suggested that these parameters present greater variation among players. Height itself is not a parameter that defines success in soccer, but it can determine the choice of a position in the field.

However, the amputee soccer players' composition is of great importance. The excess body mass of these athletes is even more problematic, because the whole weight is sustained by only one limb, thus overloading the limb, especially around the knee. This overload causes the bone to bend or become temporarily deformed, the degree of deformity depending on the magnitude and direction of power over the bone inclination axis [21]. Because soccer is often a sport of great physical contact, lesions harmful to bone health may occur during a match. During amputee soccer, the use of crutches and accidental contact may also generate pain to the bones.

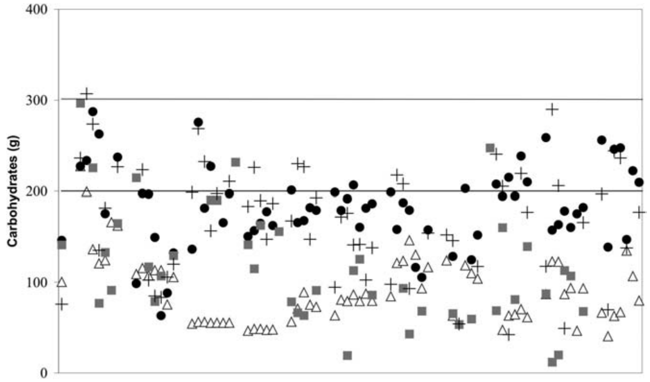

Fig. 1. Carbohydrate intakes (grams) for breakfast (triangles), lunch (circles), snack (squares), and dinner (plus sign) consumed by the Brazilian Amputee Soccer Team players.

Studies developed with non-disabled athletes make it possible to estimate percentages of fat and fat-free mass, through largely used prediction equations. Giada et al. [6] analyzed body composition in athletes of intermittent activities, among which were soccer players who had a fat-free mass of 63.0 ± 3.4 kg and percentage of fat of 11.8 ± 1.9%. Rico-Sanz [7] reported a fat percentage of around 10%. An average percentage of 14.4% of fat was found among amputee soccer players. However, these figures cannot be regarded separately, because such prediction equations were carried out in non-disabled individuals. There is a lack of equations for this sort of population. Methodologies such as dual-energy X-ray absorptiometry would be more adequate to determine body composition, but it is difficult to use them as routine procedures because they are extremely expensive.

The present study has also featured the body composition of athletes as assessed through skinfold and circumference measurements, according to the method of Frisancho [11]. A larger quantity of subcutaneous fat has been found from skinfold assessment compared with that in non-amputee athletes [6,19], especially around the abdominal region (22.7 and 10.7 mm, respectively) [19].

The fact that fullbacks exhibited larger arm muscular circumference and arm muscular area, although not significant, may be related to the need for greater effort due to the characteristics of their functions, which require more agility and strength. Midfielders showed the largest amount of subcutaneous fat (tricipital skinfold and arm fat area), which corroborated the highest percentage of fat. This finding was not confirmed in studies examining non-disabled soccer players, in which midfielders showed the lowest percentage of fat, whereas goalkeepers had the highest [7,22]. Regarding amputee soccer players, midfielders showed 18.5% of fat, whereas the other groups remained at around 13% of body fat.

Kurdibaylo [23] assessed the nutritional state of 68 lower limb amputees (transtibial, transfemoral, and bilateral) who were non-athletes and 19 to 49 y of age through indirect determination of body fat and its comparison with a control group. The results showed that transtibial, transfemoral, and bilateral subcutaneous fat levels in amputees were higher than 75.7%, 114.6% and 132.7%, respectively, and that internal fat levels were 45.4%, 61.8%, and 65.6%, respectively, in relation to the control group. Obesity was found in 37.9% of transtibial amputees, 48.0% of transfemoral amputees, and 64.2% of bilateral amputees, and it occurred mainly due to the increase of subcutaneous fat after amputation and excessive food consumption. Any individual may put on weight if physical activities are limited and the diet is hypercaloric, even with regular practice of physical exercises. The effect of sports training on these individuals was also assessed and no significant changes on amputees' body mass were found after 1 mo of aerobic training. However, all individuals reported feeling better and having an increased level of activity, thus revealing favorable changes in their bodies.

Food consumption may clearly affect health, body mass, body composition, energy amount available during exercise, recovery after physical exertion, and the sports results. The athlete who wants to optimize performance will need good hydration and nutrition [12].

There are no specific recommendations of energy for disabled soccer players. Energy intake will depend on the need to lose, maintain, or put on weight, in addition to daily energy expenditure. Guerra [8] remarked that consumption by Brazilian soccer players was 2329 to 4502 kcal/d. Rico-Sanz [7] in his review on these athletes' energy expenditure found it to be around 4000 kcal during training and 3800 kcal on match days. In general, soccer players seem to consume diets adequate in energy and midfielders have the highest intake [24], although they present with a low intake of CHO [6,7]. The present study found that midfielders also showed the highest energy intake (4294 kcal). Energy intake proved to be in accordance with that in other studies carried out in soccer players who were non-disabled.

The amputee soccer players showed a high intake of protein when compared with other studies and in disagreement with the recommended 12–15% of total daily energy intake [6,7]. The intake from 1.6 to 1.8 g of protein per kilogram of body weight per day, for soccer players, is considered the most adequate. When there is free access to the greatest variety of foods, this intake is easily accomplished by most players [4]. The average protein intake reported by the disabled athletes was 3.1 $g \cdot kg^{-1} \cdot d^{-1}$, 170.6% above the recommended level, and forwards' intake was the highest (3.2 ± 0.9 $g \cdot kg^{-1} \cdot d^{-1}$).

The high protein intake may have been influenced by the fact that the athletes were out on a training engagement and eating unusual meals. Normally consumption increases when there is free offer of food, especially food items not usually eaten, such as cold cuts and cheese, which are more expensive foods. Another important aspect is the lack of specific knowledge, which leads athletes to misunderstandings. Rosenbloom et al. [25], through a self-completed questionnaire concerning the athlete's nutritional self-knowledge, observed that among males 47% believed that protein was the main source of energy for muscles, thus emphasizing the importance of nutritional orientation to undo erroneous concepts about optimal nutrition for athletes. An excessive protein intake may harm the kidneys in the long run because these organs have to work to filter such nutrients [26]. Further, athletes generally consume large quantities of protein and do not care for the main nutrient, which is carbohydrate.

Carbohydrate body stores are an important source of fuel for muscles to work. Because a soccer match depletes large amounts of hepatic glycogen, required for energy expenditure in muscles in the athletes, the energy stores must be quickly replaced when players take part in intensive training and competition within a short period [12]. To replace these reserves between training sessions and competition, it is important to maintain an adequate intake before those activities.

Because CHO is the preferential muscle fuel during activities of moderate intensity, and because of a direct relation between the level of CHO storage and the moment of exhaustion, an intake of 6–10 g/kg of body weight per day is recommended during training and match seasons [12]. The present study found a CHO intake per kilogram of weight within the limits recommended [12], although near the minimum limit (7.3 g/kg). This intake could be maximized to the upper recommended limits, favoring an effective replacement of hepatic and muscle glycogen, through a diet rich in CHO with an emphasis on foods high on the glycemic index, especially after training and competitions.

The period in which these CHO rich foods are consumed is one of the determining factors that benefit an increase of hepatic and muscular glycogen storages [27]. It has been shown that approximately 200–300 mg of CHO proved to be adequate to optimize performance, consumed 3–4 h before exercise [12]. From the main meals taken during the period of preparation for the world amputee soccer championship, most subjects did not achieve the recommended total CHO level (Fig. 1). Breakfast, which is the first meal after the night fast and the first meal before morning training, was the one that presented the lowest intake of CHO.

The literature has highlighted that the lipid intake of soccer athletes is frequently above the recommended level [5,8], which makes it even more difficult to accomplish the optimal advised quantities of CHO [3]. The present study found a fat intake above the recommended level [12] but lower than that usually reported in the literature, except for the goalkeeper's intake, which happened to be extremely high (33.7% of total daily energy intake).

Physical exercises enhance the formation of reactive oxygen species and those react with membrane lipids to form lipid hydroperoxides, a destructive process known as lipid peroxidation. Vitamin E is the main antioxidant that works on cell membranes by reducing the lipid peroxidation rates generated by exercise. Evans [28] reported that a vitamin E deficit increased vulnerability to oxidation damage in rats and led to an early exhaustion during exercises. The present work found a low vitamin E intake among all athletes, as reported on the research made with marrow-lesioned athletes [29]. This inadequate intake could be explained by the lack of source food in the meals consumed. A positive example of dietary intake increase is the inclusion of nuts as a main source of vitamin E. However, nuts are not commonly found in several regions of Brazil, are expensive, and thus are seldom consumed. In the present study, no athlete reported consuming this food group.

Calcium is an essential micronutrient that is needed by the bone structure and teeth, is a cofactor of protein and enzymes, and is essential for muscle contraction [30]. There are no specific recommendations for calcium in disabled athletes. Nevertheless, diets should contain the minimum requirements suggested by American recommendations. In the present study, fullbacks did not achieve the recommendation, which is a matter of concern when it comes to performance and bone health, especially as regards the knee, because bone problems in such a body part can be a main cause of disabled athletes' early retirement. A way to minimize losses is to increase the offer of, milk and dairy products at breakfast and at snacks which contain calcium, therefore making it easy to accomplish the recommended intake.

In conclusion, although there are no parameters to compare amputee soccer players, the results showed that they seem to have different anthropometric characteristics, particularly with respect to body fat, when considering non-disabled soccer players. Their dietary assessment indicated that while energy intake seems to be adequate, there is an inadequate precentage of macronutrients, especially protein.

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