



## Trabajo Original

Epidemiología y dietética

### Factors associated with dietary supplementation among Brazilian athletes

*Factores asociados con la suplementación de la dieta entre los atletas brasileños*

Hellen Clair Garcêz Nabuco<sup>1</sup>, Vanessa Behrends Rodrigues<sup>2</sup>, Vânia Letícia Souza Fernandes<sup>2</sup>, Fabrício César de Paula Ravagnani<sup>1</sup>, Carlos Alexandre Fett<sup>2</sup>, Mariano Martínez Espinosa<sup>2</sup> and Christianne de Faria Coelho Ravagnani<sup>2</sup>

<sup>1</sup>Mato Grosso Federal Institute of Education, Science and Technology. Cuiabá, Mato Grosso, Brazil. <sup>2</sup>Federal University of Mato Grosso. Cuiabá, Mato Grosso, Brazil

#### Abstract

**Background:** Many factors can influence an athlete to consume dietary supplements, such as age, sex and sports, among others. Few studies regarding the prevalence and associated factors are available for athletes, especially in developing countries.

**Objective:** The aim of the study was to determine the factors associated with the consumption of dietary supplements among Brazilian athletes.

**Material and methods:** This is a cross-sectional study involving 182 athletes of both sexes. The athletes answered a questionnaire containing sociodemographic and sports information, current consumption of supplements, consumption of pharmacological substances and information on body image disorder (Body Shape Questionnaire) and muscle dysmorphia (Muscle Appearance Satisfaction Scale). Analyses were performed using Pearson's Chi-squared test, the crude prevalence ratio (PR) and Poisson regression with robust variance.

**Results:** In the bivariate analysis, the male gender, age between 25-29 years, engaging in a remunerated activity, consumption of pharmacological substances, body image disorder, risk of muscle dysmorphia, power modality athletes and lack of medical care were factors associated with supplement intake. After the regression analysis, the consumption of supplements was associated with the male gender (PR: 1.68; 95% CI: 1.01; 2.78;  $p = 0.044$ ), use of pharmacological substances (PR: 1.77; 95% CI: 1.37; 2.27;  $p < 0.001$ ) and the risk of muscle dysmorphia (PR: 1.75; 95% CI: 1.37; 2.23;  $p < 0.001$ ).

**Conclusions:** The results of this research clearly demonstrate the importance of professionals working closely with athletes to continuously monitor their use of supplements, since it was an alimentary behavior associated with other risk behavior (pharmacological use) as well as image disorders (muscle dysmorphia).

#### Key words:

Dietary supplements.  
Athletes. Body  
dysmorphic disorders.

#### Resumen

**Introducción:** muchos factores, tales como edad, sexo, deporte, entre otros, llevan al atleta a consumir suplementos alimenticios. Existen pocos estudios sobre prevalencia y factores asociados en atletas, especialmente en países en desarrollo.

**Objetivo:** el objetivo de este estudio fue determinar la prevalencia y los factores asociados al consumo de suplementos alimenticios entre atletas brasileños.

**Material y métodos:** se trata de un estudio de corte transversal realizado con 182 atletas de ambos sexos. Los atletas respondieron a un cuestionario que contenía información sociodemográfica y deportiva, consumo actual de suplementos, consumo de sustancias farmacológicas, y también sobre distorsión de la imagen corporal (BSQ) y dismorfia muscular (MASS).

**Resultados:** en el análisis bivariado, el sexo masculino, la edad entre 25 a 29 años, ejercer actividad remunerada, el consumo de sustancias farmacológicas, la distorsión de la imagen corporal, el riesgo de dismorfia muscular, la modalidad de fuerza y la ausencia de asistencia médica fueron los factores asociados al consumo de suplementos. Después del análisis de regresión, el consumo de suplementos fue asociado al sexo masculino (RPA: 1,68; IC 95%: 1,01; 2,78;  $p = 0,044$ ), consumo de sustancias farmacológicas (RPA: 1,77; IC 95%: 1,37; 2,27;  $p < 0,001$ ) y riesgo de dismorfia muscular (RPA: 1,75; IC 95%: 1,37; 2,23;  $p < 0,001$ ).

**Conclusiones:** los resultados de este estudio mostraron claramente la importancia de los profesionales que trabajan junto a los atletas para monitorizar continuamente el uso de suplementos, puesto que se trataba de un comportamiento alimentario asociado a otros comportamientos de riesgo (uso farmacológico) o a trastornos de la imagen (dismorfia muscular).

#### Palabras clave:

Suplementos  
dietéticos. Atletas.  
Trastorno dismórfico  
corporal.

Received: 10/11/2015  
Accepted: 08/04/2016

Garcêz Nabuco HC, Behrends Rodrigues V, Souza Fernandes VL, de Paula Ravagnani FC, Fett CA, Martínez Espinosa M, Coelho Ravagnani CF. Factors associated with dietary supplementation among Brazilian athletes. Nutr Hosp 2016;33:678-684

DOI: <http://dx.doi.org/10.20960/nh.278>

#### Correspondence:

Hellen Clair Garcêz Nabuco. Mato Grosso Federal Institute of Education, Science and Technology. Cuiabá, Mato Grosso, Brazil  
e-mail: [hellencgarcez@gmail.com](mailto:hellencgarcez@gmail.com)

## INTRODUCTION

According to the Dietary Supplement Health and Education Act (DSHEA) a dietary supplement is defined as a product to supply a diet and contains one or more of the following ingredients thereof: vitamins, minerals, herbal products, amino acids, and substances such as enzymes and metabolites, or a concentrate, metabolite, constituent, extract or combination of any of those mentioned above. These products can be found in several forms, such as tablets, capsules, softgels, liquids, or powders (1).

Dietary supplements consumption is common among both professional (2,3) and recreational athletes (4,5). These products may play an important role in the athletes' nutrition, such as fulfilling energy, carbohydrate, protein and other nutrient requirements, maintaining or optimizing the immune function as well as growth and muscle repair (6,7). Moreover, supplementation may be of benefit to athletes with pre-existing nutritional deficiencies, who are on dietary restriction or travelling for prolonged periods to regions with inadequate or limited food supplies. Furthermore, supplements may be a good and fast source of energy and electrolyte reposition (2,8). On the other hand, the interaction between nutrients in the supplements or between supplements and medicines may affect the absorption of nutrients (7,9). In addition, the use of supplements could be associated with a positive doping test, as they may contain substances not mentioned on the labels and this is a predictive factor for illicit substance use (10).

However, most athletes take supplements based on the belief that their performance will improve, without proven scientific evidence (11). The decision to use these products is not always rational (8) and may be influenced by intrinsic and extrinsic factors, such as age (12), sex (13-15), type of sport (13,14), training volume (13,14,16), performance level (14), motivation (13,17), an athlete's knowledge on supplementation and the constant charges of coaches, sponsors and media for better results (18,19).

In recent decades, surveillance studies regarding dietary supplements used by athletes have increased, particularly descriptive studies on the prevalence, nevertheless, few papers focus on analyzing the factors which influence an athlete's supplementation choices (2,3,14). The present study focused on little studied issues, such as body image disorders, the risk of muscle dysmorphia (MD), pharmacological substance and alcohol use, and also the medical care provided by the athlete's team. In addition, the majority of studies is conducted in developed countries and may not reflect the reality for Brazilian athletes. Therefore, there is a paucity of data concerning athletes from developing countries. It is worth highlighting that in recent years Brazil has been inserted in the world sports agenda, hosting major events such as the football World Cup and the Olympic and Paralympic Games. This is a unique moment for the human and scientific development of the country in the framework of sport.

Considering the abovementioned aspects, it is very important to track dietary supplement consumption and comprehend the factors associated with this behavior in order to expand the body of knowledge on the nutritional aspects of athletes and to propose interventions involving health issues and nutritional education on

the indiscriminate use of these products. Therefore, the aim of this study was to determine the factors associated with dietary supplement consumption among Brazilian athletes.

## METHODS

This study is part of the research Validation of Food Frequency Questionnaire for Athletes, which was a cross-sectional study conducted in NAFIMES (Physical Fitness, Metabolism and Health Center), from December 2013 to October 2014, aiming to assess the health, performance and nutritional and sports aspects of Brazilian professional athletes. In this study 182 athletes participated, aged 14 to 59 years, of both genders, and from 20 different sports.

Athletes were contacted directly through phone or e-mail and through indications from coaches or sporting federations. All athletes participated voluntarily; their identity was preserved, and received feedback on their evaluation. After receiving information about the study purposes, all athletes, or a responsible adult in the case of athletes under 18 years, signed a free and informed consent form. The research was approved by the Ethics Committee in research involving Human Beings of the Hospital Universitário Julio Müller.

## QUESTIONNAIRE AND ASSESSMENTS

A questionnaire was developed to evaluate the current dietary supplement consumption among athletes. The first section included questions on sociodemographic factors such as age, gender, education, sport type, training phase and training hours. The second section consisted of questions about dietary supplements and pharmacological substances used. In this section, the athletes reported the name of the supplements, frequency and time of use in a table. To test the accuracy of the questionnaire, a 24-hour recall was applied in two different days. In this recalls, athletes were asked whether they had used any dietary supplements. The agreement between the questionnaire and the recalls was measured by Kappa coefficient. For the purpose of this study, supplements were defined according to the 1994 Dietary Supplement Health and Education Act (1) and Kreider et al. (6).

To assess the consumption of pharmacological substances the athlete was asked whether in the last 6 months he had consumed any of the listed substances, which were anabolic steroids, diuretics, stimulants, fat burners, and their examples. It was also allowed that the athlete would add the name of any other type of substances. The third and final section contained two questionnaires to evaluate body image (Body Shape Questionnaire, BSQ) (20) and muscle dysmorphia (Muscle Appearance Satisfaction Scale, MASS) (21). The questionnaire was filled by the athletes in our laboratory with supervision of a nutritionist, and the 24-h recalls were administered by trained undergraduates in Nutrition under registered nutritionist supervision.

Body weight and height were measured using a scale with graduation of 0.1 kg and a portable stadiometer accurate to

0.1 cm. To calculate the body mass index (BMI), the World Health Organization (WHO) classification (22) was adopted. Next, the estimation of body fat was performed through tetrapolar bioelectric impedance, brand InBody S10®. Body-composition measurements were performed with subjects barefoot, in light clothing and having avoided alcohol consumption and participation in intensive exercise in the previous 24 hours. In this paper, the dependent variable or outcome was “consumption of dietary supplements” and the independent variables investigated, together with their categories, are presented in table I.

Data processing was performed in Microsoft Excel (Microsoft Corporation TM, Redmond, Washington, USA), and the Statistical Package for Social Sciences (SPSS, version 17) and Stata (version 13) software were used for the statistical analysis. To verify associations between the outcome and each independent variable, the Pearson’s Chi-squared test was used, and to identify statistically significant categories in each variable the crude prevalence ratio was estimated.

Variables that demonstrated associations with scores  $p < 0.10$ , using the Chi-square test, were selected for the adjusted Poisson multiple regression model with robust variance. Adjusted prevalence ratios with  $p$ -value  $< 0.05$  remained in the final model. In all the prevalence ratios a 95% confidence interval (CI) and significance level of 5% ( $p < 0.05$ ) were considered.

**RESULTS**

Of the 182 athletes participating in this study, the majority were male ( $n = 151, 83\%$ ) and with more than six years of sports career ( $n = 107, 59\%$ ). The greatest number of athletes participated in intermittent sports ( $n = 77, 42\%$ ) and combat sports ( $n = 49, 27\%$ ), compared to endurance sport ( $n = 23, 13\%$ ), power sport ( $n = 18, 10\%$ ) and others sports ( $n = 15, 8\%$ ). The power sport category included bodybuilders exclusively. The categorization for performance level revealed that 47% of the athletes competed at the municipal level, 32% competed at state level, 33% competed at the national level, 9% competed at the international level and only 2% declined to answer. Most of the athletes were in pre-competition period ( $n = 123$ ). Others characteristics of the participants and sports distribution are shown in tables II and III.

The bivariate analysis (Table IV) shows that supplement consumption was higher in males ( $PR = 1.76, 95\% CI: 1.01; 3.12, p = 0.026$ ), aged 25 to 29 years ( $PR = 2.19, 95\% CI: 1.45; 3.32, p < 0.001$ ) and in those who work ( $PR = 1.55, 95\% CI: 1.14; 2.11, p = 0.005$ ). The prevalence of dietary supplement use increased by 48% among athletes who did not have medical care ( $PR = 1.48, 95\% CI: 1.06; 2.08, p = 0.015$ ). In addition, all power athletes were taking supplements. The prevalence of muscle dysmorphia was twice as high among athletes who consumed supplements ( $PR = 2.0, 95\% CI: 1.62; 2.68, p < 0.001$ ). Athletes with mild image disorder tended to consume more supplements ( $PR = 1.62; 95\% CI: 1.17; 2.23, p = 0.020$ ).

Athletes who took dietary supplements used more pharmacological substances ( $PR = 2.28; 95\% CI: 1.79; 2.91, p < 0.001$ ).

**Table I. Definition of variables and categories adopted for data analysis**

Independent variables	Categorization	Criteria
Gender	Male	Auto-response
	Female	
Age	14-19	Auto-response and classified according to Kim et al.
	20-24	
	25-29	
	> 30	
Education in years	≤ 8 years	Studying: elementary school, high school; higher education or post-graduation
	> 8 years	
Job	Yes	Performs compensated function
	No	
BMI	Malnutrition	Classification based on the criteria proposed by WHO
	Overweight	
	Obesity	
	Normal	
Consumption of pharmacological substances	Yes	Use of anabolic steroids, diuretics, stimulants, fat burners and other, for at least the previous 6 months
	No	
Consumption of alcohol	Yes	Consumption at least once in the last 30 days
	No	
BSQ	Mild concern	Score above 80 points characterizes image disorder
	Moderate concern	
	Severe concern	
	Normal	
MASS	Risk of MD	Score above 48 points characterizes risk of muscle dysmorphia
	Normal	
Modality	Endurance	Differentiation of modalities followed the criteria of Lun et al. and Braun et al.
	Power	
	Combat	
	Other sports	
	Intermittent	
Have health care provided by the team	Yes	Auto response
	No	
Phase the athlete was at the time of collection	Pre-competition	Auto response
	Post-competition	
	Competition	

BMI: Body-mass index; BSQ: Body Shape Questionnaire; WHO: World Health Organization; MASS: Muscle Appearance Satisfaction Scale; MD: Muscle dysmorphia.

**Table II.** Anthropometric characteristics and average training time of the participants (n = 182)

Age group	Gender	n	Age	Weight	Height	BMI	Body fat (%)	Practice (min/day)
			(years)	(kg)	(cm)	(kg/m <sup>2</sup> )		
14-19	Male	46	17.2 ± 1.3	68.4 ± 10.4	175.7 ± 6.6	21.9 ± 2.4	10.9 ± 4.7	182.6 ± 73.4
	Female	17	15.5 ± 1.5	55.5 ± 4.2	159.1 ± 6.8	20.3 ± 2.3	19.1 ± 10.4	171.1 ± 59.7
20-24	Male	41	21.9 ± 1.6	80.6 ± 9.5	178.7 ± 6.7	25.2 ± 2.4	14.2 ± 5.5	198.0 ± 81.7
	Female	6	21.3 ± 1.5	52.0 ± 6.7	157.3 ± 4.2	21.5 ± 1.9	22.7 ± 7.6	170.0 ± 70.1
25-29	Male	39	26.9 ± 1.3	80.8 ± 11.6	177.7 ± 6.6	25.8 ± 3.6	15.3 ± 5.3	178.4 ± 83.0
	Female	4	26.3 ± 1.6	53.2 ± 2.8	168.0 ± 5.2	22.3 ± 1.5	21.8 ± 3.8	60.0 ± 53.6
≥ 30	Male	25	36.6 ± 4.5	85.7 ± 14.8	175.9 ± 7.3	27.6 ± 4.7	13.5 ± 12.0	146.4 ± 83.2
	Female	4	36.3 ± 8.6	63.3 ± 7.5	160.0 ± 2.2	21.5 ± 1.4	22.0 ± 10.8	195.0 ± 133.3
Overall		182	23.6 ± 7.2	73.8 ± 15.0	174.0 ± 9.2	24.0 ± 4.2	15.89 ± 7.0	180.8 ± 124.6

BMI: Body-mass index.

**Table III.** Distribution of sports among the sports categories

Endurance	22	Power	19	Intermittent	77	Combat	49	Other Sports	15
Triathlon	4	Bodybuilding	19	Volleyball	8	Taekwondo	6	Athletics	8
Cycling	2			Soccer	53	Karate	8	Shooting Sports	7
Swimming	16			Futsal	6	Judo	10		
				Beach volleyball	2	Kung Fu	7		
				Tennis	1	Jiu Jitsu	10		
				American Football	7	MMA	6		
						Boxing	1		
						Muay Thai	1		

All users of anabolic steroids and fat reducers took dietary supplements. With regard to users of stimulants and diuretics, 93% and 72.7%, respectively, also took supplements. There was no association between the use of supplements and BMI, education, alcohol consumption or training phase.

After adjusting for all variables included in the multivariate analysis model, the variables that remained associated with the use of supplements were male gender (PR = 1.68; 95% CI: 1.01; 2.78,  $p = 0.044$ ), consumption of pharmacological substances (PR = 1.77; 95% CI: 1.37; 2.27,  $p < 0.001$ ) and muscle dysmorphia (PR = 1.75; 95% CI: 1.37; 2.23,  $p < 0.001$ ). The variable "have medical care provided by the team" remained in the final model as an adjustment variable (Table V).

## DISCUSSION

In this study, consumption of supplements was associated with socio-demographic (gender, age, work), behavioral (use of phar-

macological substances), psychological (body image and muscle dysmorphia) and sport specific (power modes, having medical care) factors. In the multivariate analysis, the following remained associated with dietary supplement consumption: male sex, having muscle dysmorphia and using pharmacological substances.

In line with other studies in athletes (13,14), our findings showed that men are more likely to consume dietary supplements. Giannopoulou et al. (14) suggested that this differentiation is due to the primary source of information for the purchase of supplements. According to this author, men sought advice from their coaches while women asked the doctor, who may have given more cautious advice regarding the use these products. Indeed, in the bivariate analysis of the present study, having medical care was considered as a protective factor against supplement consumption among athletes. Perhaps without a support of qualified professionals, athletes tend to seek information from sources that are not always specialized in supplementation (3,13,16), such as the media, friends and coaches. Brazilian female tennis players who received counseling from a nutritionist did so through their

**Table IV.** Prevalence of supplement consumption among athletes, crude prevalence ratio, 95% confidence interval and p value

Independent variables	Prevalence % (n)	Crude PR	CI 95%	p
<i>Gender</i>				
Female	29.0 (09)	1		
Male	51.0 (77)	1.76	(1.01; 3.12)	0.026*
<i>Age</i>				
14-19	31.7 (20)	1		
20-24	48.9 (23)	1.54	(0.97; 2.45)	0.068
25-29	69.8 (30)	2.19	(1.45; 3.32)	< 0.001*
>30	44.8 (13)	1.41	(0.82; 2.43)	0.224
<i>Education in years</i>				
> 8 years	49.4 (79)	1		
≤ 8 years	33.3 (07)	0.67	(0.36; 1.26)	0.166
<i>Job</i>				
No	38.2 (39)	1		
Yes	59.5 (47)	1.55	(1.14; 2.11)	0.005
<i>BMI</i>				
Normal	43.6 (51)	1		
Malnutrition	20.0 (01)	0.46	(0.08; 2.68)	0.392
Overweight	53.2 (25)	1.22	(0.87; 1.71)	0.265
Obese	69.2 (09)	1.59	(1.05; 2.41)	0.079
<i>Consumption of pharmacological substances</i>				
No	38.5 (55)	1		
Yes	87.9 (29)	2.28	(1.79; 2.91)	< 0.001*
<i>Alcohol consumption</i>				
No	44.6 (50)	1		
Yes	54.7 (35)	1.22	(0.90; 1.66)	0.200
<i>BSQ</i>				
Normal	45.5 (70)	1		
Mild disorder	73.7 (14)	1.62	(1.17; 2.23)	0.020*
Moderate disorder	25.0 (01)	0.55	(0.10; 0.30)	0.628
Severe disorder	0 (0)	-	-	-
<i>MASS</i>				
Normal	40.0 (60)	1		
MD risk	83.3 (25)	2	(1.62; 2.68)	<0.001*
<i>Modality</i>				
Intermittent	40.3 (31)	1		
Endurance	56.5 (13)	1.4	(0.89; 2.20)	0.168
Force	100.0 (18)	-	-	< 0.001*
Combat	36.7 (18)	0.91	(0.58; 1.44)	0.692
Other sports	28.6 (02)	0.71	(0.21; 2.36)	0.699
<i>Medical care provided by staff</i>				
Yes	37.7 (29)	1		
No	56.0 (56)	1.48	(1.06; 2.08)	0.015*
<i>Phase</i>				
Pre-competition	48.0 (59)	1		
Post-competition	64.7 (11)	1.35	(0.91; 2.00)	0.196
Competition	40.0 (16)	0.83	(0.55; 1.27)	0.380

\*p-value < 0.05; PR: Prevalence ratio; CI: Confidence interval; BMI: Body-mass index; BSQ: Body Shape Questionnaire; MASS: Muscle Appearance Satisfaction Scale; MD: Muscle dysmorphia.

**Table V. Adjusted prevalence ratio and confidence intervals of factor associated with the consumption of dietary supplements**

Independent variables	Adjusted PR	CI 95%	p
<i>Gender</i>			
Female	1.67	1	0.043*
Male		(1.02; 2.75)	
<i>Consumption of pharmacological substances</i>			
No	1.79	1	< 0.001*
Yes		(1.37; 2.35)	
<i>Muscle Appearance Satisfaction Scale</i>			
Normal	1.68	1	< 0.001*
MD risk		(1.30; 2.18)	
<i>Medical care provided by staff</i>			
Yes	1.17	1	0.369
No		(0.83; 1.65)	

\*p-value < 0.05; PR: Prevalence ratio; CI: Confidence interval; MD: Muscle dysmorphia.

own will and not due to encouragement from their team (23). A study on Canadian athletes showed that they would prefer to have an individual consultation with a professional nutritionist (3).

Along the same lines as that reported in the literature (24-26), the findings of the present study revealed that dietary supplement users present an increased risk of using pharmacological substances. The aforementioned finding are also in agreement with the study by Backhouse et al. (24), who reported that dietary supplement users presented more positive attitudes toward doping because these athletes demonstrate a greater willingness to use a substance in order to change aesthetic appearance (e.g., increased muscle mass and/or weight loss). In the present study, the prevalence of banned substance use by the World Anti-Doping Agency (WADA) (27) was 18% (9.3% for anabolic steroids, 6% for diuretics, 7.7% for stimulants and 6.7% for fat burners). These values are higher than those found by Froiland et al. (25) (14.6%); however, the athletes that participated in the above-mentioned study were athletes of the first NCAA Division (National Collegiate Athletic Association), which has a strict anti-doping control, while bodybuilding athletes, who tend to use more of these substances, were included in the present study.

Within the classification of sports, bodybuilding was grouped in the power modality, which may explain the high percentage of consumption. The second most prevalent sport was intermittent sports (40.3%); this result contradicts previous studies, in which intermittent sports presented the least consumption of supplements (12,16). This difference may be due to the grouping of modalities as well as contradictory definitions of dietary supplements.

In the present study, the prevalence of dietary supplement use was higher in athletes with mild body image disorder. Regarding

muscle dysmorphia, dietary supplement users were demonstrated to be twice as likely to develop this disorder. Muscle dysmorphia is a body disorder characterized by excessive concern with body appearance, in which a person does not feel sufficiently strong and muscular (28).

This disorder is related to specific dietary patterns that include hyper protein diets and supplement use, and is also a gateway to the use of illicit substances (29). Athletes with muscle dysmorphia are usually involved in stressful sports or those that require strength, such as football, bodybuilding and weightlifting (30). In the present study 100% of the strength athletes were using dietary supplements, in line with the literature (3,31). Being that men mostly desire a progressive muscular hypertrophy (21,32), it is not surprising that dietary supplement use is related to a triad (male sex, use of pharmacological substances and muscle dysmorphia).

To our knowledge, this study is unique in demonstrating the association between supplementation consumption and image disorder as well as being one of the first studies conducted in Brazil that simultaneously focused on athletes from different modalities, and investigated the factors that may influence supplements consumption by athletes. However, some limitations of this study must be considered. The athletes who participated came from one region in Brazil, which may not report the true reality in the country. Another limitation is the use of a self-questionnaire, in which the athlete can omit or under/overestimate information. Nevertheless, this is a widely used tool in studies in this area (2,3,13,17). Furthermore, the *kappa* coefficient of 0.72 showed a substantial agreement of supplement use assessed by the questionnaire and the 24-hour recalls, applied to the athletes of this study on two non-consecutive days in the same week of the questionnaire (33).

The definition of dietary supplements is another limiting factor, considering that it can interfere with the results and confuse the comparison between studies. One final factor that may have influenced our results is the sample difference between men (83%) and women (17%).

Nonetheless, the results of this research clearly demonstrate the importance of nutritionists, coaches and other professionals working closely with athletes being aware of the use of supplements, since it is an alimentary behavior, which is possibly associated with other risky behaviors, not only to the health but also to the sporting career of these athletes, such as involuntary doping. In addition, it is advisable to consider the medical and psychological care of the athletes in order to identify the use of harmful substances or those banned by the World Anti-Doping Agency, and also to diagnose and treat image disorders, since many athletes use dietary supplements as an escape valve for achieving body satisfaction. More robust research designs are required to establish causal relationships between the use of supplements and various aspects of health and physical training of athletes. To conclude, male gender, the risk of muscle dysmorphia and the use of pharmacological substances are factors associated with the consumption of supplements by athletes and, therefore, should be considered in nutritional interventions. These results point to the possibility of a male athlete triad involving the use of nutritional supplements, pharmacological substances and image disorders.

Future research is needed to confirm this hypothesis in a larger group of athletes.

## ACKNOWLEDGEMENTS

The study was designed by HCGN and CFCR; data were collected and analyzed by HCGN, VBR, VLSF and MME; data interpretation and manuscript preparation were undertaken by HCGN, CAF, FCPR and CFCR. All authors approved the final version of the paper.

## FUNDING

This research received a financial contribution from the Coordination for the Improvement of Higher Education Personnel (CAPES/Brazil) and the National Council of Technological and Scientific Development (CNPq/Brazil) through research scholarships awarded to the participants of the research collection team.

## REFERENCES

1. Act. U. S. Government Printing. DSHA: Congress passed the Dietary Supplement Health and Education. Mar 1994. p. 103-417.
2. Dietz P, Ulrich R, Niess A, Best R, Simon P, Striegel H. Prediction profiles for nutritional supplement use among young German elite athletes. *Int J Sport Nutr Exerc Metab* 2014;24:623-31.
3. Wiens K, Erdman KA, Stadnyk M, Parnell JA. Dietary supplement usage, motivation, and education in young, Canadian athletes. *Int J Sport Nutr Exerc Metab* 2014;24:614-23.
4. Tsitsimpikou C, Chrisostomou N, Papalexis P, Tsarouhas K, Tsatsakis A, Jamurtas A. The use of nutritional supplements among recreational athletes in Athens, Greece. *Int J Sport Nutr Exerc Metab* 2011;21(5):377-84.
5. Salgado JVV, Lollo PCB, Amaya-Farfan J, Chacon-Mikahil MPT. Dietary supplement usage and motivation in Brazilian road runners. *J Int Soc Sports Nutr* 2014;11(1):41.
6. Kreider RB, Wilborn CD, Taylor L, Campbell B, Almada AL, Collins R, et al. ISSN exercise. Sport nutrition review: Research. Recommendations. *J Int Soc Sports Nutr* 2010;7(1):7.
7. Maughan R. The athlete's diet: Nutritional goals and dietary strategies. *Proc Nutr Soc* 2007;61(01):87-96.
8. Maughan RJ, King DS, Lea T. Dietary supplements. *J Sports Sci* 2004;22(1):95-113.
9. Lawson KA, Wright ME, Subar A, Mouw T, Hollenbeck A, Schatzkin A, et al. Multivitamin use and risk of prostate cancer in the National Institutes of Health-AARP Diet and Health Study. *J Natl Cancer Inst* 2013;99(10):754-64.
10. Geyer H, Parr M, Koehler K. Nutritional supplements cross-contaminated and faked with doping substances. *J Mass Spectrom* 2008;43:892-902.
11. Maughan RJ. Quality assurance issues in the use of dietary supplements, with special reference to protein supplements. *J Nutr* 2013;143(11):1843S.
12. De Silva A, Samarasinghe Y, Senanayake D, Lanerolle P. Dietary supplement intake in national-level Sri Lankan athletes. *Int J Sport Nutr Exerc Metab* 2010;20(1):15-20.
13. Diehl K, Thiel A, Zipfel S, Mayer J, Schnell A, Schneider S. Elite adolescent athletes' use of dietary supplements: Characteristics, opinions, and sources of supply and information. *Int J Sport Nutr Exerc Metab* 2012;22(3):165-74.
14. Giannopoulou I, Noutsos K, Apostolidis N, Bayios I, Nassis GP. Performance level affects the dietary supplement intake of both individual and team sports athletes. *J Sport Sci Med* 2013;12(1):190-6.
15. Kim J, Kang S, Jung H, Chun Y, Trilk J, Jung SH. Dietary supplementation patterns of Korean olympic athletes participating in the Beijing 2008 Summer Olympic Games. *Int J Sport Nutr Exerc Metab* 2011;21(2):166-74.
16. Lun V, Erdman KA, Fung TS, Reimer RA. Dietary supplementation practices in Canadian high-performance athletes. *Int J Sport Nutr Exerc Metab* 2012;22(1):31-7.
17. Walsh M, Cartwright L, Corish C, Sugrue S, Wood-Martin R. The body composition, nutritional knowledge, attitudes, behaviors, and future education needs of senior schoolboy rugby players in Ireland. *Int J Sport Nutr Exerc Metab* 2011;21(5):365-76.
18. Rubio K, Nunes AV. Comportamento de risco entre atletas: Os recursos ergogênicos e o doping no Século XXI. *Rev Bras Psicol do Esporte* 2010;3(4):147-60.
19. Molinero O, Márquez S. Use of nutritional supplements in sports: Risks, knowledge, and behavioural-related factors. *Nutr Hosp* 2009;24(2):128-34.
20. Di Pietro M, Da Silveira DX. Internal validity, dimensionality and performance of the Body Shape Questionnaire in a group of Brazilian college students. *Rev Bras Psiquiatr* 2009;31(1):21-4.
21. Pope HG, Gruber AJ, Choi P, Olivardia R, Phillips KA. Muscle dysmorphia. An underrecognized form of body dysmorphic disorder. *Psychosomatics* 1997;38(6):548-57.
22. World Health Organization. Physical status: The use and interpretation of anthropometry. Report of a WHO Expert Committee. *World Health Organ Tech Rep Ser* 1995;854:1-452.
23. Coelho GMDO, De Farias MLF, De Mendonça LMC, De Mello DB, Lanzillotti HS, Ribeiro BG, et al. The prevalence of disordered eating and possible health consequences in adolescent female tennis players from Rio de Janeiro, Brazil. *Appetite* 2013;64:39-47.
24. Backhouse SH, Whitaker L, Petróczi A. Gateway to doping? Supplement use in the context of preferred competitive situations, doping attitude, beliefs, and norms. *Scand J Med Sci Sports* 2013;23(2):244-52.
25. Froiland K, Koszewski W, Hingst J, Kopecny L. Nutritional supplement use among college athletes and their sources of information. *International Journal of Sport Nutrition and Exercise Metabolism* 2004;104-20.
26. Papadopoulos FC, Skalkidis I, Parkkari J, Petridou E. Doping use among tertiary education students in six developed countries. *Eur J Epidemiol* 2006;21(4):307-13.
27. World Anti-Doping Agency. *World Anti-doping Code 2015*. 2015;1-156.
28. Assunção SSM. Dismorfia muscular. *Rev Bras Psiquiatr* 2002;24:80-4.
29. Azevedo AP, Ferreira AC, Da Silva PP, Caminha I de O, De Freitas CM. Dismorfia muscular: A busca pelo corpo hiper musculoso. *Motricidade* 2012;8(1):53-66.
30. Leone JE, Sedory EJ, Gray KA. Recognition and treatment of muscle dysmorphia and related body image disorders. *Journal of Athletic Training* 2005;352-9.
31. Maughan RJ, Depiesse F, Geyer H. The use of dietary supplements by athletes. *J Sports Sci* 2007;25(Suppl. 1):S103-13.
32. McCreary DR, Hildebrandt TB, Heinberg LJ, Boroughs M, Thompson JK. A review of body image influences on men's fitness goals and supplement use. *Am J Mens Health* 2007;1(4):307-16.
33. Byrt T. How good is that agreement? *Epidemiology* 1996;7(5):561.