Sports Nutrition Knowledge and Supplement Consumption by Resistance Training Practitioners at a Gym Chain

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ABSTRACT

Objective: This study aims to assess knowledge on sports nutrition and dietary supplements consumption among resistance-training practitioners at a gym chain. **Methods:** This is a cross-sectional study, carried out among 168 resistance-training practitioners in three units of a gym chain in Fortaleza, Ceará, Brazil. The participants' sports nutrition and supplement consumption knowledge was assessed using a structured questionnaire that addressed: identification data, information on training and supplement use, and objective questions on sports nutrition awareness, classifying the results as low, moderate and high, accordingly to the obtained scores. Statistical analysis was performed by simple and relative frequencies, mean, standard deviation, and correlation, with significance set as 5%. **Results:** It was observed that half of the respondents mentioned the consumption of dietary supplements. Among the most consumed, protein-based supplements were prominent, with consumption independent of gender, years of resistance training, and nutrition awareness ($p<0.05$). Most participants showed moderate nutrition knowledge, despite a perceivable difficulty in associating nutrients to their functions and sport-related uses, especially protein handling. **Conclusion:** These findings show an overvaluation of protein intake in the context of resistance training, which may lead to the adoption of inadequate dietary and supplementation practices. It is thus necessary to develop and implement education and nutrition assistance actions targeting this public.

Keywords: Sports nutritional sciences, Resistance training, Dietary supplementation, Knowledge, Food and nutrition education.

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INTRODUCTION

Adequate dietary practices are essential for sports practitioners, presenting themselves as pivotal tools to increase performance, in addition to maintaining health. This also applies to resistance training; nutritional conduct that respects athletes or practitioners' individualities will contribute to the achievement of their health, performance or aesthetic goals[1,2].

Given the ever-growing value of the human physique in contemporary society, which favors a body type with minimal body fat and large muscle mass, individuals are increasingly seeking physical activities for aesthetic purposes. This is confirmed by the data of the Brazilian Council of Physical Education (CONFEF)[3] and the Brazilian Gyms Association (ACAD)[4], which point that, from 2015 to 2017, the number of gyms grew 11.3% and that of gymgoers increased 8.86%, causing Brazil to rank 2nd in the number of gyms worldwide (34509 thousand) and 4th in the number of gymgoers (9,6 million). The increasing numbers of resistance-training adherents go side by side with greater availability of inconsistent nutrition information, especially on the Internet, resulting in the adoption of often-erroneous dietary practices[5].

In this context, substances are used to optimize results, called *ergogenic aids*, which may be pharmacological, hormonal, physiological and nutritional agents[6]. The use of nutritional agents, represented by dietary supplements, stands out among resistance-training practitioners, which, when added to their diets, play a significant role in their nutritional intake, improving performance[7].

On the other hand, resistance-training practitioners make increasing use of dietary supplements with no professional guidance and often no real need, disregarding their complementary nature[8]. Kerksick *et al.*[7] point out that supplements should be seen as such, not as substitute for a proper diet. In addition, despite the need for advances in research on nutrition and physical exercise, it has been found that individuals who exercise regularly in order to stay fit do not need additional nutrients beyond those yielded by a nutritionally balanced diet[9].

Both indiscriminate uses of dietary supplements in resistance training and inappropriate dietary practices are observed, pointing to a certain overvaluation of protein intake at the expense of carbohydrate consumption, in addition to the adoption of diets that go against the principles of proper nutrition, disregarding cultural, political and ethical aspects[10-12].

In view of potentially inadequate supplementation and nutrition practices and their ensuing health damage, it is important to assess the nutrition and supplementation knowledge and behavior of resistance-training practitioners, in order to enable nutrition education and assistance planning, thus contributing to promote health and minimize health risks. This study thus aims to assess knowledge on sports nutrition and dietary supplement consumption among resistance training practitioners at a gym chain.

METHODS

The present cross-sectional study has an analytical character and was performed with resistance training practitioners at a gym chain in the city of Fortaleza, Ceará, Brazil.

The sample consisted of 168 resistance-training practitioners, both men and women, over 18 years of age, enrolled in the gyms of the network and who agreed to participate in the study by reading and signing a Free and Informed Consent Form, with approximate sample distribution in the three gym units investigated. This particular gym chain was chosen due to its units' accessibility and distribution, among three neighborhoods and three different regions of the six existing in the city. In addition, its public comes from different neighborhoods, mainly due to its units' strategic location in urban agglomeration points.

Data was collected through the application of a questionnaire before or after the informants' training. The questionnaire was composed of objective questions divided into four headings: (i) identification data, such as gender, age and education; (ii) information on the exercise routine (goals, weekly frequency, training session duration and years as practitioners); (iii) information on the use of supplements, (supplements used, motivations for use, indication for use and how long they had been taking them); and (iv) questions on sports nutrition knowledge.

Sports nutrition knowledge was assessed by ten questions based on knowledge considered key to the effectiveness of adequate nutrition by resistance training practitioners, on the following topics: energy sources, nutrient food sources, healthy diet, sports nutrition and dietary supplementation. In addition, some questions were adapted from a sports nutrition knowledge assessment questionnaire developed and validated by Almeida *et al*.[13].

Participants' knowledge was classified according to the scores obtained in the questionnaire as low (0-4), moderate (5-7) and high (8-10).

The statistical analysis of the data was performed using the SPSS Statistics version 22.0 (SPSS Inc., Chicago, Illinois, United States of America). Previously, descriptive analysis of the data was performed, which was submitted to the construction of simple and relative frequencies, means and standard deviation.

The nonparametric Chi-Square test was used to assess the association between supplement consumption and gender, years as practitioners and nutrition knowledge, as well as the association between nutrition knowledge and gender. Spearman's rank correlation coefficient was used to assess the correlation between sports nutrition knowledge level and years as practitioners. For all tests, the level of statistical significance was set at 5% ($p<0.05$).

The study has been approved by the Human Research Ethics Committee of the State University of Ceará through the evaluation of the project entitled "Body composition, metabolic syndrome, sports nutrition knowledge and consumption of supplements, and adherence to fad diets by resistance-training practitioners at a gym chain in Fortaleza-CE" (CAAE 89154618.0.0000.5534).

RESULTS

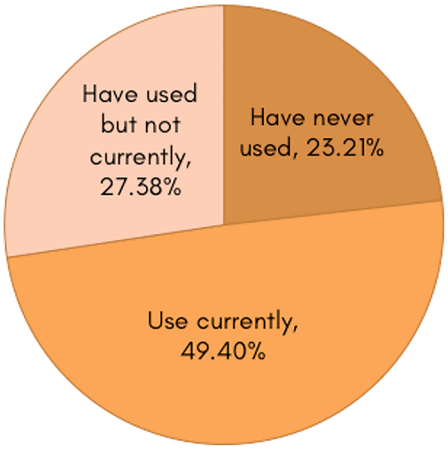
Of the 168 respondents, 55.95% were women and 44.05% were men, with a mean age of 30.62 years. Regarding the level of Education, 62.5% reported at least complete higher education. Table 1 below describes the sample and their exercise practices

Table 1 - Distribution of the sample regarding sociodemographic features and exercise practices. Fortaleza (CE), Brazil.

Variables	n (total=168)	%
Sample characterization		
Gender		
Male	74	44,05
Female	94	55,95
Age		
18 ⊢ 26	50	29,76
26 ⊢ 34	67	39,88
34 ⊢ 42	36	21,43
42 ⊢ 50	9	5,36
≥50	6	3,57
Mean	30.62 ± 8.23 years	
Education		
Middle school (incomplete)	1	0,60
Middle school	6	3,57
Higher education (incomplete)	53	31,55
Higher education	76	45,24
Specialization	10	5,95
Master's or Doctorate degree	19	11,31
Not Informed	3	1,79
Exercise practice description		
Years as practitioners		
< 6 months	34	20,24
6 months to 1 year	28	16,67
1 to 2 years	25	14,88
2 to 3 years	21	12,50
3 to 4 years	17	10,12
> 4 years	43	25,60
Weekly frequency		
< 3 times	10	5,95
3 times	37	22,02
4 times	35	20,83
5 times	51	30,36
6 times	25	14,88
Daily	10	5,95
Training session duration		
≤30	1	0,60
>30 and ≤60	112	66,67
>60 and ≤90	44	26,19
>90 and ≤120	9	5,36
>120	2	1,19

Note: n=number of individuals.

As Graph 1 below shows, nearly half of the respondents (49.40%) reported current use of supplements, 27.38% have made use of them, but were not doing so at present, and 23.21% have never consumed dietary supplements. Among the reasons for having interrupted the use of supplements, most informants (30.43%) reported no specific motivation, followed by those who reported a breach in exercise practices (28.26%). Other reasons indicated were: not achieving the expected results (10.87%), meeting their nutritional needs through food (10.87%), the high price of supplements (8.70%), recommendations by nutritionists or doctors (6.52%), health reasons (6.52%), the appearance of acne (2.17%) and pregnancy (2.17%).



Graph 1 - Resistance-training practitioners' dietary supplement use. Fortaleza (CE), Brazil.

Typification and quantification of dietary supplements consumed by practitioners, which are detailed in Table 2, show prevalent use of protein supplements, led by whey protein. Other supplements that showed considerable consumption were branched-chain amino acids (BCAAs), creatine, omega 3 and multivitamins.

Corroborating with the main exercise objectives observed in this study - which highlight sports practice for aesthetic purposes, with muscle mass gain and weight loss as main goals –, 65.06% of the respondents who reported the use of dietary supplements claimed muscle mass gain as motivation for use, followed by muscle recovery (31.33%), weight/body fat loss (26.50%), energy replacement (25.30%), supplying dietary deficiencies (19.28%) and limited time for eating (4.82%), in addition to improving immunity (1.20%), professional indication (1.20%) and health reasons (1.20%).

Table 2 - Classification and quantification of supplements consumed by resistance-training practitioners. Fortaleza (CE), Brazil.

Suplementos Alimentares	Referiu Consumo	
	n	%
Proteicos		
Whey Protein	68	40,48
Albumina	6	3,57
Colágeno	1	0,60
Aminoácidos		
BCAA	28	16,67
Glutamina	15	8,90
Metabólitos de Aminoácidos		
Creatina	23	13,69
Carnitina	2	1,19
Carboidratos		
Maltodextrina	3	1,79
Dextrose	1	0,60
Wazy Maize	1	0,60
Lipídicos		
Ômega 3	23	13,69
Vitaminas e Minerais		
Polivitamínico	20	11,90
Ferro	1	0,60
ZMA	1	0,60
Hipercalóricos	5	2,98
Termogênicos	10	5,95
Pré-treino ou Estimulantes	3	1,79

Note: % based on total sample.

Regarding dietary supplement prescriptions, most (67.47%) reported nutritionists as prescribers, followed by doctors (15.66%), self-prescription (14.46%), a referral from friends (10.84%), physical educators (3.61%), supplement store sellers (3.61%) and Internet advertisements (2.41%).

When investigating the association between dietary supplement consumption and other variables (Table 3), consumption was shown to be independent of gender, years as practitioners and sports nutrition knowledge ($p>0.05$), showing a diverse consumption among respondents.

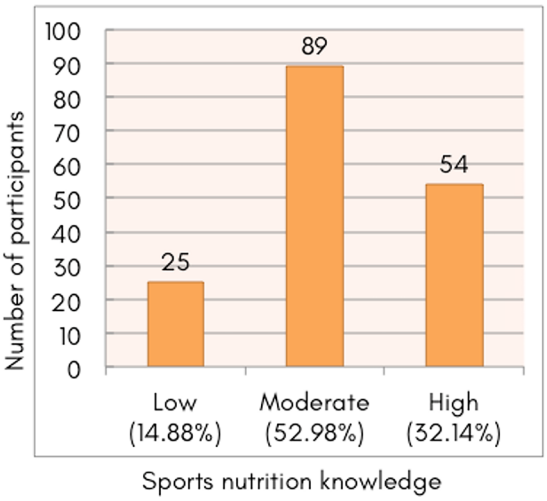
Regarding sports nutrition knowledge, most respondents (52.98%) showed moderate knowledge, as shown in Graph 2 below.

Knowledge was independent of gender ($p=0.238$), however, when correlated with years of practice, a positive and weak correlation was observed ($\rho=0.160$; $p=0.038$).

Table 3 - Association between dietary supplement consumption and gender, years as practitioners and sports nutrition knowledge. Fortaleza (CE), Brazil.

Variables	Dietary supplement consumption				p
	Yes		No		
	n	%	n	%	
Gender					
Male	37	44.6	37	43.5	0.891
Female	46	55.4	48	56.5	
Years as practitioners					
< 1 year	27	32.5	35	41.2	0.339
Between 1 and 4 years	31	37.3	32	37.6	
> 4 years	25	30.1	18	21.2	
Nutrition knowledge					
Low	9	10.8	16	18.8	0.131
Moderate	42	50.6	47	55.3	
High	32	38.6	22	25.9	

Note: n = number of subjects; % based on supplement consumption; p-value based on Chi-Square test.



Graph 2 - Resistance-training practitioners' sports nutrition knowledge. Fortaleza (CE), Brazil.

DISCUSSION

Analyzing the main resistance training goals within the sample studied, the practices of sports for aesthetic purposes were evidenced, with muscle mass gain and weight loss as the main goals, followed by health, physical conditioning and muscle strength. Most practitioners (65.06%) referred to muscle mass gain as their main motivation for the consumption of dietary supplements, corroborating with other research studies on supplementation practices[2,5,14].

Gonçalves & Alchieri[15], when investigating the motivations for the practice of physical activity among non-athletes, showed that the practitioners under the category "exercises" – encompassing resistance training, gymnastics, walking, water aerobics and dance – engaged in such activities mostly for aesthetic purposes, as opposed to those within the general sample – which involved sports such as football, volleyball, basketball, swimming, martial arts, tennis and cycling – who more often reported health reasons. These findings corroborate what was evidenced by the present study, as well as in other studies[16], including by Rodrigues & Santos[17], which investigated motivation for the practice of resistance training in the same locality of this study.

The research on supplementation practices shows that practitioners reported prevalent consumption of protein supplements, especially whey protein. Whey protein presents an excellent amino acid profile, with emphasis on branched-chain amino acids, characterizing it as a source of proteins of high biological value, which favors anabolism[18]. Widely used in the sports context, whey protein appears to exert a small to medium ergogenic effect on resistance training. However, in order for its use to be effective, training must provide adequate stimulation; a diet meeting the recommendations for physically active individuals is also necessary[19,20].

Alongside whey protein, BCAA and creatine showed high consumption within the studied sample; these three main supplements, with the prevalence of whey protein, were shown to be predominant in several other studies with resistance-training practitioners[14,21-23].

Creatine is one of the most popular nutritional ergogenic aids, exerting considerable effects on muscle strength, post-exercise recovery, and consequently, muscle hypertrophy[24,25]. On the other hand, despite current knowledge of the effects of essential amino acid supplementation on stimulating protein synthesis, to date there is limited evidence that supplementation of essential amino acids in free form, as in BCAA supplementation, positively impacts muscle mass gain in resistance training[7].

Although no significant association was observed between supplement consumption and years as resistance-training practitioners (Table 3), protein supplementation may not have a great impact on lean body mass and muscle strength during the initial weeks of resistance training. However, as the duration, frequency, and volume of resistance training increase, protein supplementation may promote muscle hypertrophy and increase muscle strength gain[19].

Regarding the prescription of dietary supplements, although most individuals claim to consume dietary supplements under the guidance of a professional nutritionist, many still reported self-prescription or other indications. According to the Federal Council of Nutritionists (CFN), through Resolution No. 309/2006[26] and Recommendation No. 004/2016[27], it is the nutritionist's responsibility to prescribe dietary supplements, which must be supplementary to the food plan, preceded by a nutritional and health assessment, in order to identify the risks of nutritional deficiencies and possible health risks. Supplement prescription should be made by the professional nutritionist, individually, indicating the route of administration, dosage, time of administration and duration of use in order to balance supplementation.

When analyzing nutrition knowledge, most respondents (52.98%) showed moderate knowledge, independently of gender (p=0.238), and a positive and weak correlation with years of practicing resistance training (ρ=0.160; p=0.038). In addition, analyzing the answers given to each question, it is possible to infer that, in general, practitioners knew how to relate nutrients to their food sources, despite showing difficulties in associating them with their functions, with a 52.38% error rate when reporting which nutrient (protein, lipids, carbohydrates and vitamins) does not provide energy.

Analysis of the respondents' nutrition knowledge and supplementation practices also showed an overvaluation of protein intake. When asked which nutrient should make up the largest portion of an athlete's diet, 64.88% of the sample indicated protein; when assessing the following statement: "active individuals (moderate to intense training) need three times more protein as sedentary individuals", 73.81% marked it as true. These facts, associated with the prevalence of the use of protein supplements, as well as the combined use of up to two protein supplements (whey protein and albumin), point to respondents overvaluating protein intake.

Adequate consumption of the three macronutrient groups is known to be very important, both for health and to optimize sports practice. Thus, contrary to the respondents' stated beliefs as to which nutrient should make up the largest portion of an athlete's diet, individuals who train for physical conditioning generally achieve their nutritional goals by consuming a normal diet, with a prevalence of carbohydrate consumption (45-55% of total caloric value; 3-5 g/kg/day), protein (15-20% of total caloric value; 0.8–1.2 g/kg/day) and lipids (25-35% of total caloric value; 0.5-1.5 g/kg/day); even for athletes, the prevalence of carbohydrate consumption is needed in order to maintain glycogen reserves and optimize results[7].

As for the protein needs of individuals, these vary according to the type of exercise practiced, its intensity, duration and frequency. Strength exercises, such as resistance training, require higher protein consumption when compared to other activities. In this sense, for those individuals who seek to increase muscle mass, the Brazilian Society of Sports Medicine[8] suggests the intake of 1.6 to 1.7 g/kg/day, adding that protein consumption beyond recommended levels does not lead to an additional increase in lean body mass. This statement could also be evidenced by the systematic review with meta-analysis and meta-regression performed by Morton *et al*.[28], which shows that protein intake should be approximately 1.6 g/kg/day, with larger amounts not contributing to the gain of muscle mass induced by resistance exercises.

With regard to safe protein intake, Schwingshackl & Hoffmann[29] conduct a meta-analysis of the relation between high-protein diets and renal function, showing an increase in glomerular filtration rate, serum urea, urinary calcium excretion and serum uric acid concentrations, referring to these changes as possible physiological adaptation mechanisms induced by a high-protein diet.

A study conducted by Santos *et al.*[30] investigated the relationship between high-protein diets and anger expression, finding significant correlations between anger levels and the total weekly protein intake. Therefore, high-protein diets should be handled with caution, especially with animal protein.

Furthermore, most respondents (50.59%) showed distortion in their knowledge of protein functions in sports, marking as true the statement "protein is the main source of energy muscle in exercise". In general, the fuel mixture that triggers exercise will depend on the intensity and duration of the effort, as well as on factors inherent to the individual, such as fitness and nutritional status [9], however, given the anaerobic nature of the exercise, carbohydrates are configured as the muscles' main energy supplier during exercise, and most of the energy needs are met by the ATP-phosphocreatine (PCr) system and by anaerobic glycolysis, from muscle glycogen[6,31,32].

The above results, alongside other studies assessing the food consumption of resistance-training practitioners [22,33,34] – all of which show high-protein and low-carbohydrate dietary patterns linked to wide use of protein supplements – point to protein overvaluation to the detriment of the consumption of other macronutrients in the context of resistance training, which favors the adoption of inappropriate dietary practices with ensuing health and sports performance hazards.

FINAL REMARKS

The present study showed a wide consumption of dietary supplements by resistance training practitioners, independently of gender, years of practice and nutrition knowledge. Proteins, amino acids and amino acids metabolites were shown to be the most widely consumed supplements, which results, in association with the nutrition knowledge levels identified, point to an overvaluation of protein intake.

Nutrition education actions targeting the audience here under study are thus necessary, tackling diet and supplementation in their relation to physical activity, as well as individual nutritional assistance that may contribute to optimize sports practice, promoting health and minimizing health hazards.

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Authorship requirements
Substantial contribution to study design or data interpretation (EOC, MRTM); Participation in the drafting of the preliminary version (EOC); Participation in the review and approval of the final version (MRTM); Compliance with being responsible for the accuracy or completeness of any part of the study (EOC).

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