

Knowledge and Prevalence of Supplements Used by Brazilian Resistance Training Practitioners Before Coronavirus Outbreak

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Introduction: The use of dietary supplements and ergogenic aids (DSEA) is popular among physical activity enthusiasts. Particularly, resistance training (RT) practitioners represent important DSEA consumers due to its easy access and the appeal of claims related to muscle hypertrophy, aesthetics, and physical performance improvements.

Methods: Our aim was to study knowledge, prevalence, and profile of DSEA used by Brazilian recreational RT practitioners. For this, RT practitioners of both sexes (n=129, female=58 and male=71) answered a paper-based questionnaire. The questionnaire was specifically created for the studied population to assess different aspects of the DSEA used and sociodemographic variables.

Results: Seventy-seven percent of the participants (n=99) declared that they had already used DSEA. The majority (53%) searched the internet to obtain information about DSEA. Whey protein (66%) was the most used followed by branched chain amino acids (48%).

Conclusion: The use of DSEA, before coronavirus outbreak, was popular among RT practitioners; protein and amino acids were the most used DSEA. Most users used internet to obtain information about DSEA. The results suggest the need for appropriate attitude and guidance by health professionals who deal with this population, especially dietitians, nutritionists, and physical training professionals in order to promote best and security practices.

Keywords: nutrition, supplements, gyms, resistance training, ergogenic

Introduction

Dietary supplements and ergogenic aids (DSEA) are easily available and widely used to improve physical performance.¹⁻³ Previous studies showed that more than three million people in the US use or have used DSEA.^{4,5} DSEA is usually consumed for obtaining aesthetic and physical results and is heavily influenced by media advertising.⁶ Athletes and exercise enthusiasts are the most frequent consumers,¹⁻³ including recreational exercisers who aim health and/or aesthetic outcomes.⁷⁻⁹ As for athletes, in many cases, the use of DSEA aims to increase dietary protein intake (usually ≥ 1.2 grams of protein/kg/day), to improve physical recovery and increase the adaptive and anabolic responses of skeletal muscle to physical training.¹⁰ Regarding physically active individuals, the most popular reasons for using nutritional supplements are to increase muscle size and strength and/or prevent diseases.¹¹⁻¹³

Some authors compared sociodemographic characteristics (age, sex, region, education, income, and level of physical activity), specific exercise programs and

sports practiced between DSEA users and non-users, and found significant differences in motivators, knowledge level, DSEA types, and profiles.^{4,9,14–17} In addition, studies found that older participants more frequently ingested DSEA to prevent diseases and younger participants did it for aesthetics and physical performance; men made use of DSEA more frequently than women and people who used protein supplements also consumed greater amounts of protein-rich foods in the diet when compared to those who did not consume DSEA.^{4,9,10,14–17} The most popular DSEA used by gym practitioners from different countries (US., UK., Italy, Canada, and Switzerland) are protein supplements.¹⁵ Knapik et al¹⁸ showed that elite athletes used DSEA more frequently than their non-elite peers, DSEA use was similar between men and women, and a higher proportion of athletes used DSEA compared to the general population.

Previous studies (before the 2019 coronavirus pandemic) have shown that protein supplements are the most widely taken by gym attendees.^{4,9,16} However, physically active people, in general, do not need additional nutrients and DSEA, as long as they have an adequate diet.^{19,20} It should be noted that some DSEA contain high concentrations of ingredients that are potentially harmful to health and some potentially toxic ingredients.^{21,22} Moreover, many DSEA do not correctly report the amounts and quality of the components listed on the labels, as well as whether their composition contains substances that could cause doping.^{21,22} Despite this, the use of DSEA has only increased and this market is highly profitable.^{19,20}

Another apparent problem is that many DSEA users who attend gyms obtain information about supplements from unqualified sources and professionals, which is an additional risk.^{1,9} For example, Mettler et al²³ showed that there is a high prevalence of DSEA intake among Swiss gym attendees and this use is associated with a low quality information on safety and risks. Based on this, it might be important that health professionals (preferably dietitians) develop education programs directed to guide the best practices for DSEA use. Wardenaar et al²⁴ demonstrated in an expressive sample of female and male Dutch elite and sub-elite athletes that dietary counseling could result in more accurate choices regarding DSEA use with a focus on improving physical performance, physical recovery, and of health status.

Thus, our aim is to evaluate the knowledge, prevalence, and use profile of DSEA among Brazilian recreational RT practitioners. Despite the existence of much

information on the use of DSEA among athletes,^{25–27} there is still little information on the intake of supplements and the profile of Brazilian recreational RT practitioners.^{1,9,28} which is an important gap, since Brazil is the second country with most gyms in the world. In fact, although it is known that the use of DSEA is a widespread practice among exercisers, few studies have been conducted in specific regions of Brazil. Furthermore, data collected before the coronavirus pandemic (2019) became interesting to be disseminated.

Materials and Methods

Participant's Characteristics and Ethical Approval

Our research was a single-phase cross-sectional study that involved a convenience sample (n=129), chosen at random by personal invitation among RT practitioners from gyms from different regions of the State of Espírito Santo (Southeastern region of Brazil). To participate in the study, people had to regularly practice RT (at least twice a week), be over 18 years old, and be free from apparent cognitive limitations. Data were collected and analyzed in the 1st and 2nd semester of 2017, that is, two years before the coronavirus pandemic. People from different cities in the State, representing the main regions and with the highest population density, participated in the study: Vitória (n=32), Vila Velha (n=31), Serra (n=33) and Cariacica (n=33). As far as possible, samples were equalized to be more homogeneous and, therefore, to present less biased data. The aim was to include people with different education levels and socioeconomic status from different regions. Gym visits were carried out randomly and on different days of the week and at different times (morning, afternoon, or night). All RT practitioners included in this study were approached, before or after training, to complete the questionnaire in full. The sample size was chosen based on studies that evaluated the use of DSEA by RT practitioners. To achieve the aims of this research, a questionnaire was designed - which was evaluated by a panel of experts and with different backgrounds in the field. To choose the most relevant questions, we studied the literature in the area (by PubMed) as well as practical and market aspects of the DSEA (by Google search) that we considered important, so that the questionnaire was attractive and had greater ecological validity. DSEA inclusion in the questionnaire was performed based on scientific and market research. The questionnaire was applied to

assess different aspects of DSEA use (type, prevalence, frequency, use profile, and knowledge level) and socio-economic and demographic variables. Questionnaire questions were designed to assess qualitative and quantitative aspects of DSEA use, with a focus on closed questions (yes or no, true or false, and/or quantity) and that assessed frequency of DSEA use and level of knowledge. The main researcher remained at the place where the questionnaire was applied to clarify any doubts that might arise. In addition, the importance of the veracity of the information provided was emphasized in order to minimize the effect of the subjectivity of the answer to the questionnaire. All participants signed an informed consent form. All procedures were approved by the Research Ethics Committee of the Federal University of Espírito Santo (Certificate of Presentation of Ethical Appreciation - CAAE: 63228215.1.3001.5505).

Questionnaire

An instrument was designed, created, and applied to assess sociodemographic profile and knowledge about DSEA. The instrument was composed of variables and information related to physical activity and DSEA use (for more information, in the same link, see [Supplementary Material 1 and 2](#)). For the socioeconomic classification, a specific questionnaire was used.²⁹ The instrument used was validated to define social class through the assessment of possession of items, such as tv, computer, radio, bathroom at home, car, maid, washing machine, and refrigerator and their respective quantities and education level of the head of the family.

Statistical Analysis

Pearson's chi-square test was used to verify association between variables. The level of significance adopted in all analyzes was set at $\alpha=0.05$ and 95% confidence intervals were calculated. All data analyses were performed in the IBM SPSS v24 (IBM Corp., Armonk, NY, USA). Data are presented as absolute and relative frequency unless otherwise stated.

Results

RT Participants Characteristics

Tables 1 and 2 showed the general characteristics of RT participants ($n = 129$). Participants exercised 5.0 ± 1.0 times/week and 96.0 ± 36.0 minutes/day. As for the modalities practiced, 46.5% ($n=60$) practiced only RT; 42.6%

Table 1 Characteristics of Participants, $n=129$ (Female/Male = 58/71*)

Variables	Mean (Standard Deviation)	Minimum-Maximum
Age (years)	30.1 (8.8)	18.0–60.0
Body mass (kg)	70.8 (14.0)	47.0–128.0
Height (cm)	170.0 (0.1)	150.0–190.0
Body mass index (kg/m^2)	24.5 (3.4)	18.0–37.4

Notes: n: sample size. *Absolute number of female and male participants, respectively.

($n=55$) practiced another sport in addition to RT; 9.3% ($n=12$) practiced RT plus two modalities, and only 1.6% ($n=2$) practiced three or more modalities in addition to RT.

DSEA Profile Use

Most RT participants declared they had already used DSEA. Of the 99 subjects who declared they had already used DSEA, 77 were current users (60% of the total sample). Most participants (34.9%, $n=45$) were from social class B2 according Brazilian classification, 65% ($n=84$) were single, and 39% ($n=50$) had completed high school. Table 3 below shows the participant's sociodemographic profile.

The majority 53% ($n=68$) of the participants searched in the internet to obtain information about DSEA and 39% ($n=50$) through dietitian or nutritionist, 30% ($n=39$) obtained information from friends, 18% ($n=23$) on television, 17% ($n=22$) from the supplement store staff, 16% ($n=20$) at college, 5% ($n=7$) with a physical education professional, 3% ($n=4$) in Journalistic fonts, 2% ($n=2$) on the radio, 2% ($n=2$) in scientific fonts, 1% ($n=1$) in street

Table 2 Profile of Physical Activities Performed by the Participants, $n=129$

Practice of Physical Activity	%(n)
Experience (years)	
<1	27 (35)
1–2	13.2 (17)
2–3	15.5 (20)
3–4	5.4 (7)
≥ 4	38 (50)
Exercise modalities	
Only resistance training (RT)	46.5 (60)
RT plus 2 other modalities	9.3 (12)
RT plus other 3 modalities	42.6 (55)
RT plus ≥ 3 other modalities	1.6 (2)

Table 3 Participant's Socioeconomic and Demographic Profile, n=129

Variables	%(n)
Socioeconomic class	
A1	2.3 (3)
A2	14 (18)
B1	23.3 (30)
B2	34.9 (45)
C1	20.2 (26)
C2	5.4 (7)
Marital status	
Single	65 (84)
Married or stable relationship	29 (37)
Divorced	5 (6)
Widowed	2 (2)
Educational level	
High school (complete)	39 (50)
Higher education (incomplete)	26 (33)
High education (complete)	18 (23)
Specialization	9 (12)
Master's degree	1 (1)
PhD	1 (1)

advertising, and 6% (n=8) never obtained information on the topic.

Seventy nine percent (n=102) of the participations alleged in DSEA effectiveness; 9.3% (n=12) did not trust and 11.6% (n=15) did not know how to position themselves. Regarding security, 54.2% (n=70) believed in security, 29.4% (n=38) did not trust and 16.3% (n=21) did not know how to answer.

Among DSEA users (n=99) 50.5% (n=50) used up to two types of DSEA, 27.2% (n=27) used three or four types, and 22.2% (n=22) used five or more types. Whey Protein was the most used DSEA, being used by 66% of the users (n=66); followed by branched chain amino acids (BCAA) 48% (n=48). Table 4 shows the types of DSEA used by the sample of RT practitioners evaluated (n=129). It is important to note that the participant could choose more than one type of DSEA.

Among those who claimed to use DSEA, 36.3% (n=36) stated that the dietitian was the professional responsible for the prescription, 23.2% (n=23) self-prescribed, 24.2% (n=24) ingested under the guidance of a Physical Education Professional/Personal trainer, 9.1% (n=9) for medical advice, 3% (n=3) claimed to be the seller of the supplement store who prescribed it, 3%

(n=3) under the guidance of a training colleague and 1% (n=1) under the guidance of a beautician. In addition, of the 99 individuals who reported having used supplements and/or ergogenic aids 89% (n=88) reported never having experienced side effects.

It was observed that 6.2% (n=8) answered that they visited DSEA stores once a week or more frequently; 36.4% (n=47) visited once a month; 7.8% (n=10) once every 3 months; 11.6% (n=15) once every 6 months or less; 38.0% (n=49) answered that they did not visit.

Finally, regarding the monthly expenditure on DSEA, of those who were currently using it (n=77) it was observed that 52% (n=40) spent up to \$37.6 American dollars (\$) - data also shown according to the average price of a cup of coffee in Miami (US.)=\$3.9³⁰ (9.5 cup of coffees); 34% (n=26) between \$37.8 (9.5 cup of coffees) and \$75.3 (19.1 cup of coffees); 13% (n=10) between \$75.5 (19.2 cup of coffees) and \$150.6 (38.3 cup of coffees), and 1% (n=1) above \$188.3 (47.9 cup of coffees). Our data collection was in the year 2017. This year the minimum wage in Brazil was \$177.1 (45.0 cup of coffees).

DSEA Knowledge

The participants' knowledge about DSEA use was evaluated by the questions:

1. Ergogenic effects are any and all mechanisms, physiological, nutritional or pharmacological effects that are capable of improving performance in physical, sports or even occupational activity. Is that correct for you? (Right answer is YES), approximately 60% (n=77) were unable to answer; 1.6% (n=2) answered no, and 38% (n=50) answered yes.

2. Nutritional supplements are preparations designed to complement the diet and provide nutrients, such as vitamins, minerals, fibers, fatty acids or amino acids, which may be lacking or cannot be consumed in sufficient quantities in a person's diet. Is that correct for you? (Right answer is YES), 91.4% (n=118) answered yes; 3.1% (n=4) answered no and 5.4% (n=7) did not know how to answer.

3. To achieve my aesthetic and physical and sporting performance goals, I would take supplements, even if that would put my health and quality of life at risk. For you, this statement is: (...) The majority, 83.7% (n=108) said that this statement is "absolutely false"; 8.5% (n=11) said that it is "partially false"; 6.2% (n=8) which is "partially true" and only 1.6% (n=2) said it is "true".

Table 4 Types of Dietary Supplements and Ergogenic Aids (DSEA) Reported and Used by the Sample of RT Practitioners Evaluated, n=129

DSEA Type	n	%
Whey protein	66	51.1
Branched chain amino acids	48	37.2
Vitamins	34	26.3
Creatine	20	15.5
Caffeine	20	15.5
Glutamine	19	14.7
Hypercaloric	14	10.8
Thermogenic	14	10.8
Multivitamin	14	10.8
Albumin	11	8.5
Carb-up	9	6.9
Dextrose	9	6.9
Energy bars	7	5.4
Isotonic	6	4.6
Energetic	6	4.6
Antioxidant complex in capsules	6	4.6
Maltodextrin	5	3.8
Hydrolyzed meat protein	5	3.8
Casein	5	3.8
Collagen	4	3.1
Tribulus terrestris	4	3.1
Shakes	4	3.1
Anti-inflammatory	3	2.3
Anabolic steroid	3	2.3
Carnitine	3	2.3
Conjugated linoleic acid	2	1.5
Omega-3	2	1.5
Coconut oil - in capsule	1	0.7
Prohormonal	1	0.7

Possible Associations of DSEA Use with Variables of Interest

There was no significant association between participant's sex and body mass index classification ($X^2=7.488$, $p=0.11$), time of physical activity practice ($X^2=1.917$, $p=0.75$), educational levels ($x^2=8.989$, $p=0.25$), and marital status ($X^2=4.809$, $p=0.30$). In addition, there was no significant association between participant's sex and the usage of DSEA ($X^2=2.136$, $p=0.14$). Also, there was no significant association between the usage of DSEA and marital status ($X^2=3.646$, $p=0.45$), educational level ($X^2=9.914$, $p=0.19$), socioeconomic class ($X^2=10.362$, $p=0.06$).

Discussion

The main aim of the present study was to obtain a profile of DSEA use among recreational Brazilian RT

practitioners. Our findings were that 77% (n=99) declared that they had already used DSEA and 79% said they believed in their effectiveness. The majority (53%) sought information over the internet and 39% through a dietitian/nutritionist. It should be noted that 24.2% ingested DSEA with the guidance of a Physical Education Professional/Personal trainer, which is not ethical or appropriate. As for the number of DSEA used, 50.5% used up to two types. Whey Protein (66%) was the most used followed by BCAAs (48%). As for the sociodemographic profile 34.9% were from class B2 and 39% had completed high school. A point to be highlighted was that there was no association between the variables of interest (sex, body mass index, physical activity practice, educational level, marital status, and socioeconomic level) and the factors of DSEA use.

El Khoury and Antoine-Jonville²⁸ evaluated the use of DSEA among Beirut gyms attendees. The intake of nutritional supplements was reported by 36.3% of the participants and with a low presence of medical supervision. Men and beginners used more DSEA associated with improving physical performance and muscle strengthening; while women, older people and more experienced practitioners were more concerned with health-promoting products (vitamins and minerals). The authors suggested that the adequate dissemination of accurate and scientifically based information on the benefits and side effects of nutritional supplements is highly recommended in the gym environment. Bianco et al¹⁵ evaluated DSEA intake by exercisers (in the suburbs and center) in the city of Palermo (Italy) and observed that protein consumption was the most frequent, with similar prevalence in both groups (30% for exercisers in the center and 28.8% in the suburbs of the city). Wardenaar et al²⁴ evaluated the prevalence of DSEA use by Dutch competitive athletes (n=778). Among them, 97.2% used DSEA at some point in their sports career. Among the DSEAs used without guidance in the last month, the use of multivitamins and minerals (42.9%), isotonic drinks (44.1%), and caffeine (13.0%) was reported. Dietary counseling was associated with a higher prevalence of vitamin D, isotonic protein drinks, energy bars, dextrose, beta-alanine, and sodium bicarbonate use. Dietary counseling was inversely associated with the use of multivitamins, calcium, vitamin E and B, energy drinks, and BCAA. Therefore, receiving dietary counseling seems to result in more appropriate choices regarding DSEA use related to physical performance, physical recovery and health.

Goston and Correia¹ observed that 36.8% of exercisers in the city of Belo Horizonte (southeast region of Brazil) reported taking DSEA. The highest intake was among men (44.6%) and proteins and amino acids were the most used supplements (58%). The majority (55%) reported the use of supplements without specialized professional guidance and relied on self-prescription. Individuals under 30 years, mainly men, took protein-rich supplements and older participants reported taking supplements rich in vitamins, minerals and herbal medicines. In our study, 36.3% of the users reported that the dietitian was responsible for the prescription, 23.2% relied on self-prescription, 24.2% used it under the guidance of a personal trainer physical, 9.1% with medical advice, 3% followed the prescription of a seller from supplement store, 3% under the guidance of a training colleague and 1% under the guidance of a beautician. Our results are worrying since the professional responsible for the prescription and guidance should be the dietitian, according to regional laws.

It should be noted that the results of the present study corroborate similar studies carried out in Brazil. Santos and Santos³¹ in a research carried out in Vitória-ES observed that the relative frequency of DSEA use was 70%. Hirschbrusch et al³² found values of 61% and Gomes et al³³ in a survey conducted in Ribeirão Preto-SP found 52.7%. In the study by Linhares and Lima,³⁴ the prevalence of DSEA use by RT practitioners in the gyms of Campos dos Goytacazes-RJ was 65%. We found the predominance of proteins as the DSEA most used by recreational RT practitioners. This corroborates the findings of Theodoro et al.³⁵ Araújo et al.³⁶ Goston and Correia¹ and Linhares and Lima,³⁴ who found 81%, 49%, 69%, and 78% respectively, for the predominance of protein supplements.

Despite most interviewees affirmed having had information on the topic, the main problem is the source of this information. Most respondents searched the internet (53%) and friends (30%). Only 39% sought to obtain information from a dietitian. Domingues and Marins,³⁷ Costa and Rogatto³⁸ and Pamplona et al³⁹ also reported a low frequency of consultation with a specialized professional (36%, 13 and 22.2%, respectively). Furthermore, we are surprised by the fact that 22% of supplement users in the present study seek out physical education professionals to recommend them.

Navarro and Araújo⁴⁰ and Araújo et al³⁶ highlight that the dietitian is usually consulted for supplements prescription. However, other studies reported that other professionals and unqualified sources are also consulted by

users, such as physical education professionals/instructors, friends or even self-prescribing.^{41–44}

Another point to highlight is the low quality of information provided in gyms. Mettler et al²³ observed that the high prevalence of supplement intake among users of Swiss gyms was associated with a low level of information quality. In a recent study, Ruano and Teixeira⁴⁵ concluded that gyms attendees in Portugal are major consumers of dietary supplements. The biggest users are men and young people who use powdered protein supplements to increase muscle mass who get information from accredited nutritionists and consider themselves well informed and buy supplements online. AlRuthia et al⁴⁶ warn that public health campaigns are needed to educate the public about the potential harmful effects of DSEA if purchased from unofficial providers or ingested without consulting qualified professionals.

An important aspect assessed in our study are the expenses with DSEA. There are important issues: people spend on ineffective strategies and something that might be bad for their health.

Study Strengths and Limitations

The strengths of our study are that it involved different regions of the State of Espírito Santo which is an important state in the Southeast region of Brazil with approximately 4 million inhabitants. Our results involved municipalities that were not previously studied about the use of DSEA. One limitation is the difficulty in obtaining accurate answers when the research tools are questionnaires due to the presence of subjectivity bias. On the other hand, questionnaires are the instruments with the largest and easiest access and low cost, which is a real advantage. Another limitation is that the assessment through a questionnaire necessarily needs large samples to draw more accurate scenarios. In our case, a sample with more than 100 people is relatively considerable, as we assess an audience with specific characteristics, that is, practitioners of regular exercise and RT. In addition, questionnaire studies are relatively effective as pilot and initial studies and easy to access and execute and reproduce. Although our tool has not been validated, it underwent an evaluation by experts (one of the validation phases) and may have greater ecological validity because it was designed specifically for the target audience. To search for possible associations between variables of interest, one of the ways would be to evaluate more expressive samples in terms of number of people and range of different profiles.

Conclusion

Our study evaluated the use of DSEA among recreational Brazilian RT practitioners (before 2019 coronavirus pandemic) and found that DSEA use is highly prevalent, especially protein supplements. Most users obtained information about DSEA from the internet. Thus, the necessity of an appropriate attitude and orientation by health professionals working with RT practitioners was highlighted. Also, attention should be paid to the quality of information in social networks, website, and the internet in general. It is relevant that health professionals help RT practitioners with correct information and guidance so that practitioners can develop an appropriate attitude towards DSEA use as well as reflect on whether this use would be appropriate. For these people, this information is important because most DSEA used do not have robust scientific evidence as to its safety and effectiveness. Finally, if it is necessary to use DSEA to meet a nutritional need or for health reasons, it is essential that health professionals help RT practitioners in choosing tested and safe products.

Institutional Review Board Statement

The study was conducted according to the guidelines of the Declaration of Helsinki, and was approved by the Research Ethics Committee of the Federal University of Espírito Santo (CAAE: 63228215.1.3001.5505). Informed consent was obtained from all subjects involved in the study.

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Author Contributions

All authors made a significant contribution to the article, whether in conception, study design, execution, data acquisition, analysis and interpretation. In addition, everyone participated in the writing, in the critical review of the article; gave final approval of the version to be published; and agreed with the Journal to which the article was submitted and are responsible for all aspects of the research.

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