



ORIGINAL ARTICLE

Sports supplements: use, knowledge, and risks for Algerian athletes

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Abstract

Background: In recent years, sports nutrition has become a major part of the athlete's lifestyle. Even if this field is well considered in several countries, the situation remains deficient in Algeria. **Aims:** The aim of this primary study in Algeria was to investigate the prevalence of the use of sports supplements among recreational and professional athletes, the health risks associated with this consumption as well as their knowledge and attitudes towards sports supplements. **Subjects and Methods:** This is a cross-sectional survey carried out in western Algeria on 200 athletes who completed a validated questionnaire on socio-demographical parameters, sports supplementation practices, and knowledge. **Results:** Of the sample, 100% reported having used at least one type of sports supplements, predominantly gainers (25%), whey protein (20%) and BCAA (20%). The main motivation for this consumption was to increase muscle (59%) mass and improve performance (25%). Retail stores (76%) were the most common sources of SS products. The prevalence of using prohibited substances (doping) was (11%) primarily anabolic steroid (95%). 31% of consumers experienced side effects. The internet was the principal source of information regarding supplementation and the main finding was a gap in knowledge and risk perception of supplement use among 61%. **Conclusions:** Data reported by this study represent a serious concern about the factual extent of this issue. It would be necessary and appropriate to initiate a targeted prevention strategy to improve the athlete's knowledge aiming to change their behavior toward the use of sports supplements.

Keywords: Sports supplements, Athletes, Algeria, Adverse effects, Knowledge.

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1 Introduction

Sports nutrition represents the integration and application of scientifically-based nutrition and exercises physiology principles that support and enhance physical activity, athletic performance, and recovery. Besides the implementation of sports nutrition and training strategies, athletes seek some ergogenic aid, an external influence, which may just be the key impetus for victory [1,2]. Nutritional supplements can be grouped into dietary supplements, ergogenic aids, and sports foods [3] and the ones intended for the improvement of athletic performance and faster recovery are known as sports supplements [1,2]. A large number of recreational and elite athletes use nutritional supplements (NS) [4-9]. This overemphasis of NS use, as endorsed by the internet and social media, along with the efforts of nutritional supplement companies to sponsor remarkable athletes [10] have aided at increasing the use of these products worldwide. In 2017,

global sales of supplements reached USD128 billion [11]. Although the use of supplements varies across different sports, its usage is generally higher in men than in women and increases with age [7]. In addition, the athletes involved in short sprint-based activities typically consume less dietary supplements than athletes competing in endurance-based activities [12]. Overall, the prevalence of supplement consumption ranges from approximately 29 to 100% [13-24]. Prevalence data differ between studies, and a possible explanation can be found in variable sample size, age, category and different level of competition among athletes [23]. According to the literature, performance enhancement, prevention of nutritional deficiencies, better physical appearance, immune system enhancement, and recovery from training and injury are some of the known reasons why athletes use supplements [20,25-27]. The consumption of

sports supplements has rapidly increased over the last decade and the rate of new products available on the market cannot be followed by the appropriate scientifically-based studies about their safety, quality, and effectiveness [28-29]. However, sports nutritionists or scientists are rarely the main sources of information to plan a supplementation program [30], even at the elite level. This initiative may lead athletes to an excessive and/or incorrect use of dietary supplements along with possible adverse interactions due to polypharmacy [31]. In addition, there are significant risks associated with the use of supplements, such as the absence of active ingredients, the presence of harmful substances, or even the presence of doping agents [32] with rates of contamination between 12 and 58% [33].

In Algeria, this practice has become increasingly popular being prevalent not only among athletes but even among those who practice physical activity for recreational purposes and non-professional athletes. Moreover, due to the lack of regulation of the nutritional supplement industry, an abundance of supplement products of dubious value, content, and quality are now available in the market [4]. Unfortunately, the abusive consumption of these sports supplements can represent a health risk for consumers [34].

Given the lack of research that has analyzed the consumption of sports supplements in Algeria, the aim of this study was to investigate the pattern of nutritional supplement use, supplement-related knowledge, attitudes, and practices among Algerian athletes. Furthermore, we aimed to identify sources of information regarding supplements and their effects among the study participants. The results from this study are intended to help reduce the risk associated with the incorrect or abusive use of dietary and nutritional supplementation through better informed the athletes.

2 Subjects and Methods

2.1 Study design and subjects

The participants of this cross-sectional study were sport athletes ($n = 200$, 10 females) from 12 different sport centers and 8 retail stores (sport nutrition stores) located in three western Algerian cities: Oran, Sidi-Bel-Abbes, and Mascara.

To be included in the study, athletes should practice at least one professional or recreational sport activity. The sample was made up of competitive athletes i.e. defined as individuals who participate in “competitive physical activities” or sports/games that require physical strength, agility, or stamina [35]. However, recreational athletes represent individuals who are physically active but do not train for competition at the same level of intensity and focus as a competitive athlete [35]. Athletes were randomly selected using the convenience sampling technique. i.e., the

participant athletes were selected based on availability and accessibility after contacting sports clubs and coaches.

The sample design used was defined according to the calculation of the sample size to a proportion, considering a value of 50% for the proportion ($p = 50\%$) for the athletes to submit to nutritional supplementation, with a variation of 7% ($v = 7\%$) and 95% confidence level with a 5% margin of error ($\alpha = 5\%$). Thus, a total of 196 interviews was determined as necessary. Also, considering 5% of loss and rejection, 206 questionnaires were distributed over a period of three months (January 10th, 2019 to March 10th, 2019).

For the purpose of the current study, it is important to note that elite athletes we investigated were not supported and/or sponsored by companies related to NS manufacturing and/or distribution.

2.2 Variables and testing

After a review of the literature, a questionnaire was self-constructed by the authors then reviewed and validated by experts from the epidemiology department of Sidi-Bel-Abbes university hospital center. It was then pilot tested to ensure and determine clarity.

The anonymous self-administered questionnaire consisted of 20 questions, divided into four main parts: 1) Demographic and personal information of the study participants such as age, gender, educational background, smoking status, health condition, sport type); 2) Athlete’s nutritional and dietary supplementation, including categories of supplements used, frequency and timing of consumption, personal beliefs and motivations for use, possible prohibited substances use, procurement and the sources of sports nutrition information; 3) Impact of this consumption on health (adverse effects, impact on the performances, satisfaction with the results); and 4) Athlete’s knowledge of sports supplements and sources of this nutrition information.

Table 1: Socio-demographic characteristics of respondents

Variables	Frequency (n)	Percentage (%)
Gender	200	
Man	190	95
Women	10	5
Age range		
<20 years	24	12
[21-30] years	126	63
[31-40] years	42	21
>40 years	8	4
Education Level		
Primary school	2	1
Middle school	26	13
Hight school	54	27
University	118	59
Smoking status		

Smoking	54	27
No smoking	146	73
Sport kind		
Bodybuilding	125	62.5
Bodybuilding+ Football	44	22
Bodybuilding+ Martial Arts	14	7
Bodybuilding + Athletics	6	3
Athletics	3	1.5
Football	2	1
Cross-Fit	2	1
Bodybuilding + Power-Lifting	2	1
Power Lifting	1	0.5
Bodybuilding+ Swimming	1	0.5
Health status		
Healthy	198	99
Chronic disease	2	1

Table 2: Timing and frequency of sports supplements use

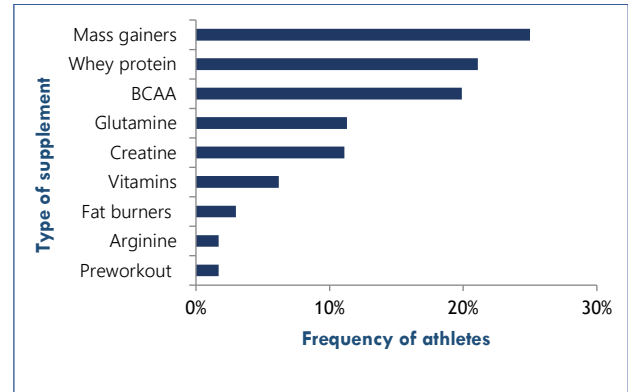
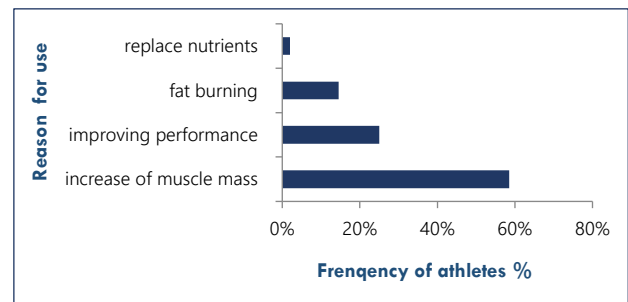
Timing of use	n (n = 200)	%
Before workout	94	47
During workout	50	25
After workout	22	11
Morning	28	14
Evening	6	3
Frequency of use	n (n = 200)	%
Daily	94	47
Training days only	106	53

In the current study, sports supplements were defined as vitamins or multivitamins, minerals, creatine, sports drinks, pre-workout mixture (typically containing a blend of ingredients such as caffeine, creatine, beta-alanine, amino acids, and nitric oxide agents) [36]. Protein, carbohydrate and protein mix or gainer, amino acids, including branched-chain amino acids (BCAA), fat burners, carnitine, arginine, fish oils (omega 3,6) and herbal or homeopathic supplements such as echinacea, garlic, ginseng, and *Tribulus Terrestris* extracts were also included.

Approval to perform the study was obtained from the scientific board of the Faculty of Medicine, Djillali Liabes University Sidi-Bel-Abbes Algeria. The protocol was carried out in accordance with the procedures approved by the Declaration of Helsinki while informed verbal consent was obtained from all respondents prior to the study.

2.3 Statistical analyses

Data were processed using Microsoft Excel 2010 software, analyzed using IBM®SPSS® Statistics; version 25, and expressed as, frequencies, percentages in tables and charts. A p-value < 0.05 was considered statistically significant.

**Figure 1:** Sport supplements used by athletes**Figure 2:** Motivations for supplement use

3 Results

3.1 Demographics

A total of 200 respondents completed the questionnaire, (190 males and 10 females). The most dominant age group, among athletes (63%), was the 21–30 years of age group. Approximately three quarters (73%) were not smokers. Regarding socioeconomic status, almost (60%) of the participants had attained tertiary education. Ninety-six percent (96%) of athletes practiced bodybuilding alone or combined with other sports (football, martial arts, athletics, powerlifting, and swimming). All investigated athletes were healthy during the intervention, excluding two men with diabetes type 1 and coagulopathy. Participant characteristics are summarized in (Table 1).

3.2 Nutritional and dietary supplementation

3.2.1 Prevalence of use

All of the subjects (100%) were taking at least one sports supplement.

3.2.2 Motivations and patterns of use

The sports supplements used by athletes in the current study are presented on Figure .1. In sum, «gainers» were most commonly used (25%), followed by whey protein (20%), branched-chain amino acids (BCAA) (20%), glutamine (11%), creatine (11%), vitamins (6%), fat burners (3%), arginine (2%) and pre-workout (2%). In terms of frequency, 53% of respondents used supplements only during training days, and (47%) daily. The timing and frequency of supplements use are presented in table 2. The most frequently mentioned reasons for supplements consumption were to increase muscle mass (59%), improve performance (25%), fat-burning (15 %) and finally, replace nutrients (2%) as shown in Fig. 2. The majority of athletes reported retail stores (70%) as the main sources of obtaining their supplement needs, following by respectively sport centers (7%), an intermediary abroad (5,5%), and internet websites (1%) as shown in (Fig.3). US brands were the most desired brands, Optimum Nutrition® (20%), Scitec Nutrition® (12%) and MuscleTech® (10%) were the three most appreciated (Figure 4).

3.2.3 Doping

Twenty two (22) respondents (11%) using supplements declared that they had consumed prohibited substances. Among those who had contravened sports doping regulations (8%) were professional bodybuilders. The data of banned substances consumed are shown in (Figure 5).

3.2.4 Impact of the Sports supplements consumption

Most users (97,5 %) felt that they benefited from supplementation and reported a positive effect on actual sports performance. However, approximately 62 athletes (31%) reported adverse effects from supplement use. As shown in (Fig.6) (28.6%) experienced gastrointestinal disorders (such as diarrhea, constipation, flatulence, and nausea), (21.4%) skin disorders, (19.1%) neuropsychiatric alterations, (16.7%) cardiovascular disorders, more than (8%) hormonal disturbances and approximately (6%) kidney dysfunctions. Among those who experienced adverse effects (78%) decided to stop the supplementation which led to a health condition improvement in almost all cases (93.5%). Table 3 presented the occurrence rate of adverse effects and remission rates after stopping consumption.

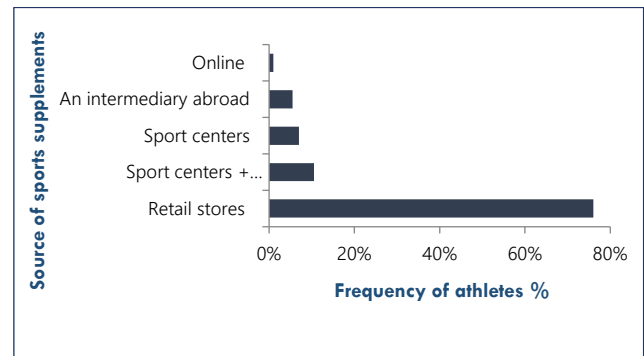


Figure 3: Sources of nutritional supplements

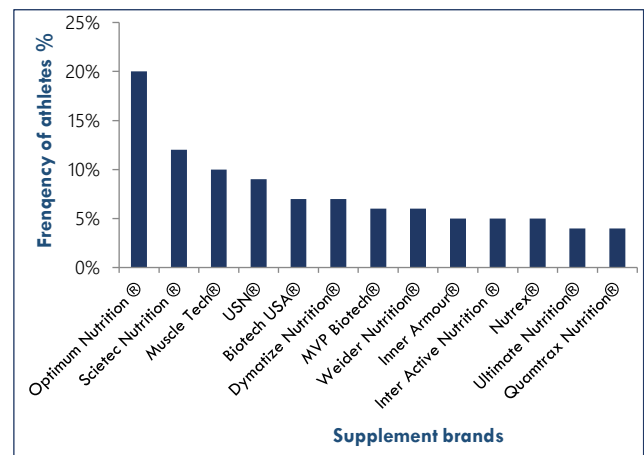


Figure 4: Brands of Sports supplements used by athletes

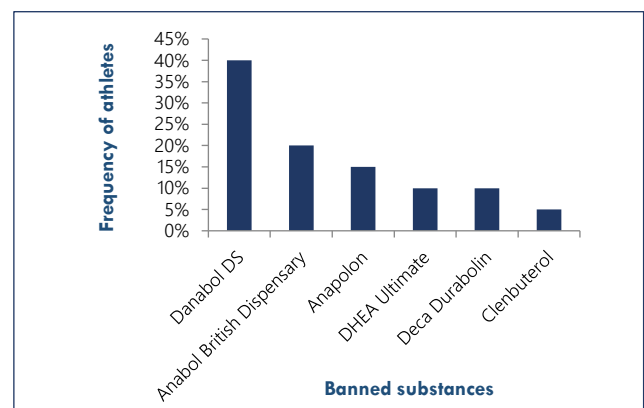


Figure 5: Prohibited substances used by athletes

3.3 Supplement Knowledge and Beliefs

More than three fifths (61%) of supplements users' self-reported no knowledge about the product they consumed or his safety, most (61%) were unaware that supplements can adversely affect health and believed there were no risks (health or otherwise) associated with any supplements ingested, (39 %) of the studied individuals considered themselves knowledgeable about sport nutrition issues although they

seem to examine the reliability of the information on the internet as mentioned in (Table 4).

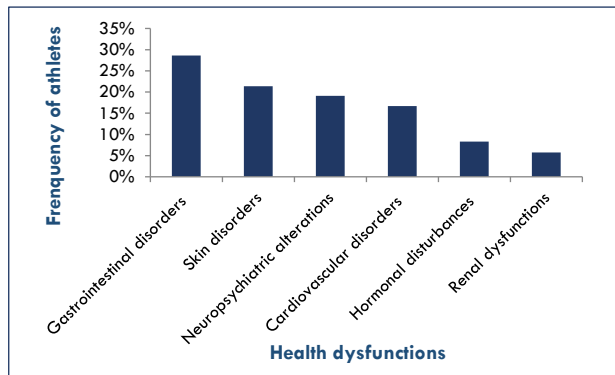


Figure 6: Adverse effects experienced by supplement users

Table 3: Occurrence rate of adverse effects and remission rate after stopping consumption

Occurrence of adverse effects	n (n = 200)	%
Yes	62	31
No	138	69
Consumer shut down	n (n = 200)	%
Yes	156	78
No	44	22
Remission rate	n (n = 200)	%
Yes	187	93.5
No	13	6.5

Table 4: Supplement knowledge and source of information

Supplement knowledge	n (n = 200)	%
Yes	122	61
No	78	39
Risks knowledge	n (n = 200)	%
Yes	122	61
No	78	39
Source of information	n (n = 122)	%
Internet	122	100
Other	0	0

4 Discussion

To the best of our knowledge, this is the first study from Algeria on the practices of sports supplements use in recreational and elite sport. There were several important findings in this descriptive survey. On one hand, the totality of athletes (100%) used SS, while the prevalence of supplement use observed in the present study is in an agreement with the studies that pointed out high supplement consumption among athletes [5,6,11,23]. On the other hand,

similar prevalence can be observed in Danish female (100%) and male (94. %) fitness customers, as well as female (92.6%) and male (85. %) elite athletes [24]. On the contrary, Nabuco *et al.* [18] reported that only (47.3%) of Brazilian athletes use sports supplements. Giannopoulou *et al.* [14] reported that only 37% of various performance levels athletes consume supplements. The overall prevalence rate of sports supplements differs between studies, and a possible explanation can be found in variable sample size, age category and different level of competition among athletes. Other factors related to the different methodologies (type of instruments) used, such as the definition of sports supplements, the particular time period of consumption, and the different sports evaluated, may also explain the variation in the prevalence of dietary consumption among the different studies. Several factors could influence the increase in dietary supplement use (DSU) in modern sports. Most likely, the DSU has become more prevalent because of an increase in the psychophysiological demands of sports training and competition and because of supplement market growth and aggressive advertising [7,37]. Such aggressive marketing is especially oriented toward athletes who seek every legal edge to improve their performance [7,38].

Almost two-thirds of the sample was composed of young adult athletes, which may have influenced the prevalence of consumption in this study, consistent with the findings of Sekulic *et al.* [19] who found a higher prevalence of consumption of dietary supplement in this age category. Further factor that might affect the prevalence data is the fact that (95%) of the respondents were men that agrees with the literature where male athletes were found to be more likely to use performance enhancements than females [21,22].

Mass gainers, whey protein, and BCAA were the most frequently used supplements by athletes in our study. This was consistent with findings from earlier studies [18,21]. The athletes' motivation for supplement use is known to influence the choice of supplement [18,27]. In the present study, the fact that the athletes preferred carbohydrates, protein, and amino acid supplements could be a direct reflection of their motivations for supplement use: increased muscle mass (59%) and improved performance (25%). These data corroborate with findings from another study on athlete dietary habits and can partly explain the reason we found that whey protein was one of the most commonly consumed supplement, in agreement with the findings reported by Wiens *et al.* [6], Giannopoulou *et al.* [14] and Nabuco *et al.* [18]. In addition, the intake of post-exercise protein stimulates the synthesis of myofibrillar protein and a positive nitrogen balance [39] but only the essential amino acids have demonstrated an improvement of myoprotein synthesis [40]. Thus, whey

protein is more effective than another type of protein, such as soya, for this positive effect [41].

In the last few years, many studies have agreed that post-workout supplementation performed by (47%) of this study athletes is vital to recovery and training adaptations. According to the International Society of Sports Nutrition, ingesting carbohydrates with protein, following exercise, has been a popular strategy to heighten adaptations seen as part of a resistance training program. The rationale behind this strategy centers upon providing an energy source to stimulate muscle protein synthesis (MPS) via key signal transduction pathways. Additionally, carbohydrate intake will impact insulin status which could promote MPS, limit protein breakdown or both. Furthermore, combining carbohydrate with protein can heighten glycogen synthesis rates, particularly when carbohydrate intake is not optimal and can improve muscle damage responses after exhaustive exercise [42] like bodybuilding, the main sport (96%) in this survey.

In recent years, consumption of ergogenic aids (e.g. Ephedra alkaloids, anabolic steroids, protein hormone) has been increased to enhance athletic performance. Young athletes, especially elite and competitive, are the main target market for such supplements [20]. The data of the current study showed that 22 athletes (of whom 8 were competitive level bodybuilders) used banned substances, mostly anabolic steroids (95%). Our findings corroborate those reported by Mekacher *et al.* [43], who found that the statements of doping cases of Algerian student from sport's high school are (16.4%).

Besides that, a recent Spanish study showed that (83.3%) of the bodybuilders declared that they had consumed or would consume banned substances and the most consumed were anabolic steroids (72.9%) [44].

It should be mentioned that, supplements are not risk-free, and among the different possible negative effects associated with the use of SS are: positive, voluntary or involuntary, in a doping test, sports performance impairment and/or adverse health effects [45]. Thus, it is vital to know that SS can contain harmful and doping substances such as stimulants, estrogenic compounds, diuretics, and anabolic agents, including anabolic and androgenic steroids, design steroids and prohormones [46]. The presence of heavy metals, such as mercury has also been reported in whey protein supplements [47].

The data gathered in a study carried out by Geller *et al.* [48], in which it was noticed that each year there are more than 23,000 emergency visits due to adverse events related with NS of which 9% end in hospitalization. On the other hand, the concomitant use of several supplements may lead to drug-nutrient or nutrient-nutrient interactions, and thus can be harmful to athletes' health or affect their performance in the

short, medium, or long term [25]. This may explain why 30% of this survey SS consumers experienced different side effects.

The purchase of supplements in physical stores was listed as the main preference for athletes (76%) in our investigation. This might be justified by a possibly increased safety perception by athletes when purchasing supplements directly from the vendor when compared to purchasing online (1%). However, research on this topic is scarce and the justification of purchase preference merits further studies. Moreover, SS are sold in many gyms and sports clubs displayed and made accessible, which is the second source of SS procurement of our participants, this reinforces the normativity of supplement use. According to Druker *et al.* [49], most gym members do not consult professionals before buying these products but rather other members or trainers, making consumption uncontrolled and occasionally injudicious.

Given the current supplementation and doping climate, it is alarming that the majority of athletes (61%) had no knowledge about their sports supplement's routine. The results of this study corroborate with the study of Slater *et al.* [50] (more than 60% had little or limited knowledge about the subject).

Therefore, special efforts are required to increase the level of knowledge and awareness of both, benefits and risks of supplementation among the Algerian athlete population. The importance of systematic and organized education is clearly supported by the fact that the majority of auto-proclaimed « knowledgeable » athletes declared the internet as the main source of information about nutrition and SS. Although self-education may be a potentially valuable type of life-long learning, it should not be the main source of information on nutrition and SS issues. Namely, only properly educated athletes will be able to objectively evaluate information obtained from different informal sources (i.e., internet, food stores, etc.) and consequently will be less vulnerable to potential misinformation [51]. Therefore, our findings reinforce the importance of the presence of professional staff who hold a sports nutrition certification and thus can develop personalized dietary strategies that meet the needs of the athletes while considering efficacy aspects, the risk and benefits of these supplements to the athlete's health, and the risk of a positive doping test. It is worth mentioning that many Algerian athletes or sports clubs cannot afford to have a qualified professional on their own or as part of their staff, respectively. In these cases, a consultant dietitian should be hired to train and educate coaches and athletes, without incurring costs associated with specialized technical staff.

This investigation presents some limitations that should be considered to improve the results' applicability. The first one is related to the cross-sectional design with a possible bias of

reporting. Furthermore, the questionnaire may not reflect the reality of the participants, leading to under- and overestimates; however, this type of instrument has been widely used in studies in this field. Unequal distribution of sexes in this analysis may also underestimate the true supplements use prevalence in females. Another limitation of this analysis is a relatively small sample size for this category of study. Moreover, all study participants were allocated from one region (western Algeria), which may limit the generalizability of the results. However, the results obtained in this study may serve to obtain valuable guidelines towards future global trends about sports supplementation.

Despite these limitations, the authors believe that the article presents valuable information for the scientific community about patterns of sports supplementation consumption.

5 Conclusion

In conclusion, the results of this study demonstrate a widespread use of sports supplements in recreational and professional Algerian athletes. Carbohydrates, whey proteins, and BCAA were the most consumed supplements, associated with increasing muscle mass and improving performances as a primary goal of consumption. This was mainly due to the high number of commercially-available dietary supplements that fulfill this definition exacerbated by the lack of regulation within the marketing and production of supplements. Furthermore, athletes seem to rely on inadequate sources of information when acquiring and using supplements, with a considerable proportion of athletes engaging in self-prescription and purchase without consulting an accredited professional. Additionally, a considerable proportion of athletes are unaware of the health risks that sports supplements may generate, which exposes them to possible adverse effects. Urgent nutritional education and consulting should be made available to athletes and coaches, emphasizing the role of the nutritionist, sport scientists, and the acute and long-term side effects of incorrect plans of supplementation.

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