Evaluating the Use of Dietary Supplements to Improve Physical and Sports Performance - Survey Study

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Abstract

Background/Objectives: Dietary supplements (DS) use among athletes to enhance endurance, strength and muscle recovery is a complex issue influenced by factors such as sport type, individual goals, access to nutritional information, and nutrition trends, with higher prevalence among elite performers. Despite their growing popularity and benign perception, scientific evidence regarding the safety, quality, and efficacy of DS remains insufficient. Therefore, the objective of the current study was to assess Romanian athletes' awareness and consumption behaviours, as well as potential adverse effects associated with DS use. Methods: We designed a survey to examine correlations between athletes' age, background, gender, supplement types and usage frequency, and reported adverse reactions. Statistical analysis was used to reveal relevant correlations among the examined variables, providing insight into usage patterns. Results: The results highlight a high prevalence of DS consumption among young people and frequent reports of adverse reactions. Conclusion: Thus, educational interventions become essential to reduce potentially risky self-medication. The study revealed also the effectiveness of questionnaires as data collection tool among both amateur and competitive athletes, facilitating data-driven insights for enhancing athletic performance, promoting balanced lifestyles, and informing evidence-based guidance regarding the consumption of DS for both athletes and regulators.

Keywords: dietary supplements; enhancing sport performance; survey study

INTRODUCTION

Beyond structured training and tailored sports nutrition plans, athletes actively incorporate specific supplements to optimize their performance and recovery [1, 2]. Dietary supplements intended for athletes aim to increase muscle mass, boost energy levels, and promote weight loss. Supplements can help reduce post-workout recovery time, allowing athletes to train more frequently and intensely. Among the various dietary strategies applied as ergogenic sources, particular attention is given to the use of dietary supplements considered effective, safe, and legal, which contribute to energy production, promote faster recovery, and enhance performance.

Despite their growing popularity, scientific data on the safety, quality, and efficacy of these products remains limited [3,4]. Currently, their overuse represents a widespread societal concern, particularly among athletes, with potential consequences including health complications and diminished performance [5-8]. While the effectiveness of numerous supplements continues to be debated, some may induce serious adverse effects, such as cardiovascular, renal and central nervous system effects, liver disease, and pancreatitis [9-13].

The consumption of dietary supplements by athletes poses potential risks to both their health and professional careers, especially when these products contain substances prohibited by anti-doping regulations. Athletes must maintain awareness of the regulations of anti-doping agencies such as the World Anti-Doping Agency (WADA) and are advised to seek guidance from qualified nutritionists or sports medicine professionals prior to initiating any supplementation regimen. Comprehensive education on nutrition and supplement use is critical for enabling informed decision-making. Furthermore, thorough examination of product labelling and active ingredients is essential to identify and avoid the inadvertent intake of undeclared or contaminated substances. To mitigate these risks, athletes should prioritize the use of supplements certified by recognized third-party verification programs, which ensure product integrity, safety, and compliance with established quality standards [14].

Aim and objectives

Supplement use among athletes can provide significant performance and recovery benefits, but it is essential that these products be administered with caution and an approach based on reliable information and supported by scientific evidence is indispensable for optimizing positive effects and minimizing associated risks. In order to assess the level of knowledge and the use of supplements by athletes, but also the risk of adverse reactions, we developed a survey questionnaire that correlates information on athletes' age, background, gender, types of supplements used and frequency of consumption, and reported adverse reactions to supplements. The results of this study provide guidance for the selection of products to be analytically investigated for the possible presence of adulterants.

MATERIAL AND METHODS

A survey study to assess the degree of exposure of athletes to supplement consumption and to identify the main adverse reactions experienced by consumers was conducted using Google Forms and the questionnaire was distributed in Romania. The study "Consumption of dietary supplements by athletes and the possible presence of adulterants" was conducted in accordance with the principles outlined in the Declaration of Helsinki, and the protocol (Project identification code) was approved by the Ethics Commission of the National Anti-Doping Agency (ANAD) on 30th October 2024 (Project identification code

4176). The questionnaire, distributed through ANAD, targeted Romanian athletes and data collection was carried out over a period of approximately three months.

The collection of information based on the questionnaire was carried out in compliance with the provisions of Regulation No. 679/2016 (GDPR) for EU countries for the protection of individuals with regard to the processing of personal data and the free movement of such data, with subsequent amendments and additions, in accordance with Law No. 190/2018 on the measures for the implementation of Regulation (EU) 2016/679 (the law regulating the implementation of GDPR in Romania).

Study design

The questionnaire aimed to obtain information on the types of supplements used by athletes and to assess the risk of adverse reactions in order to outline possible correlations with the presence of synthetic adulterants in such supplements.

The first section of the questionnaire was designed to positioning respondents within their social environments and to gather comprehensive socio-demographic information, including gender, age, residential setting, and level of educational attainment. This segment also aimed to assess participants' level of awareness regarding dietary supplements and to capture their perceptions of supplement use. In addition, it included specific items intended to determine whether respondents, particularly athletes, had previously consumed dietary supplements and to identify the types of supplements used. The second section of the questionnaire was administered exclusively to respondents who indicated prior or current use of dietary supplements, primarily high-performance athletes.

The objectives of the questions included in the questionnaire were the following:

- to characterize the study groups taking into account socio-demographic parameters (gender, age, residence environment, educational level)
- to define of the prevalence of consumption and its characterization (methods of consumption, type of consumption - supplement alone or in combination, age at onset of consumption, reason for use, frequency of consumption)
- to determine the level of knowledge of dietary supplements among the participating athletes (type of supplement consumed, information, accessibility, awareness of risks)
- to identify the effects desired by the users (increased energy, weight loss, increased muscle mass, increased self-confidence) when consuming these supplements and the adverse effects experienced after consumption.

The adverse effects observed were categorized according to the physiological systems affected:

- cardiac effects: palpitations, accelerated heart rate, chest pain, bradycardia, sympathomimetic toxidrome: tachycardia, hypertension
- otorhinolaryngological effects: xerostomia, epistaxis, nose pain, oropharyngeal pain, tinnitus
- gastrointestinal effects: abdominal pain, anorexia, nausea, vomiting, diarrhoea, constipation, flatulence, cramps
- musculoskeletal effects: musculoskeletal pain, muscle cramps, changes in extremities (coldness, discoloration, numbness, tingling, tingling, numbness)
- neurological effects: bruxism, vertigo, headache, fainting, blurred vision, memory loss, tremor, convulsions
- psychological effects: agitation, anxiety, depression, fatigue, tiredness, drowsiness, poor concentration, dysphoria, increased energy
- pulmonary: shortness of breath, cough
- other: heavy sweating, insomnia, nightmares, skin rashes

The questionnaire was designed to analyse several aspects, including: consumption pattern (use of a single supplement or combination of several products); the effects that athletes experience when using these supplements; and possible side effects experienced as a result of consumption.

The questionnaire was administered online via the Google Forms platform and was accessed by athletes affiliated with national sports organizations, as well as individuals engaged in training at fitness centres, through a dedicated hyperlink or QR code.

Statistical data analysis was performed using Microsoft Excel version 2108. For each item in the questionnaire, the total number of responses was quantified and also expressed as a percentage (%). In order to analyse the correlations between the variables studied among athletes who consume dietary supplements, two statistical tests were used: the chi-square test and Pearson's correlation coefficient.

Chi-square test

The chi-square test was used to assess the relationship between the athletes' background (urban or rural) or level of education and supplement consumption, ease of obtaining supplements and awareness of possible risks. The relationship between variables is described using Chi-square test of independence, expressed as X^2 (DF = degrees of freedom, N = sample size) = chi-square statistic value, p = p-value. We compared the estimated value with the critical value in the chi-square table for a given significance level (usually 0.05).

Pearson correlation test

The Pearson correlation test, expressed as r (degrees of freedom) = r static, p = p-value, was applied to check the correlation between different parameters. Pearson's correlation coefficient measures the strength and direction of the relationship between two variables. The correlation coefficient varies between -1 and 1. A value close to 1 indicates a positive correlation, while a value close to -1 indicates a negative correlation. The Pearson test result is significant at p values < 0,05.

RESULTS

Characterization of the study group based on socio-demographic parameters

The research encompassed a cohort of 87 individuals actively engaged in sports activities. A socio-demographic assessment of the participant group revealed a pronounced predominance of female representation, accounting for 68.96% of the total sample.

The living environment can facilitate or, conversely, hinder both access to information and access to supplements. In this regard, the majority of responses were obtained from subjects residing in urban areas, accounting for 80% of the total sample.

Regarding the age distribution, as illustrated in Figure 1, the dominant age group consisted of individuals between 14 and 20 years old, representing 55.17% of the research participants. This was followed by 25.30% aged between 21 and 30 years, 10.34% under the age of 14, 4.59% between 31 and 40 years, and only 2.3% of participants aged between 40 and 50 years and over 50 years, respectively.

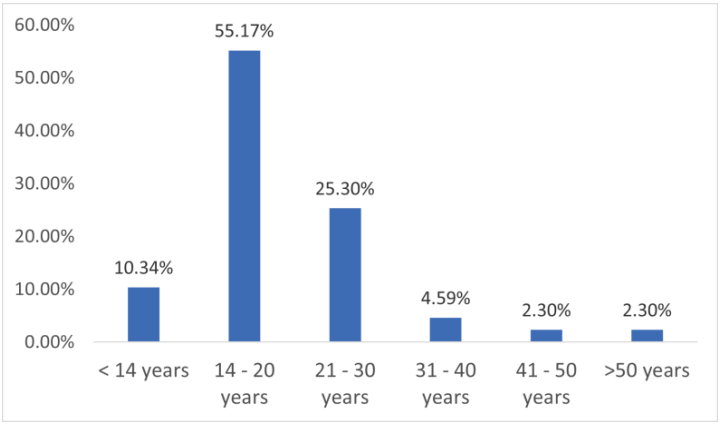

Figure 1. Demographic distribution by age among study participants

In terms of educational status, the majority of participants within the study group had completed high school, accounting for 44.2% of the sample. University graduates represented 30.8% of the group, while 15.4% had attained secondary school education. Participants with only primary education comprised 9.6% of the total, as illustrated in Figure 2.

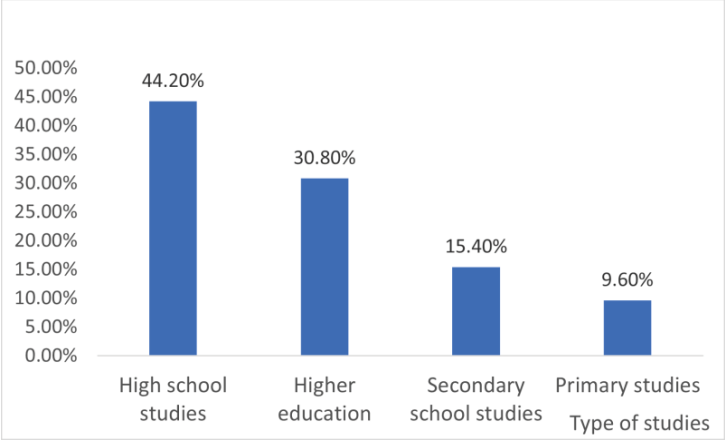

Figure 2. Demographic distribution by education level among study participants

Definition and characterization of consumption prevalence

Responses to the items addressing the definition of prevalence and the characterization of consumption indicated that the majority of athletes reported using dietary supplements, with a prevalence rate of 79.32%.

The majority of individuals reported initiating supplement use between the ages of 14 and 18, accounting for 71.4% of the respondents.

More than half of the respondents (58.1%) reported consuming a single dietary supplement. Among those who consume multiple supplements, 97.3% indicated that they do not associate their supplement use with steroids or hormonal substances.

The majority of supplement users (68.2%) reported learning about these products through interpersonal sources, including friends, colleagues, and family members. An additional 25% acquired information via online platforms, while the remaining 6.8% cited mass media or published literature as their primary sources.

Consumption patterns among users are predominantly motivated by the pursuit of rapid physical results and improved endurance during training, as indicated by 86.20% of

respondents. As illustrated in Figure 3, curiosity accounts for 12.07% of reported motivations, while 1.73% attribute their behaviour to external influences, such as mass media exposure.

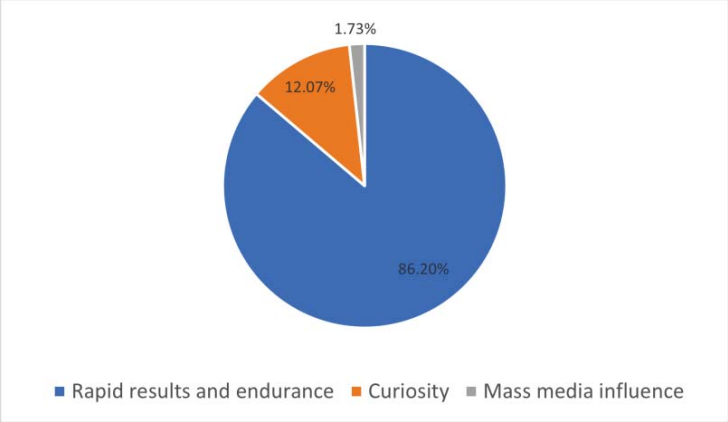

Figure 3. Distribution of study participants based on their stated reason for consumption

Capsules constitute the most frequently utilized dosage form, reported by 50% of respondents. Additional orally administered formats include powders for suspension, oral solutions (commonly referred to as 'shots'), and tablets. Regarding consumption frequency, approximately two-thirds of users indicate intake occurring one to two times per week.

Assessment of athletes' knowledge regarding dietary supplements

Based on the responses provided regarding the types of supplements consumed, sources of information, ease of access, and awareness of potential risks, the following findings were identified: the most frequently used supplements are those containing vitamins and minerals, representing 74.57% of users, amino acid and protein-based supplements are consumed by 30.50% of respondents, creatine-based supplements are used by 13.55% of participants, as illustrated in Figure 4.

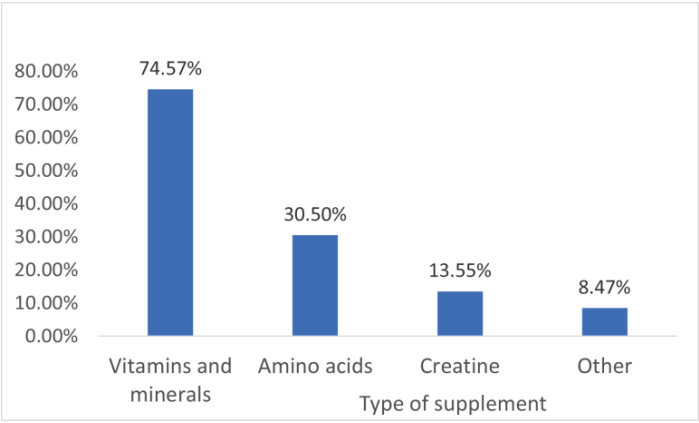

Figure 4. Distribution of study participants based on the type of supplement used

A significant majority (84.1%) report that supplements are easily accessible. Notably, 69.6% of respondents lack awareness regarding the potential risks associated with dietary supplement use, as illustrated in figure 5.

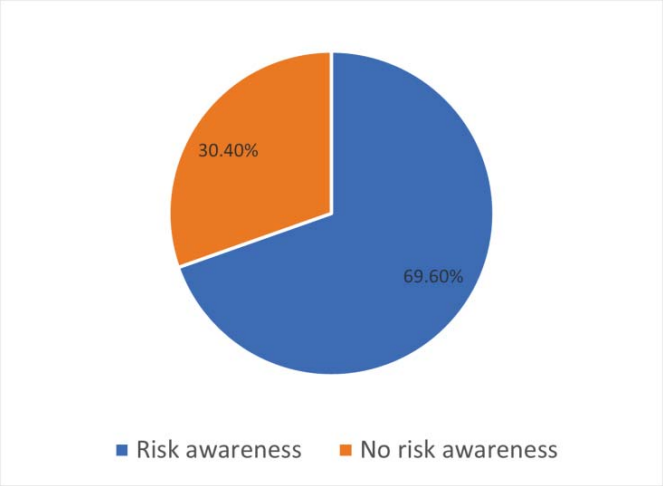

Figure 5. Distribution of study participants based on the awareness of the potential risks associated with dietary supplement use

Characterization of the study group based on desired effects and adverse reactions

Regarding the users' desired effects (as indicated by affirmative responses to questions concerning each type of effect), over half (60.5%) reported increased energy, while 51% indicated muscle mass gain. Enhanced self-confidence was reported by 38.1% of users and weight loss was cited by a smaller proportion (14%). The timeframe for achieving these effects (e.g., increased muscle mass and weight loss) was most frequently reported to be between one and three months, according to 64.7% of respondents (Figure 6).

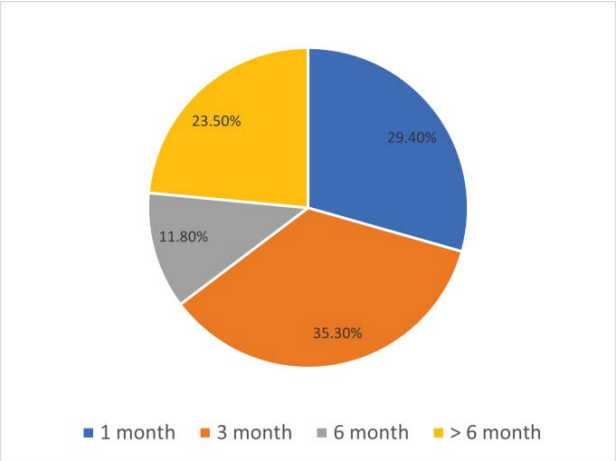

Figure 6. Distribution of study participants based on the time required to achieve the effect of the dietary supplement use (weight loss and muscle mass gain)

The characterization of the study group based on the reported adverse effects reveals that, at the cardiovascular level, palpitations and increased heart rate predominated (48.1%).

At the respiratory level, the most frequently reported effects were coughing reported by 63.5% of consumers and shortness of breath reported by 36.5% of the consumers.

The predominant ENT (ear, nose, and throat) related effects were xerostomia, reported by almost 75% of users, and tinnitus reported by 9.06% of users as shown in figure 7.

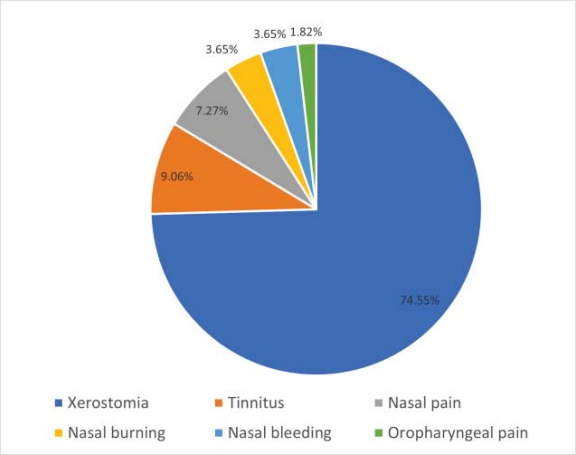

Figure 7. Distribution of study participants based on the adverse reactions in the ENT area

At the gastrointestinal level, the most common reactions were abdominal pain (30.8%) and anorexia (26.9%) as shown in figure 8.

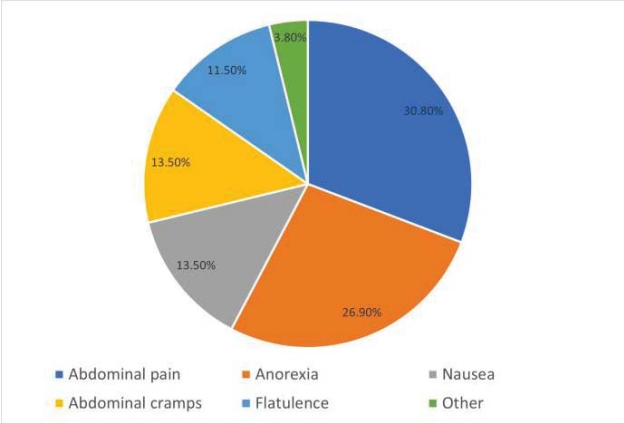

Figure 8. Distribution of study participants based on the gastrointestinal adverse reactions

The most frequently reported muscular effects included musculoskeletal pain (30.8%), numbness (25%), and muscle cramps (19.2%).

Among neurological effects, headache was the most commonly reported (55.8% of users), followed by hearing impairment (21.2%) and bruxism (9.6%) as shown in figure 9.

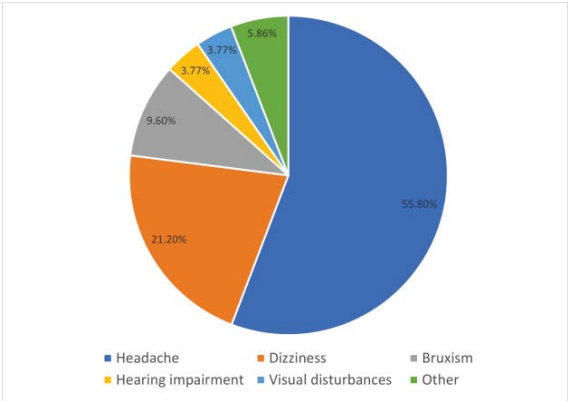

Figure 9. Distribution of study participants based on the neurological adverse reactions

The most frequent psychological effects were agitation (21% of consumers) and increased energy (15.4%). Within the category of other effects, the most commonly cited were excessive sweating (33% of users) and insomnia (17.6%).

Statistical analysis of the data

Chi-square test

Correlation of background (rural/urban) with dietary supplement consumption (question "Have you ever consumed dietary supplements?"). The Chi-square test, X^2 (1, 83) = 0.3446, p = 0.557209 indicates no statistically significant difference between rural and urban respondents in terms of the consumption of food supplements.

Correlation of background (rural/urban) with easiness of obtaining food supplements (question "Was it easy for you to get them?"). The Chi-square test, X^2 (1, 65) = 0.0577, p = 0.810223, indicates no statistically significant difference between rural and urban respondents in terms of how easy they find it to acquire dietary supplements. This can be explained by the type of supplements used, mainly from the vitamin and mineral category.

Correlation of background (rural/urban) with the awareness of possible risks (question "Did you know before taking supplements for the first time that they can cause serious health problems?"). The Chi-square test, X^2 (1, 70) = 3.6296, p = 0.056759, indicates no statistically significant difference between rural and urban respondents in terms of awareness of possible risks associated with the consumption of supplements, even though the result is borderline statistically significant.

Correlation of educational attainment (primary/secondary/high school/higher education) with Consumption of food supplements (question "Have you ever consumed food supplements?"). The Chi-square test, X^2 (3, 86) = 8.4853, p = 0.036977 indicates a statistically significant difference ($p < 0.05$) between different educational attainment of respondents in terms of the consumption of food supplements as the null hypothesis that there are no statistical differences between the categories of respondents in terms of dietary supplement consumption is rejected. According to the obtained results, the group of respondents with primary education (Chi-square contribution 1.72) have a predilection to use dietary supplements more frequently.

Correlation of educational attainment (primary/secondary/high school/higher education) with the easiness of obtaining dietary supplements (question "Did you find it easy to get them?"). The Chi-square test, X^2 (2, 59) = 2.5761, p = 0.275801 indicates no statistically significant difference between different educational attainment of respondents in terms of the easiness of obtaining dietary supplements. As no responses were obtained for the "no" option among secondary school graduates, these values were excluded from the analysis.

Correlation of educational attainment (primary/secondary/high school/higher education) with the awareness of possible risks associated with the consumption of dietary supplements (question "Did you know before taking supplements for the first time that they can cause serious health problems?"). The Chi-square test, X^2 (3, 73) = 2.5634, p = 0.463933 indicates no statistically significant difference between different educational attainment of respondents in terms of the awareness of possible risks associated with the consumption of dietary supplements. As no responses were obtained for the "no" option among secondary school graduates, these values were excluded from the analysis.

Pearson test

Correlation of the intake of creatine supplements or amino acid products with time required to achieve the effect of the dietary supplement use (weight loss and muscle mass gain) was assessed. The Pearson test, *R (17) = -0.539, p-value = 0.017251* indicates a moderate negative correlation. Thus, consumption of amino acid products correlates with a shorter time to desired effects (weight loss and muscle gain).

Correlation of the observed time to weight loss with frequency of use per week was assessed. The Pearson test, *R(48) = -0.1641, p-value = 0.2551* indicates a very weak negative correlation. Considering only the responses received from consumers of creatine / amino acid products, the obtained results *R(17) = -0.1278, p-value = 0.604386* showed a very weak negative correlation. We conclude that there is virtually no statistically significant correlation between the observed time to weight loss and frequency of use per week, regardless of the dietary supplement consumed.

Correlation of the reported headache with frequency of use per week was assessed. The Pearson test, *R(59) = -0.086, p-value = 0.53999957* indicates a very weak negative correlation. We conclude that there is no statistically significant correlation between headache onset and frequency of use per week, regardless of the dietary supplement consumed.

Correlation of the headache as neurological adverse reactions with dry mouth as ENT adverse reaction was assessed. The Pearson test, *R(85) = 0.4293, p-value 0.000033* indicates a positive and highly statistically significant correlation between the occurrence of headache (neurologic adverse effect) and dry mouth (ENT adverse effect). It is possible that these are adverse reactions of the same type of supplement, also suggesting potential adulteration.

DISCUSSIONS

The rising trend of supplement overuse among athlete, particularly youth athlete, is a growing concern. Although supplements can support athletic performance when used responsibly, excessive or improper intake may pose health risks and potentially impair rather than enhance results.

In this context, the study investigates athletes' awareness and consumption of dietary supplements, along with the potential risk of adverse effects. To achieve this, a questionnaire-based survey was carried out among athletes in Romania. The questionnaire compiled a variety of data, including socio-demographic characteristics, types of supplements used, consumption frequency, and any adverse reactions experienced by users following administration.

The results indicate a high percentage of supplement users (approximately 80%) and a greater prevalence of consumption among young athletes, in a group 14 – 20 years old (55%). The primary reason for supplement use is to achieve rapid results and performance and to increase the endurance. These findings are consistent with data previously published in the literature. Numerous studies report a relatively high prevalence of dietary supplement use among athletic populations [15]. Thus, a study conducted in Hungary revealed that a considerable percentage of adolescent recreational athletes use dietary supplements, primarily aiming to enhance their athletic performance [16]. Additionally, another study found a significant proportion of fitness athletes in Kashan gyms (57.9%) reported using dietary supplements [2]. The primary motivations for supplement use were to accelerate muscle repair after exercise (69.5%) and to improve overall performance (41.8%). Among a group of 164 young German elite athletes, aged between 10 and 25 years, dietary supplement use was estimated at 80% [17].

The global market for dietary supplements continues to expand not only in sales volume but also in the diversity of products offered to consumers. This growth is especially pronounced among gym-users and athletes, who exhibit a notably high rate of supplement use. Published literature consistently highlighted this trend, revealing that elite athletes tend to consume supplements more frequently than their non-elite peers [18]. However, the appeal of dietary supplements is rapidly spreading beyond the professional sphere, with increasing popularity among the general population—including gym users who may lack adequate knowledge about these products. A systematic review study also revealed a high rate of

supplement use among gym-users, with the internet and media serving as the primary sources of information [19]. The most commonly cited reason for taking supplements was to improve overall health, while protein supplements emerged as the most frequently used type.

The socio-demographic analysis of the study group indicated a predominance of female participants (68.96%), which may be linked to a greater willingness to engage with the questionnaire. However, certain studies report a higher prevalence of supplements use among female athletes [20, 21].

Regarding supplement types, our study found that products containing vitamins and minerals were the most frequently consumed, with 74.57% of participants reporting their use. Amino acid and protein-based supplements were used by 30.50% of individuals, while 13.55% reported using supplements containing creatine. These findings align with existing literature, which also identifies vitamin C, vitamin D, omega-3 fatty acids, whey protein, and L-carnitine as among the most commonly used supplements [2, 16].

In terms of awareness of the risks associated with supplement use, the majority of users stated that they were not familiar with these risks. Thus, the findings are consistent with other data published in the literature. A recent study revealed that more than 60% of users are unaware of the risks or believe that dietary supplements have no adverse effects [2].

Regarding reported adverse effects, these were most frequently observed in the ENT (ear, nose, and throat) area, such as dry mouth reported by 75% of users. Gastrointestinal symptoms included abdominal pain and anorexia (57.7%), which would signal an anorexigenic effect associated with possible adulteration. Neurological effects such as headache and dizziness were also mentioned, along with psychological responses like agitation or increased energy levels.

Literature data associate the use of creatine with minor side effects such as gastrointestinal discomfort; skin rashes, and headaches were occasionally reported. However, due to limited long-term data, the potential effects of extended creatine use remain unclear [22, 23].

Statistical analysis revealed that the consumption of amino acid and protein products correlates with a shorter time to desired effects (weight loss and muscle gain). Amino acids and proteins are essential components for optimal athletic performance and recovery. As fundamental building blocks of proteins, amino acids—along with proteins—play a key role in supporting muscle repair, facilitating growth, and maintaining overall health. Amino acids play a fundamental role in repairing muscle tissue that is stressed or damaged during physical activity, while also supporting the development of new muscle mass [24-26].

A strong and statistically significant positive correlation was observed between the incidence of headache and dry mouth. This relationship may indicate that both symptoms are adverse reactions associated with the same type of supplement, potentially pointing to issues of adulteration. One notable example is sibutramine—an anorectic agent withdrawn from the market due to its association with increased adverse events in individuals with cardiovascular conditions. Known side effects of sibutramine include headache, dry mouth, constipation, and insomnia. Numerous studies have documented its presence as an adulterant in dietary supplements marketed to athletes [14, 27-29].

CONCLUSIONS

This research highlights the utility of questionnaires as an effective method for data collection among both amateur and professional athletes. These instruments demonstrated notable advantages, including ease of access, simplicity in completion, and their capacity to rapidly yield substantial volumes of structured data suitable for research purposes. The results highlight a high prevalence of dietary supplement consumption among young people,

often without prior medical consultation. Although the general perception of the desired effects is predominantly positive, adverse reactions are frequently reported and require a responsible approach. Furthermore, the resulting data offer suggestion for issuing recommendations to athletes and governing bodies regarding the appropriate use of dietary supplements. The findings of the study highlight a need to enhance awareness and educational efforts regarding dietary supplement use, particularly among young athletes. Encouraging informed decision-making, fostering an understanding of balanced nutrition, and advocating for professional guidance can significantly reduce the risks linked to supplement consumption and promote safer, more responsible habits within the vulnerable age groups.

Conflicts of Interest

The author declares no conflict of interest.

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