

AN ASSESSMENT OF THE CONSUMPTION OF DIETARY SUPPLEMENTS BY PLAYERS OF SELECTED SPORTS

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Abstract

Introduction. Increasing interest in dietary supplements designed for athletes is accompanied by an increase in the number of commercial vendors offering a broad range of dietary supplements. It is also followed by phenomenon of wide availability and as a consequence universality of application of this group of preparations. The goal of this research project was to assess the use of dietary supplements by players of selected sports with consideration given to sex, age, education, level of physical activity and training experience. **Material and methods.** The study was conducted using the diagnostic survey method with the aid of a survey written by the authors themselves. The study population consisted of 216 athletes (100 powerlifters and 116 volleyball players) ages 16÷30. Statistical analysis of empirical material was conducted on the basis of an χ^2 test ($p \leq 0.05$ or higher). **Results.** A clear majority of subjects claimed to be convinced that diet and dietary supplementation exerted an important influence on their athletic performance. Despite giving their own diet a favorable assessment, more than 95% of respondents reported having difficulty following the diet, while simultaneously reporting the causes of this difficulty. The subjects rated their knowledge of how diet and supplementation enhance athletic performance as either average or very good. Their primary sources of knowledge on this subject were: the Internet, periodicals and promotional materials. The role of trainers, dieticians and physiologists was relatively insignificant. Around 64% of subjects reported general use of dietary supplements, while 72.7% claimed dietary supplementation to have a positive influence on their fitness and efficiency. The popularity of supplement use depended on the character of the athletic discipline. The most frequently used supplements were, in order of popularity: vitamin and mineral preparations, creatine, carbohydrate and protein supplements, BCAA and caffeine. The subjects were convinced that supplements for athletes, despite the various contraindications concerning their use and the presence of substances banned in certain sports, are not harmful to their health. **Conclusion.** Use of dietary supplements by athletes is universal and depends on the type of sport played.

Key words: diet, dietary supplements, ergogenic nutrition

Introduction

Dietary practices have long been known to play an important role in an athlete's training and have frequently served as the subject of scientific studies and debates. These practices can have both a positive and a negative influence on an organism's physical fitness and efficiency [1]. It is well known that a properly balanced diet is one of the key elements in optimizing the effects of training, thus leading to satisfactory athletic performance [2]. Contemporary athletic competition is characterized by a very heavy physical and emotional training burden, and at the same time by a high level of metabolic activity. These conditions lead to an increased need for energy and various dietary elements that are difficult to obtain in situations where the athlete has limited options for increasing the size of his or her dietary intake. These needs are manifold and depend on the requirements of the athletic discipline in question, as well as on the intensity and duration of physical exertion [3, 4, 5]. The optimal solution is to provide supplements whose ingredients are tailored to meet the specific needs of the organism. A special group of such ingredients consists of ergogenic dietary supplements. These stimulate energy production and lead to the development of muscle mass and strength, while also supporting

physical and psychological efficiency. Furthermore, they counterbalance the excessive strain and exertion demanded of the athlete's body [3]. Recent years have seen an intensive expansion of dietary supplements and increased interest in a broad range of products. This also applies to supplements intended for athletes. Because these supplements are universally available and heavily marketed they are used by all and sundry [6, 7]. It can be taken for granted that supplements have become an integral part of the dietary habits of contemporary society, especially among physically active individuals. It is believed that supplements are taken significantly more often by athletes than by people who do not play a sport. There is also information indicating that Poland is among the leading consumers of this type of dietary aid [8]. The increasing availability of these types of preparations has not been accompanied by a comparable level of awareness and knowledge regarding indications and contraindications or hazards involved in their use. Numerous groups of researchers have raised the question of education within this scope [1, 9, 10, 11, 12]. The goal of this research project was to assess the use of dietary supplements by players of selected sports with consideration given to sex, age, education, level of physical activity and training experience.

Material and methods

The study was conducted between 2011 and 2012 using the diagnostic survey method with the aid of a survey written by the authors themselves. It consisted entirely of closed-ended questions that allowed respondents to choose one to three answers. The introduction consisted of questions concerning the profile of the respondent, including age, sex, level of education and physical activity, as well as training time and experience. The main body of the questionnaire consisted of questions concerning dietary habits, including supplementation strategies over the past three months. It also included questions concerning general knowledge about supplementation and the potential benefits and health risks associated with their use.

The study population consisted of 216 powerlifters (100 men between the ages of 21÷30) and volleyball players (61 women and 55 men between the ages of 16÷30) still in training. The results were analyzed using the following criteria: sex, age, education level (V – vocational, H – high school, U – university), type of sport, training experience and amount of time devoted to training. Statistical analysis of empirical material was conducted on the basis of an χ^2 test ($p \leq 0.05$ or higher).

Results

The profile of the study population, including the socio-demographic profile of the athletes, their level of athletic activity and whether or not they were supplementing their diets, is presented in Table 1. The results of the study indicate that nearly two thirds of the entire study population claimed to have made use of various types of dietary supplements; furthermore, every member of this subset claimed to use more than one preparation daily. Assuming that the type of sport was a criterion that might potentially influence test results, it was concluded that almost all of the athletes (99%) involved in powerlifting reported using dietary supplements. In the group of volleyball players, a clear majority (66.4%) reported using no dietary supplements (45% of women, 55% of men). The small group of volleyball players that did use supplements ($n=39$) consisted of 67% women and 33% men. It was also noted that an athlete's sex, age and educational level exerted a significant ($p < 0.001$) influence on their supplementation procedure. The group that most frequently used dietary supplements consisted of men (72.3%) and athletes ages 21÷25 (86.6%), while women (42.6%) and the youngest athletes (27.7%) were the least likely to resort to supplementation. A higher level of education corresponded to increased use of supplements ($p < 0.001$). Another important difference ($p < 0.05$) was identified in connection with the criterion of training experience, with longer training periods resulting in increased interest in supplementation. A connection ($p < 0.01$) was also discovered between how a person assessed their own diet and whether or not they used supplements. The largest group of supplement users consisted of athletes who gave their dietary methods a high rating. Daily training times did not have a significant influence on the use of supplementation practices (Tab. 1).

Table 1. Socio-demographic characteristics of the study population, including athletes' supplement use and athletic activity

	Percentage of subject (n=216)	Percentage of subjects using supplements (n=138)	p*
Total	100	63.9	
Sex			
F	28.2	42.6	< 0.001
M	71.8	72.3	
Age (years)			
16÷20	30.1	27.7	< 0.001
21÷25	58.8	86.6	
26÷30	11.1	41.7	
Education			
Vocational	23.2	30.0	< 0.001
High school	43.5	65.9	
University	33.3	84.7	
Sport			
Powerlifting	46.3	99.0	< 0.001
Volleyball	53.7	33.6	
Training experience (years)			
< 2	19.9	46.5	< 0.05
2÷5	60.7	67.2	
> 5	19.4	71.4	
Daily training duration (h)			
0,5÷2	50.0	66.7	> 0.05
2÷4	50.0	61.1	
Training days per week			
1÷3	9.3	40.0	< 0.01
3÷4	29.6	73.4	
4÷5	21.8	48.9	
5÷6	39.3	70.6	
Self-assessment of diet			
Very good	7.4	31.2	< 0,01
Good	64.4	71.9	
Average	24.1	53.8	
Poor	2.3	60.0	
No opinion	1.8	50.0	

* p – statistical significance

The recommended and healthiest means to ensure an athlete receives the optimal quantity of nutritional elements is a well balanced diet adapted to training requirements combined with proper dietary practices. When asked whether dietary habits can influence athletic performance, most respondents (57.9%) said yes, 27.3% said probably, 4.6% said probably not, while 10.2% had no opinion on the subject. None of the subjects flatly denied the existence of a connection between dietary practices and athletic performance. Powerlifters were more convinced that such a connection existed. The distribution of answers provided by the athletes differed significantly ($p < 0.001$) for each of the criteria used to differentiate among the study population (Tab. 2). The only criterion that failed to exhibit this level of differentiation was the distinction between male and female volleyball players.

Table 2. Athletes' self-assessment of their dietary practices and their opinion on whether diet affects athletic performance [%]

	Dietary practices					p*	Does diet influence athletic performance?					p*
	very good	good	average	poor	no opinion		YES	probably	no opinion	probably NOT	NO	
Total	7.4	64.4	24.1	2.3	1.9		57.9	27.3	10.2	4.6	0	
Sex												
F	11.5	44.3	37.7	3.3	3.3	< 0.01	31.1	45.9	16.4	6.6	0	< 0.001
M	5.8	72.3	18.7	1.9	1.3		68.4	20.0	7.7	3.9	0	
Age (years)												
16 ÷ 20	15.4	53.8	26.2	3.1	1.5	< 0.01	32.3	36.9	16.9	13.8	0	< 0.001
21 ÷ 25	3.1	72.4	19.7	2.4	2.4		78.0	17.3	3.9	0.8	0	
26 ÷ 30	8.3	50.0	41.7	0	0		20.8	54.2	25.0	0	0	
Education												
Vocational	12.0	52.0	28.0	4.0	4.0	> 0.05	34.0	32.0	20.0	14.0	0	< 0.001
High school	9.6	70.2	17.0	1.1	2.1		60.6	26.6	9.6	3.2	0	
University	1.4	65.3	30.6	2.8	0		70.8	25.0	4.2	0	0	
Sport												
Powerlifting	0	83.0	17.0	0	0	< 0.001	91.0	9.0	0	0	0	< 0.001
Volleyball	13.8	48.3	30.2	4.3	3.4		29.3	43.1	19.0	8.6	0	
Training experience (years)												
< 2	9.3	53.5	30.2	4.7	2.3	> 0.05	27.9	44.2	23.3	4.7	0	< 0.001
2 ÷ 5	6.9	67.2	22.1	2.3	1.5		62.6	24.4	8.4	4.6	0	
> 5	7.1	66.7	23.8	0	2.4		73.8	19.0	2.4	4.8	0	
Daily training duration (h)												
0,5 ÷ 2	3.7	69.4	21.3	2.8	2.8	> 0.05	70.4	15.7	11.1	2.8	0	< 0.001
2 ÷ 4	11.1	59.3	26.9	1.9	0.9		45.4	38.9	9.3	6.5	0	
Self-assessment of diet												
1 ÷ 3	0	50.0	35.0	15.0	0	< 0.05	20.0	25.0	40.0	15.0	0	< 0.001
3 ÷ 4	6.3	57.8	31.3	0	4.7		56.3	37.5	6.3	0	0	
4 ÷ 5	8.5	76.6	12.8	0	2.1		66.0	14.9	12.8	6.4	0	
5 ÷ 6	9.4	65.9	22.4	2.4	0		63.5	27.1	4.7	4.7	0	

* p – statistical significance

Most respondents assessed their own dietary practices as good (64.4%) to average (24.1%), while 7.4% (volleyball players) assessed theirs as very good. The remaining respondents reported having poor dietary practices (2.3%) or were unable to assess their own dietary practices (1.9%). Variables that exerted a significant influence on self-assessment of dietary practices were: type of sport ($p < 0.001$), the athletes' sex and age ($p < 0.01$) and the number of training days per week ($p < 0.05$) (Tab. 2). The main reasons given for difficulties in following dietary principles were the pursuit of a very active lifestyle leaving little time for planning and preparing meals (47.7%), limited financial means (45.3%), lack of cooking skills (42.6%) and lack of knowledge within this scope (25.1%). An overwhelming majority of athletes (97.7%) did not follow diets prescribed by dietitians or nutritional specialists.

When asked to assess their knowledge of supplements and indications for their use, most of the respondents (59.7%) rated their knowledge as very good, while the remaining 40.3% rated their knowledge as "average". The only factor to significantly influence athletes' self-assessment ($p < 0.001$) was training experience. Athletes with more training experience exhibited higher self-assessments. The remaining criteria did not exert a significant influence on the athletes' assessment of their knowledge of supplementation (Tab. 3). However, the sex of the respondent within the group of volleyball players ($p < 0.05$) was seen to influence self-assessment of knowledge regarding supplementation and indications concerning the use of supplements.

Women as a whole rated their knowledge considerably higher than men in this area.

Use of dietary supplements by the group of powerlifters was accompanied by a firm conviction that the preparations had a positive influence on their health, on increased efficiency and endurance and on minimizing tiredness. 72.7% of respondents reported that dietary supplementation had a positive influence on physical fitness and efficiency. Analysis of the results of the study indicated that the factors exerting a significant ($p < 0.001$) influence on whether a respondent reported their supplementation strategy as correct and effective were age, education level, type of sport, and training experience. Athletes who reported gaining many benefits from supplementation were mainly: powerlifters (99%), people between the ages of 21 ÷ 25 (92.1%), those with a college education (88.9%) and those who had been training the longest (81.0%). Furthermore, variables that significantly ($p < 0.01$) influenced the distribution of athletes' assessment of the potential influence of supplements on their psychophysical parameters were: sex and number of training days per week. The number of training hours per day did not have a statistically significant influence on the distribution of answers within this scope (Tab. 3). Opinions among volleyball players were highly divided. The sex of a volleyball player using supplements did not have a noteworthy influence on his or her assessment of the role of supplementation in the functioning of the human body. These results can be taken to indicate targeted use of supplements by the group of athletes in question.

Table 3. Athlete's self assessment of their knowledge regarding dietary supplements and their opinion on whether supplementation positively affects the body, including their awareness of potential contraindications regarding supplement use [%]

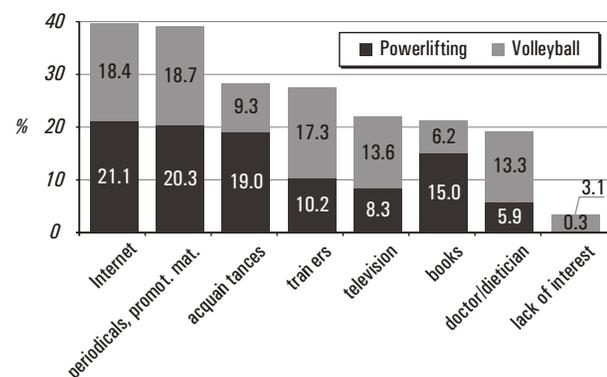
	Knowledge on the subject of supplements		p*	Positive influence of supplementation		p*	Contraindications for supplementation		p*
	average	very extensive		YES	NO		YES	NO	
Total	40.3	59.7		72.7	27.3		81.9	18.1	
Sex									
F	31.1	68.9	> 0.5	59.0	41.0	< 0.01	91.8	8.2	< 0.05
M	43.9	56.1		78.1	21.9		78.1	21.9	
Age (years)									
16÷20	46.1	53.9	> 0.5	44.6	55.4	< 0.001	83.1	16.9	> 0.05
21÷25	35.4	64.6		92.1	7.9		81.1	18.9	
26÷30	50.0	50.0		45.8	54.2		83.3	16.7	
Education									
Vocational	42.0	58.0	> 0.5	44.0	56.0	< 0.001	88.0	12.0	< 0.01
High school	44.4	55.6		75.5	24.5		71.3	28.7	
University	30.6	69.4		88.9	11.1		91.7	8.3	
Sport									
Powerlifting	41.0	59.0	> 0.5	99.0	1.0	< 0.001	81.0	19.0	> 0.05
Volleyball	39.6	60.4		50.0	50.0		82.8	17.2	
Training experience (years)									
< 2	51.2	48.8	< 0.001	48.8	51.2	< 0.001	81.4	18.6	> 0.05
2÷5	45.0	55.0		77.9	22.1		78.6	21.4	
> 5	14.3	85.7		81.0	19.0		92.9	7.1	
Daily training duration (h)									
0,5÷2	40.7	59.3	> 0.5	76.9	23.1	> 0.05	75.0	25.0	< 0.01
2÷4	39.8	60.2		68.5	31.5		88.9	11.1	
Self-assessment of diet									
1÷3	30.0	70.0	> 0.5	45.0	55.0	< 0.01	80.0	20.0	> 0.05
3÷4	39.1	60.9		82.8	17.2		89.1	10.9	
4÷5	29.8	70.2		68.1	31.9		83.0	17.0	
5÷6	49.4	50.6		74.1	25.9		76.5	23.5	

* p – statistical significance

Awareness that supplements can negatively affect health was relatively low. As many as 90% of respondents did not recognize the existence of potential hazards arising from their use. At the same time, 81.9% of respondents recognized that supplements may have contraindications (Tab. 3), while 77.7% of respondents held that one should not make unlimited use of over-the-counter dietary supplements. Men and women in the group of volleyball players differed significantly ($p < 0.05$) on this point. The women exhibited a higher level of awareness within this scope than the men. Particular attention should be drawn to the relatively high level of awareness among respondents (88.9%) regarding the possibility of deliberate or accidental contamination of dietary supplements by harmful elements or ingredients banned by the World Anti-Doping Agency (WADA), the International Olympic Committee (IOC) or sports federations. Independent of the type of sport or criterion applied, 82.1% of all athletes reported always paying attention to the ingredients in the supplements they use, while 17.9% reported making an effort to learn more about those ingredients.

In analyzing the sources of the respondents' knowledge on dietary supplements for athletes, it was determined that the main sources, regardless of the type of sport, were the Internet, periodicals and promotional materials (Fig. 1). An important source of knowledge was acquaintances and other athletes engaged in the sport (28.3%) as well as the opinion of trainers (27.5%). Furthermore, television broadcasts, trade literature

and doctors' or dieticians' recommendations were among the least frequently used sources of knowledge on dietary supplementation. The criterion of sex was not seen to play a role in the choice of source for information on supplementation. It should be noted that a key source of knowledge was fairly unreliable and non-scientific: prevailing opinions and promotional materials.

**Figure 1.** Sources of information on supplements

The most frequently used supplemental preparations were, in order of popularity: vitamin and mineral preparations, creatine, carbohydrate/protein supplements (gainers), BCAA and caffeine and glutamine. Analysis of the use of supplements revealed significant ($p < 0.001$) differences in the range of assortments used, based on the type of sport, training experience and age. Powerlifters used, in order of popularity: creatine, carbohydrate/protein supplements, BCAA and caffeine, while volleyball players primarily used vitamin and mineral preparations, creatine and L-carnitine (Fig. 2). Male and female volleyball players exhibited no statistically significant differences with regard to supplement type.

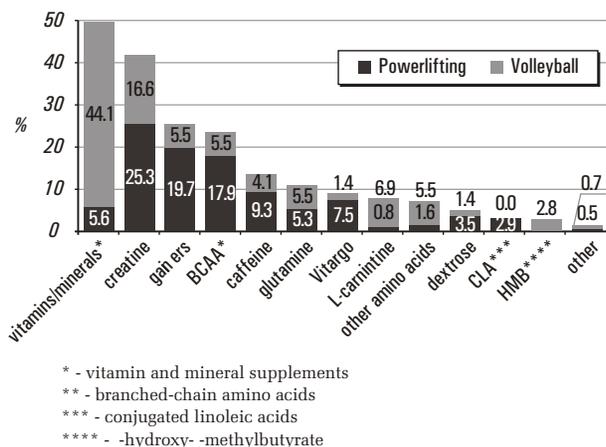


Figure 2. Dietary supplements used within the study group by sport (respondents could indicate multiple substances)

Analysis of dosage methods reported by respondents who used supplements indicated that these methods were primarily based on information contained on packaging and in materials included with the packaging by the producer (Fig. 3). A relatively large percentage (39.0 and 40.1%) of respondents from both sports declared that they used dietary supplements at their own discretion, guided primarily by their current level of experience and their desire to increase the effects of training and to maximize athletic performance. Only a small percentage (8.2 and 9.0%) deferred to a trainer's recommendations. None of the athletes consulted doctors or dieticians on how to use supplements.

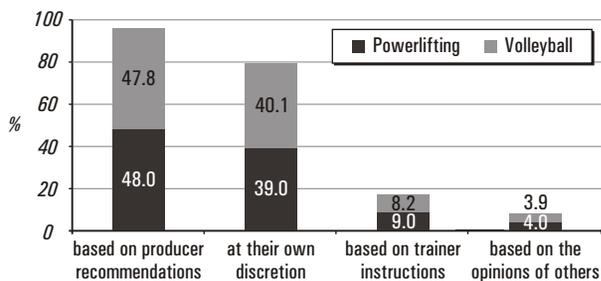


Figure 3. Supplement dosage methods used by athletes [%]

Discussion

Enhancement of the training process through diet and supplementation has become an indispensable part of contemporary athletic rivalry. In professional sports, as well as in recre-

ational forms of exercise, consideration of the increased need for energy and certain nutritional elements should constitute an elementary part of the canon of dietary practices [3, 5, 13, 14]. The results of the study have unambiguously shown that in the minds of athletes there exists a deep-seated conviction regarding the important role played by dietary practices in improving athletic performance. Furthermore, athletes' subjective self-assessment of their own dietary practices indicate that in most cases they take a positive view of these practices. Durkalec-Michalski and others [15] have also shown that athletes exhibit a high self-assessment in this scope.

This study has shown that supplementary preparations are very widely used by athletes. The structure of supplement use depended to a significant degree ($p < 0.001$) on the type of sport. Numerous studies have proven that supplement use represents a deliberate strategy, while also showing this strategy to be in widespread use depending on country and type of sport [3, 6, 9, 11, 12, 13]. It is recommended that athletes use only those supplements that have been scientifically proven to help athletes and to minimize potential side effects [7]. In keeping with this recommendation, the Australian Institute of Sport (AIS) has, on the basis of a critical analysis of scientific studies, divided supplements into groups based on these categories [16]. In this study, respondents were most interested in group A preparations, i.e. supplements whose effectiveness has been scientifically proven (vitamin and mineral preparations, creatine and caffeine) as well as carbohydrate/protein preparations (gainers) and BCAA. Numerous studies indicate a similar level of interest in this group of supplements among athletes [9, 12, 13, 17, 18]. Interest in vitamin and mineral preparations was highest in the group of volleyball players. This may be due to athletes' conviction that vitamins and minerals play an important role in numerous metabolic processes, especially under conditions of heightened physical exertion and/or when symptoms of vitamin or mineral deficiency are feared [7, 19]. Given the widespread popularity of vitamin and mineral preparations, many authors raise the question of potential health risks associated with uncontrolled overdoses of these elements [3, 7, 10, 11]. Another frequently used supplement was creatine, one of the most popular and comprehensively studied supplements. Its widespread use can be attributed to its high anabolic and ergogenic potential. It is particularly important in conditions involving large expenditures of strength and strength/speed (strength training, team sports) [16, 20, 21]. The popularity of the use of creatine among the study population resulted primarily from the desire to quickly increase strength and muscle mass. Rapid increases in muscle mass and endurance are also the main reasons the respondents, especially the powerlifters, gave to justify their frequent use of protein and carbohydrate preparations. Caffeine and BCAA were also of interest primarily to the powerlifters, while a relatively high number of volleyball players reported taking L-carnitine. An important role in the nutritional strategy pursued under conditions of increased physical exertion was played by isotonic and energy drinks [6]. Analysis of the consumption of this range of products by the study group is presented in a different paper [22].

The sources used to obtain knowledge regarding the characteristics, effects and usage of supplements varied depending on the type of sport. The results of the study obtained within this scope indicate that a key role was played by information obtained from the Internet and from promotional materials. It goes without saying that the objectivity and factual value of this information may be called into question [6, 7, 17]. Another equally disturbing sign detected in this study is the way in which athletes determine supplement dosages. Apart from following producer recommendations, many of the respondents simply used the preparations at their own discretion based on prior experience. This approach was not accompanied by an at-

tempt to first get to know what their body needs, contrary to the recommendation of many specialists within this scope [10]. The crucial role of a doctor and dietician was overlooked entirely.

Given how popular these supplements are, it should be borne in mind that optimizing the capacity for exercise and the indirect effects of training should always be based on rational and individualized dietary practices [10]. This should be a condition sine qua non for dietary support in athletics, because preparations and supplements are no substitute for a normal, balanced diet, and should only serve as an additional element whose application should be justified by the actual needs of the athlete's body [11, 23]. Due to the fact that a percentage of the study group consisted of young athletes still at the ontogenic stage, the decision to supplement the diet of these young people is of particular importance. In order to maintain good health and avoid disrupting the development process, young athletes should always consult doctors and dieticians before making decisions of this nature.

Conclusions

1. Athletes are deeply convinced that dietary practices play an important role in improving athletic performance.
2. Most of the respondents (64%) reported using supplements to help them in their sport.
3. The popularity of a given supplement preparation varied from sport to sport. Powerlifters were the most frequent users of creatine, protein/carbohydrate preparations, BCAA and caffeine, while volleyball players most frequently used vitamin and mineral preparations, creatine and L-carnitine.
4. Powerlifters obtained their information on dietary supplements primarily from: the Internet, promotional materials, periodicals and acquaintances. Volleyball players obtained this information from: the Internet, promotional materials, periodicals and trainers.
5. The low level of awareness concerning possible risks associated with improper use of supplements indicates the need for education within this scope.

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