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Differences in dietary supplements used by performance athletes and recreationally active individuals

Diferenţe în utilizarea suplimentelor alimentare de către sportivii de performanţă şi cei amatori

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Abstract

Background. Nutrition is a highly debated topic in athletes, as well as the use of dietary supplements (DS) to improve sport performance. However, a proper delimitation must be made between performance athletes (PA) and those interested in sports but who do not seek to achieve performance, recreationally active individuals (RAI), as the need for supplementing the daily diet with various proteins, carbohydrates, etc. is different.

Aims. The purpose of the study was to identify the preference for certain DS among PA members in sport clubs (active or retired athletes) and RAI.

Methods. Standardized questionnaires were distributed to 121 athletes (PA or RAI), 18-50 years old. Men (n=64) and women (n=57) answered an anonymous questionnaire containing 16 questions regarding the diets followed and the preference for certain DS.

Results. Among the study participants, only in the RAI group types of diet (ovo-lacto-vegetarian or strictly vegetarian) other than omnivore were found, PA having a mixed diet, according to their nutritional needs. Vitamins and minerals were the most commonly used DS in both categories, followed by carbohydrates. A preference for post-exercise and muscle recovery DS was identified in PA, and weight-loss DS were the most frequently used among RAI.

Conclusions. DS are used both by PA and RAI, but while PA use DS to increase their athletic performance, RAI use DS for aesthetic reasons, to improve their body image. If in the case of PA the use of DS is highly recommended for pharmacologic reasons, in the case of RAI, the use of DS is often influenced by mass-media and frequently these DS are not chosen correctly, according to the type of exercise.

Keywords: diet, dietary supplements, performance athletes, recreationally active individuals

Rezumat

Premize. Alimentaţia şi utilizarea suplimentelor alimentare pentru îmbunătăţirea performanţei sportive este un subiect extrem de controversat în literatura de specialitate. Totuşi, trebuie făcută diferenţa între sportivii de performanţă şi cei care practică sportul recreaţional în ce priveşte nevoia suplimentării dietei cu proteine, carbohidraţi, etc.

Scop. Scopul acestui studiu a fost de a identifica preferinţa pentru utilizarea unor anumite suplimente alimentare de către sportivii amatori şi cei de performanţă, legitimaţi în cluburi sportive.

Metode. Au fost distribuite 121 de chestionare standardizate sportivilor amatori şi de performanţă (activi sau retraşi din activitatea sportivă) cu vârsta cuprinsă între 18-50 de ani. La chestionarul format din 16 întrebări referitoare la dietele urmate şi utilizarea suplimentelor alimentare au răspuns sub anonimat 64 bărbaţi şi 57 femei.

Rezultate. Între participanţii la studiu, doar sportivii amatori au prezentat alte tipuri de dietă decât cea omnivoră (ovo-lacto-vegetariană sau vegetariană strictă), în timp ce sportivii de performaţă urmează o dietă echilibrată conform cerinţelor nutriţionale. Suplimentele alimentare cu vitamine şi minerale au fost cele mai utilizate de către ambele grupe de sportivi, urmate de carbohidraţi. La sportivii de performanţă a fost pusă în evidenţă preferinţa pentru suplimente alimentare pentru recuperare musculară, iar în cazul sportivilor amatori pentru suplimente alimentare şi scăderea în greutate.

Concluzii. Suplimentele alimentare sunt utilizate atât de către sportivii de performanţă, cât şi de cei amatori, dar în timp ce sportivii de performanţă le utilizează pentru îmbunătăţirea performanţei sportive, sportivii amatori le utilizează din motive estetice. Utilizarea suplimentelor alimentare este recomandată sportivilor de performanţă din motive farmacologice, iar alegerea suplimentelor alimentare de către sportivii amatori este adesea incorectă, influenţată de mass-media şi neţinând cont de tipul de efort fizic depus.

Cuvinte cheie: diete, suplimente alimentare, sportivi de performanţă, sportivi amatori

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Introduction

Nowadays, more and more people choose to change their lifestyle, dreaming of a healthier one. But we cannot speak about a healthy lifestyle without referring to sport and a balanced diet. Performance athletes (PA) and recreationally active individuals (RAI) exercise to achieve their goal (to obtain a certain physical appearance or a better performance) and often use dietary supplements (DS). There are many "specialists" who promote through the media various diets and DS to "help" them. However, there is a difference between PA and RAI when it comes to following a particular diet or using DS, a difference that starts with proper counseling. PA registered in sport clubs benefit from counseling in sports medicine and nutrition, have a balanced diet and use DS with an appropriate composition and nutrient amounts, according to personal needs.

Problems appear in the case of RAI, who, in order to achieve their goal as quickly as possible, usually related to aesthetic reasons rather than achieving performance in sport, use different DS without benefiting from an expert's advice. Unfortunately, there are many websites on the internet that recommend various DS to enhance physical performance and to help achieve that much dreamed of physical appearance. Few persons question whether these recommendations are appropriate for them and forget that the main purpose of these sites is product marketing and promotion.

Hypothesis

The selection of a certain DS must consider the energy needs correlated with the conformational type and exercise intensity. PA are usually well informed regarding the quality and content of active substances in DS, while RAI use mass media information about DS in order to achieve the desired physical appearance without knowledge of the real needs. RAI usually use weight-loss DS to get the desired results much faster.

Material and methods

The purpose of our study was to identify the differences between PA and RAI in using DS based on a 16-item questionnaire. The study was approved by the Ethical Committee of Scientific Research from the University of Medicine and Pharmacy of Târgu Mureş, Romania.

a) Place of the research. The survey was run for 3 months in gyms from Târgu Mureş city, Romania.

b) Subjects and groups

The questionnaire was completed by 121 subjects - 51 performance athletes (active or retired from sports) and 70 recreationally active individuals, aged between 18 and 50 years. The gender distribution was 53% males and 47% females.

c) Test applied

Participants were asked to fill out a questionnaire after being informed about its purpose (the use of DS among athletes). The questionnaire was anonymous and freely consented to (the decision to complete and return the survey was interpreted as an indicator of the consent to participate).

d) Data analysis

Data analysis was performed by obtaining the percentages of each response (Yes or No) using Microsoft Excel.

The differences between age categories and genders were analyzed using Kruskal-Wallis test followed by Dunn's multiple comparison test as a post hoc test. T-test was used to compare the BMI between athlete groups (PA and RAI) of the same gender. All tests were performed using Graph Pad Prism 5, differences being considered statistically significant if $p<0.05$.

Results

The first *two questions* were related to gender and age.

Age distribution among athletes differed. PA were mostly under 30 years old (61%), while RAI were aged between 30-40 years (~ 40%) or between 40-50 years (~ 30%).

Table I

Age distribution (%) by gender and the type of physical activity (PA or RAI)

Age categories	Men		Women	
	PA	RAI	PA	RAI
18-30	61	61	33	26
30-40	32	35	42	38
40-50	7	4	25	36
>50	0	0	0	0
p* (PA vs. RAI /gender)	p > 0.05		p > 0.05	

***** Kruskal-Wallis and Dunn's multiple comparison tests

There were no statistically significant differences between age groups, regardless of the variable (male PA vs. male RAI, female PA vs. female RAI).

The answers to *questions 3 and 4* (related to height and weight) were used to calculate the BMI [weight (kg)/height $(m)^2$]. The results are presented in table II as average ± SD.

Table II

Anthropometric data

Monitored parameters	Men		Women	
	PA	RAI	PA	RAI
Weight (kg)	74.25 ± 6.02	75.53 ± 10.12	56.25 ± 7.05	63.02 ± 11.03
Height (cm)	176.25 ± 4.01	175.22 ± 4.49	163.01 ± 8.21	161.51± 7.25
BMI	23.89 ± 1.75	24.59 ± 3.06	21.20 ± 2.15	24.80 ± 4.33
p*	p > 0.05		p < 0.05	

***** t-test

The BMI differences were statistically significant only between female PA and RAI.

The self-perception regarding their inclusion in one of the four weight categories (underweight, normal weight, overweight, obese) and constitutional type (ectomorph, mesomorph or endomorph) was also evaluated (*questions 5 and 6*). Most athletes considered themselves as being normal weight (85% PA and 64% RAI) and having a mesomorph (67% PA) or endomorph (43% RAI) body type. Of all participants, 17% considered themselves obese, but the inclusion in this weight category was confirmed only in 5% of the cases taking into account the BMI value.

Question 7 evaluated the number of training sessions/ week. Participants had to choose between 1, 2, 3 or more than 3 training sessions/week. Most of the PA declared

more than 3 (60%), while RAI reported one (32%) or two training sessions (27%).

The answers to *questions 8 and 9* were used to identify the type of diet followed by athletes. First (question 8), they had to choose between Yes or No to answer if they suffered from any diseases requiring a special diet. Only 2% of RAI gave an affirmative answer.

Participants were then asked to choose between different types of diet: mixed, ovo-lacto-vegetarian, strictly vegetarian or other (question 9). The results (%) are presented in Table III.

Table III

The type of diet followed by athletes (results presented as %)

Type of diet	Men		Women	
	PA	RAI	PA	RAI
Mixed	100	100	89	70
Ovo-lacto-vegetarian	0	0	11	18
Strictly vegetarian	0	0	0	12
Other	0	0	0	0

The question 10 (*Do you take dietary supplements?*) was answered by all PA with Yes, unlike the RAI group, in which 78% of men and only 29% of women reported the use of dietary supplements.

Questions 11-16 evaluated the type of dietary supplement used by athletes. They had to choose between Yes or No.

Table IV

The type of dietary supplement used according to gender and the type of physical activity (no. of affirmative answers presented as %)

Do you take…..?	Men		Women	
	PA	RAI	PA	RAI
DS containing carbohydrates	100	42	100	24
DS containing creatine, arginine, nitric oxide donors	37	56	39	9
Weight-loss DS	0	25	0	53
Vitamins and minerals	100	19	100	53
Post-exercise and muscle recovery DS	100	17	100	9
DS containing ephedrine, pseudoephedrine, L-carnitine	0	28	0	0

DS containing carbohydrates and post-exercise and muscle recovery DS were preferred especially by PA. The percentages of PA using DS containing creatine, arginine, nitric oxide donors were similar. In the case of RAI, men preferred DS containing creatine, arginine, nitric oxide donors, while women preferred vitamins and minerals. Only RAI mentioned that they used weight-loss DS, and 28% of male RAI reported the use of DS containing ephedrine, pseudoephedrine, L-carnitine.

Discussion

Most of the PA (men and women) use carbohydrates, vitamins, minerals and post-exercise and muscle recovery DS, while male RAI use carbohydrates, creatine, arginine, nitric oxide donors, ephedrine, pseudoephedrine or L-carnitine. Female RAI use mostly vitamins and minerals or DS for weight loss.

PA have a balanced diet which theoretically should ensure their daily energy expenditure, and when they use DS, these are judiciously selected according to their energy needs. For fitness programs that require a workout of 30-40 minutes/day (up to 3 days a week) without a necessary increase in caloric intake, the energy expenditure is between 1800-2400 kcal/day. In the case of medium intensity exercise (2-3 h/day, 5-6 times/week) or high intensity exercise (3-6 h/day in 1-2 workouts for 5-6 days/week), the energy needs are much higher, up to 600-1.200 kcal or more per hour during exercise (Kreider et al., 2010). Moreover, in order to prevent gastric discomfort during exercise, a meal timetable of 4-6 meals and snacks/day is recommended.

Daily nutrition of an athlete must benefit from carbohydrates and proteins, the percentage and amount of carbohydrates depending on exercise intensity and duration. In practicing sports that require aerobic exercise, the main causes of fatigue are glycogen depletion and dehydration due to long-lasting exercise (Briars et al., 2017). Almost all athletes consume before exercise a commercially prepared high carbohydrate energy bar which contains approximately 47-50 g carbohydrates that are oxidized in 50-60 minutes (as the body can oxidize 1-1.1 grams of carbohydrates/minute or about 60 grams/hour) (Kerksick et al., 2008). This is all the energy that RAI need during 1 h of exercise, and supplementary energy from the meal they eat before workout is not required. In the case of increased intensity training, the protein intake should be double than the recommended daily dose of 1.5-2.0 g/kg/day in order to maintain protein balance (Kreider et al., 2010). The quality of proteins is also very important because they are used differently in the body, DS that contain whey, colostrum, casein, milk and egg proteins being the best choice of high quality protein (van Loon, 2014). Carbohydrate supplementation improves sports performance, and carbohydrate mixtures (monosaccharides - glucose, fructose, etc. with fast absorption, or polysaccharides with long-time digestion and slow absorption) have a great importance, providing a quick but also constant effect over time.

Increased preference regarding the use of *creatine, arginine and nitric oxide donor DS* was found especially in male RAI. L-arginine is important for the ammonia detoxification of the body, through the urea cycle, but it also controls the release of several hormones such as insulin, glucagon, growth hormone (GH), prolactin and catecholamines that influence metabolism. The growth hormone is an anabolic hormone which stimulates lipolysis and reduces glucose oxidation to maintain blood glucose levels, while insulin increases glucose storage, as glycogen, in liver and muscle cells. Although all these mechanisms enhance exercise performance, there are no studies reporting that these DS could have any benefits in PA (Bescós et al., 2012). L-arginine supplementation induces an increase in capillary density during acute anaerobic exercise, but this effect disappears after exercise. During anaerobic exercise, oxygen delivery is increased through vasodilatation according to different metabolic demands. Although muscle capillary density is lower in women than in men, during training it increases more in women (Pranskunas et al., 2015).

All PA took DS containing *vitamins and minerals*.

Few studies have correlated vitamins with an ergogenic effect, but vitamin intake is important for many metabolic processes, energy generation from different endogenous substances, cell integrity and some neurological processes. Among vitamins, the most frequently used are vitamins C and E because they reduce muscle damage and, hence, shorten the regeneration time between trainings or competitions. Omega 3 fatty acids (eicosapentaenoic and docosahexaenoic acid) have an important role in anabolic processes, stimulating Leydig cells to produce testosterone, an anabolic hormone (Rowell et al., 2018).

Minerals are also important in numerous metabolic pathways as constituents of enzymes and hormones, which is why mineral supplementation improves exercise capacity. For example, iron deficiency could lead to anemia limiting work capacity, while magnesium deprivation reduces endurance performance by increasing oxygen requirements (Paulsen et al., 2014). Our study also revealed that female RAI take vitamins and minerals more often than men. Women are exercising for aesthetic reasons and most of them have a restrictive diet, so the supplementation is justified. Iron has a direct effect on sports performance by playing an important role in oxygen transport and metabolism both in PA and RAI. A decrease in the iron content of mitochondrial cytochromes influences skeletal muscle metabolic processes with decreased energy output and decreased sports performance. Frequent training increases the risk of developing iron deficiency as a result of hemolysis. Women in both groups have a higher chance of developing anemia by iron depletion as a result of the menstrual cycle. An optimal level of iron for both groups, PA and RAI, should be monitored before starting supplementation to prevent side effects caused by iron. Zinc is frequently found in DS because it has an important role in regulating metabolism and immune processes, but it also influences antioxidant enzymes, being part of the structure of *superoxide dismutase* (Nikolaidis et al., 2012).

Post-exercise and muscle recovery DS are important for athletes. The administration schedule is very important not only for improving physical performance and delaying fatigue, but also for accelerating regeneration. The right combination must be chosen according to the exercise type and exercise intensity. Protein DS are often consumed by athletes even though there are no evidence-based data on their benefits (Pasiakos et al., 2014). Restoring glycogen deposits in the muscle is essential for PA because it directly influences their results, so intake of carbohydrates immediately after training will increase glycogen synthesis (Burke et al., 2017). Fast-absorption carbohydrates with low glycemic index are recommended for quick recovery as they induce a lower insulin response; the use of a mixture of carbohydrates and proteins seems to have a greater beneficial effect but should be consumed as soon as possible after exercise (Outlaw et al., 2014). The increase in insulin sensitivity can be achieved with a mixture of leucine-phenylalanine-tyrosine-carbohydrate DS (Nakayama et al., 2018).

Only male RAI admitted that they used *ephedrine, pseudoephedrine and L-carnitine DS.* These are considered thermogenic DS and are designed to stimulate the metabolism and to promote weight loss (Tinsley et al., 2017). Because ephedrine and pseudoephedrine are monitored in competition, due to their stimulant activity, it is unlikely that PA use such substances.

PA use and mobilize fatty acid reserves in the adipose tissue much more efficiently than sedentary people, and a DS used in this regard is *L-carnitine,* which facilitates the transport of free fatty acids to mitochondria for beta-oxidation and provides a greater amount of energy than carbohydrates. In speed sports, special attention must be given to the lactic acid produced from anaerobic glycolysis causing a pH decrease both in the blood and in the muscles. For this purpose, a non-proteinogenic amino acid, beta-alanine, may be used as a DS. It must be administered a few weeks before competition to prevent pH decrease (Baguet et al., 2010). Beta-alanine increases the levels of carnosine (beta-alanyl-L-histidine) in the muscle, a dipeptide that presents a rather important buffer ability. Another way to adjust pH is to use sodium bicarbonate. Administration of these two DS provides a better buffer capacity, both intracellular (beta-alanine) and extracellular (bicarbonate) (Sale et al., 2011).

For people who practice sports only to improve their appearance, weight is an important issue. It must be considered that rapid weight loss may have dangerous physiological consequences such as dysfunctions of the immune and endocrine systems, bone decalcification, hydro-electrolyte imbalances, depression and dysfunctions of the nervous system. Dehydration during rapid weight loss should be avoided. Longer and more intense training produces free radicals that will be neutralized by the use of DS antioxidants taken by both PA and RAI. There are no experimental studies with conclusive results demonstrating that the use of antioxidants would improve sports performance. In some cases, they delay fatigue, but the effects are accompanied by a decrease in strength. The general purpose of antioxidants is to reduce oxidative stress, which influences normal enzyme activity, alters cell membranes or the structure of DNA. Administration of resveratrol reduced exercise performance in low-capacity rats; instead, those with increased capacity showed an increase in physical performance (Hart et al., 2013; Hart et al., 2014). This shows that there is an impact of genotype on diet adaptation responses.

Administering caffeine before a competition can also have a beneficial role because (it reaches a maximum plasma concentration at 30-90 minutes after ingestion) (Astley et al., 2018) it improves resistance to exercise, stimulates sensitive hormone lipase and releases fatty acids that will be used during the exercise.

Conclusions

1. DS are a controversial topic today and the effectiveness of some is not supported by scientific studies. Choosing a DS should be done with caution and taking into account the nature of the exercise (aerobic or anaerobic), its intensity and the physical fitness of the athlete.

2. PA are very attentive to their diet, which is adapted to their energy needs, but also to the type of DS used and the correct administration before, during or after exercise.

3. RAI are more interested in achieving a certain target (weight loss, muscle gain or a certain physical appearance),

often abusing of DS (including those for weight loss).

4. In order to use these DS correctly, it is necessary to consult a specialist in this area, as mass-media often provides incomplete data, promising the desired results in a short time.

Conflict of interests

There are no conflicts of interest.

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