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Nutrition and supplementation in physically active people: An overview

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***Abstract**: Nowadays, there is more and more research dealing with the nutrition of athletes and physically active people in general, and there is an increasing number of supplementation that appears in various forms. Considering the higher energy consumption, physically active people also have increased nutritional requirements. In addition to other important factors for practicing sports, such as good health and physical predisposition, adequate nutrition is a fundamental component. A well-balanced ratio of macro- and micronutrients and adequate hydration can significantly improve sports performance and play a key role in achieving the best possible results. An athlete's diet must be well planned and individually adapted based on body characteristics, tendency to gain weight or lose weight, frequency, length and intensity of training. An optimally designed nutrition program, with realistic and achievable goals, which follow well-planned training, is the basis for successful sports.*

Keywords: nutrition, supplements, macronutrients, micronutrients

1. **INTRODUCTION**

In the present, modern times, a healthy lifestyle has become imperative in society, and habits in the consumption of food and supplements have also changed. Physical activity, health and quality of life are closely related. Supplements, as the name suggests, are additions to a normal and balanced diet, and they usually contain a higher level of vitamins, macronutrients, proteins and other ingredients that are intended to supplement and balance the diet (15). Physical activity, along with proper nutrition, is a basic element of a healthy lifestyle, the effect of which can be deepened through the consumption of dietary supplements to improve health. Dietary supplements are food products whose purpose is to supplement the usual diet, which are a concentrated source of vitamins or minerals or other substances with a nutritional or other physiological effect, individual or complex, which are sold in a form that allows dosing: capsules, tablets, drops and in in other similar forms, sachets of powder, liquid ampoules and other similar forms of liquids and powders intended for consumption in small, measured unit quantities. They are usually low doses of the active substance, which makes their impact on the body underestimated (9), and they are sold without a prescription and there are more and more possibilities for their purchase, although some are also found in pharmacies.

In recent years, the use of supplementation has increased among people of all ages, and some of the reasons for this are increased and aggressive marketing, easy access, and the general belief that they reduce the risk of chronic diseases and enhance sports performance without harmful side effects for the consumer (24, 29). The most commonly used supplements in the general population are vitamins, including vitamin C, vitamin B complex and multivitamins, minerals, such as calcium and zinc, as shown by several studies (4, 17, 28). Protein supplements are most commonly used among athletes, and their widespread use, which is mostly self-prescribed and widely available, ultimately gives users free access and lower consumption limits (1, 11, 14). The large use and consumption of supplementation was also confirmed by a study by Dascombe et al. (10), where it is stated that 87.5% of athletes take one or more dietary supplements.

Professional athletes or recreational athletes often take supplements without thinking about side effects, mainly because they are substances that improve physical condition (2, 3). It is therefore widely used among athletes at all levels, reflecting the prevalence of their use in society. Most athletes use supplements for the following reasons: muscle building, mineral loss, to increase exercise intensity, post-exercise recovery, and to optimize weight and body composition (2, 12). That is why there is a need for education on the principles and ways of using supplements in athletes in order to develop good eating habits and preserve health.

As the prevalence and use of supplementation is very popular in the world, the pharmaceutical industry has marketed a large number of nutritional supplements designed to intensify the effects of sustained effort. Because of this, some of the most popular nutritional products sold in pharmacies and online stores cover the following product categories: amino acids, protein bars to speed up the weight loss process, creatine, glutamine-based products, various types of proteins (protein powders), vitamins, etc. (13, 26, 30).

2 MICRONUTRIENTS

Very different groups of nutrients, vitamins and minerals are considered micronutrients. They enable biochemical reactions to take place, by means of which energy is obtained from macronutrients. They enable the use of macronutrients for all physiological processes and are key regulators in health and performance (25). Physical activity increases the intake of micronutrients, due to increased consumption, so the intake of vitamins and minerals, as antioxidants that reduce oxidative stress, is of great importance. High volumes of training and activity in stressful conditions (e.g. high heat), altitude can cause a large loss of micronutrients due to increased catabolism (25). Also, this happens if athletes undergo restrictive diets or have large fluctuations in body weight. Vitamins and minerals that are of great importance for athletes are iron, calcium, vitamin D and antioxidants (31). Multivitamin supplements may be needed if it is a reduction diet, recovery from injuries or there is a specific lack of micronutrients. When it comes to supplementation, there should be individual recommendations, because targeted supplementation is needed to treat or prevent deficits (31).

3 **MACRONUTRIENTS**

Macronutrients are nutrients that provide energy to the body through their breakdown. This group includes carbohydrates, dietary fiber, fatty acids, fats and proteins. Recommendations of the Washington Institute of Medicine for healthy adults should provide 45-65% of carbohydrates, 20-30% of fats and proteins 10-35% of total daily energy (6). In addition to optimal energy intake, adequate carbohydrate, protein and fat intake is important for athletes to optimize training and sports performance (21).

Energy for muscle work can be created anaerobically, through the glycolysis process, where glucose or glycogen are exclusively broken down, or aerobically, through the Krebs cycle, where the metabolic products of glycolysis are used together with fatty acids through the beta oxidation process. When the body is at rest, most of the energy (about 60%) comes from fat burning, while the share of carbohydrates is significantly smaller (about 35%). The remaining 5% on average comes from protein. During muscular effort, the relative participation of fuel in the production of the necessary energy depends on the intensity and duration of the exercise, as well as on the nutrition and training level of the athlete (22).

3.1 Carbohydrates

Carbohydrates are an important fuel during physical activity and are a key component of an athlete's diet. In the preparation period for the competition, they become even more important and are equally necessary in the recovery phase after physical activity (20). The human body has a reserve of about 500 g of carbohydrates. Most of the carbohydrates are stored in the form of glycogen in the muscles (about 450 g) and the liver (about 50 g), and only 15 g in the form of glucose in the blood. A high-carb diet can nearly double muscle and liver reserves, while a low-carb diet will have the opposite effect (22). Carbohydrates replace muscle glycogen and serve to maintain blood glucose during exercise. Carbohydrate intake in athletes depends on the athlete's daily energy consumption, type of sport, gender and environmental conditions.

Athletes must consume enough carbohydrates to provide enough energy and meet most caloric needs, to optimize glycogen reserves, enable muscle recovery after physical activity, provide a quick and easily accessible source of energy between meals, and maintain optimal blood glucose levels. Glucose is the main source of energy for muscle activity. With an increase in the intensity of exercise, there is an increasing need for glucose as an energy fuel. Maintaining the amount of carbohydrates at a high level is very demanding because, unlike the ability of the human body to deposit fat, the capacities for depositing carbohydrates are very limited. Carbohydrate intake becomes especially important during very intense training sessions, because the energy metabolism then relies on them as a source of energy for the muscles. Numerous studies have shown that low carbohydrate levels during exercise are associated with a relatively rapid onset of fatigue (7, 34).

The most well-known way to determine the need for carbohydrates is reflected in the consideration of the participation of carbohydrates in the total intake of calories. Recommendations for the general population suggest a carbohydrate intake of 50 to 55% of total calories (33). However, the recommended amount for athletes is 55 to 65% of the calorie intake from carbohydrates (5). Another, and certainly better way to determine the need for carbohydrates is to take into consideration the amount of carbohydrates (in grams) that should be consumed per kilogram of body weight.

Most carbohydrates should come from grains, legumes, fruits and vegetables. However, if the glycemic index is a measure of the rate at which dietary carbohydrates are absorbed and appear in the circulation, it is desirable for the general population (including athletes) to consume carbohydrates that have a low to medium glycemic index value (banana, orange, pasta, whole grains wheat bread, oatmeal).

There are periods, however, (eg during and immediately after exercise), when foods with high glycemic values (white bread, honey, baked potatoes, flakes) are more useful for athletes. Generally speaking, carbohydrate-rich foods with higher fiber content have a lower glycemic index, making them a good choice for athletes (5).

3.2 Fats

Fats are a necessary component of a healthy diet because they provide energy, essential elements of cell membranes and enable the absorption of fat-soluble vitamins. Fats are the ideal form through which cells can store and expend energy. One gram of fat contains about 9 kcal, twice as much as one gram of protein or carbohydrates. Fats are stored in the form of triglycerides in muscle cells (about 500 g) and adipocytes (about 14,000 g), while a negligible amount (0.4 g) is in the plasma in the form of free fatty acids (5, 22). According to the degree of saturation, fatty acids can be divided into saturated (do not contain a double bond), monounsaturated (contain one double bond in the molecule) and polyunsaturated fatty acids (contain two or more double bonds in the molecule) (6).

From the standpoint of physical activity and exercise, it has not been proven that increasing fat intake results in improved athletic performance, unless increased fat intake is the only way for the athlete to get enough energy. Athletes who require more than 4,000 kcal each day to meet the combined needs of growth, exercise, and tissue regeneration may require a moderate increase in dietary fat (preferably of plant or fish origin). Since fat is a more concentrated form of energy than both carbohydrates and protein, more energy can be provided in smaller amounts of food if foods contain more fat. If the intake of fats were to be stopped, a very large amount of food would have to be consumed, which could not be organized without obtaining energy (5). Because athletes store more calories from fat than from carbohydrates, increasing the ability to use fat causes a proportional reduction in reliance on carbohydrates, thereby increasing endurance. Simply put, if more fat is burned at a higher intensity of exercise, carbohydrate stores will last longer, thus improving endurance.

Recently, more attention has been paid to the intake of omega 3 fatty acids, in order to improve sports performance. They influence the acceleration of aerobic metabolic processes, which refers to a better use of energy in athletes. This is not to say that increased fat intake gives better results, but to consider changes in dietary intake, which would include periodic (regular) meals of salmon, tuna, herring and other cold deep sea fish in the amount of 110 to 140 grams to increase the proportion of omega 3 fatty acids available to them. However, some studies have not found statistically significant improvements in strength and endurance, nor that omega-3 fatty acids reduce exercise-induced inflammation (18, 23).

3.3 Proteins

Proteins are the basic elements of living cells of every organism and bearers of numerous physiological functions. By chemical composition, complex organic compounds are mainly composed of carbon, hydrogen, oxygen and nitrogen, many of them contain sulfur and phosphorus, and some contain iron, iodine, copper and zinc (19). Carbohydrates and fatty acids are the priority fuel that serves as a source of energy during exercise. With prolonged exercise, muscle glycogen reserves decrease, and proteins begin to be used. Amino acids are converted in the liver via gluconeogenesis and lead to oxidative processes (22).

The basic chemical compounds that make up all proteins are called amino acids. All the complexity and diversity of the protein structures of human tissue is made up of only twenty amino acids, of which only nine are considered very necessary or essential. Seen from this perspective, our need for protein in the diet actually comes down to the need for amino acids (19). Many athletes are of the opinion that proteins are the most important for achieving good results in sports. Some kind of protein supplementation is increasingly used in strength sports. Adequate intake of protein reduces the possibility of adequate intake of other essential nutrients. There are also frequent situations in which the need for protein is greater than the athlete's intake. Competitors in aerobic endurance sports, who appear leaner and less muscular than e.g. weightlifters actually have almost as high a protein requirement (per unit of body mass) as strength athletes (8, 27).

The recommended daily level of protein intake for the general population is 12-15% of total calorie intake, which would amount to about 0.8 g of protein per kilogram of body weight. Athletes need more protein because of a higher lean body mass, a greater need for tissue recovery, and because a small amount of protein is burned during physical activity. This increases the protein needs of athletes to approximately double the needs of non-athletes (1.2 to 1.7 grams per kilogram) (5). Table 1 shows the protein needs of physically active people with a body weight of 70 kg. If the athlete consumes enough carbohydrates for energy purposes, the proteins will be spared from burning so that they can be used for much more important functions. The rule of sports nutrition is that carbohydrates have a protein-saving effect.

Table 1. Protein needs for physically active people (16).

Type of athlete	Energy (calories/day)	Grams of protein per kg body weight per day	Grams/day	% of daily calories
Endurance, b	3800	1.2-1.4	84-98	9-10
Strength, c	3200	1.6-1.7	112-119	14-15

[a]Assuming that energy consumption at rest is 40 kcal per kg of body mass per day
[b]Assuming that a male athlete runs 16 km per day at a pace of 3.7 minutes per km
[c]Assuming that an additional 6 kcal per kg of body mass per day is needed for high-load training

Athletes who consume insufficient protein will develop and maintain a negative nitrogen balance, indicating protein catabolism and slow recovery. Long-term protein deficiency can lead to injury, muscle wasting, exercise intolerance, and disease (32).

4 **CONCLUSION**

Athletes are always trying to find a new way to improve their results, and proper nutrition is a path that opens up great opportunities for them. Even a small change in diet can improve a competitive result by a fraction of a second or a few millimeters. Proper nutrition for athletes consists in the intake of sufficient amounts of all nutrients (fats, carbohydrates and proteins), as well as minerals and vitamins, which often play a large role in the quality of training. Daily calorie needs depend on an individual's body weight, training intensity and gender. Athletes should pay close attention to nutrition before, during and after training. It is essential that athletes and coaches learn to assess the energy intake required and the ratio of carbohydrates, fats and proteins in each meal, in order to ensure the optimal mental and muscle functions necessary for the sport they are engaged in. A good nutrition program, designed in time, optimally designed and with realistic goals should be the basis that every serious athlete would have at his disposal. Only fulfilled nutritional requirements can prevent deficits and improve sports performance to the limit.

REFERENCES

1. Allen, T., Thomson, WM, Emmerton, LM, & Poulton, R. (2000). Nutritional supplement use among 26-year-olds. NZ Med. J. 113, 274–277.
2. Antonio, J. (2019). High-protein diets in trained individuals. Research in Sports Medicine, 27(2), 195–203.
3. Antonioni, A., Fantini, C., Dimauro, I., & Caporossi, D. (2019). Redox homeostasis in sport: Do athletes really need antioxidant support? Research in Sports Medicine, 27(2), 147–165.
4. Baker, B., Probert, B., Pomeroy, D., Carins, J., & Tooley, K. (2019). prevalence and predictors of dietary and nutritional supplement use in the Australian army: A cross-sectional survey. Nutrients. 11, 1462.
5. Benardot, D. (2010). Advanced sports nutrition. RS: Belgrade, Data Status.
6. Bender, DV., & Krstev, S. (2008). Macronutrients and micronutrients in human nutrition. Medicus. 17(1), 19-25.
7. Bosch, AN., Dennis, SC., & Noakes, TD. (1993). Influence of carbohydrate loading on fuel substrate turnover and oxidation during prolonged exercise. J Appl Physiol. 74, 1921-1927.
8. Butterfield, GE, & Calloway, DH (1984). Physical activity improves protein utilization in young men. The British journal of nutrition, 51(2), 171–184.
9. Cameron, DI., Kurrle, SE., Uy, C., Lockwood, KA., Au, L., & Schaasfsma, FG. (2011). Effectiveness of oral nutritional supplementation for older women after a fracture: rationale, design and study of the feasibility of a randomized controlled study. BMC Geriatrics. 11, 32-37.
10. Dascombe, BJ , Karunaratna, M., Cartoon, J., Fergie, B., Goodman, C. (2010) Nutritional supplementation habits and perceptions of elite athletes within a state-based sporting institute.J. Sci. Med. Sport 13, 274 – 280.
11. Dwyer, JT., Coates, PM., & Smith, MJ. (2018). Dietary supplements: Regulatory challenges and research resources. Nutrients. 10, 41.
12. Đorđević-Nikić, M., & Đorđević, A. (2006). Opinion about and use of nutritional supplements by the students of the faculty of sport and PE Fizička Kultura, 60(2), 188–196.

13. El Khoury, D., Dwyer, JJM, Fein, L., Brauer, P., Brennan, S., & Alfaro, I. (2019). Understanding the use of dietary supplements among athlete and non-athlete university students: Development and validation of a questionnaire. Sports, 7(7), 166.
14. Froiland, K., Koszewski, W., Hingst, J., & Kopecky, L. (2004). Nutritional supplement use among college athletes and their sources of information. Int. J. Sport Nutr. Exerc. Metab. 14, 104–120.
15. Gardiner, P., Kemper, KJ, Legedza, A., & Phillips, RS (2007). Factors associated with herb and dietary supplement use by young adults in the United States. BMC Complement. Alternate. Med. 7, 39.
16. Gibala, MJ. (2002). ,Dietary protein, amino acid supplements, and recovery from exercise. GSSI Sports Science Exchange. 15(4), 87.
17. Gong, W., Liu, A., Yao, Y., Ma, Y., Ding, C., Song, C., Yuan, F., Zhang, Y., Feng, G., Chen, Z., et al. (2018). Nutrient Supplement Use among the Chinese Population: A Cross-Sectional Study of the 2010–2012 China Nutrition and Health Surveillance. Nutrients. 10, 1733.
18. Huffman, DM, Altena, TS, Mawhinney, TP, & Thomas, TR (2004). Effect of n-3 fatty acids on free tryptophan and exercise fatigue. European journal of applied physiology, 92(4-5), 584–591.
19. Jäger, R., Kerksick, CM, Campbell, BI, Cribb, PJ, Wells, SD, Skwiat, TM, Purpura, M., Ziegenfuss, TN, Ferrando, AA, Arent, SM, Smith-Ryan, AE, Stout, JR, Arciero, PJ, Ormsbee, MJ, Taylor, LW, Wilborn, CD, Kalman, DS, Kreider, RB, Willoughby, DS, Hoffman, JR, … Antonio, J. (2017). International Society of Sports Nutrition Position Stand: protein and exercise. Journal of the International Society of Sports Nutrition, 14, 20.
20. Jeukendrup, A., & Gleeson, M. (2004) Sport nutrition. 3rd Edition, Human Kinetics, Champaign.
21. Kerksick, CM Wilborn, CD, Roberts, MD, Ryan, AS, Kleiner, SM, Jäger, R., Colli, R., Cooke, M., Davis, JN, Galvan, E., Greenwood, M., Lowery, LM, Wildman, R., Antonio, J., Kreider, RB (2018) ISSN exercise & sports nutrition review update: research and recommendations. J. Int. Soc. Sports Nutr., 1-57.
22. Klissouras, V. (2013). Basics of sports physiology; [translated by Andjelkovic M. et al.]; Dikić N. RS: Belgrade, Institute of Sport.
23. Lenn, J., Uhl, T., Mattacola, C., Boissonneault, G., Yates, J., Ibrahim, W., & Bruckner, G. (2002). The effects of fish oil and isoflavones on delayed onset muscle soreness. Medicine and science in sports and exercise, 34(10), 1605–1613.
24. Lentjes, MAH. (2019). The balance between food and dietary supplements in the general population. Proc. Nutr. Soc. 78, 97–109.
25. Mahan, LK, & Raymond, JL (2017) Krause's food & the nutrition care process. E-Book 14th Edition, Elsevier Health Sciences St. Louis, Missouri.
26. Maughan, RJ, Shirreffs, SM, & Vernec, A. (2018). Making decisions about supplement use. International Journal of Sport Nutrition and Exercise Metabolism, 28(2), 212–219.
27. Meredith, CN, Zackin, MJ, Frontera, WR, & Evans, WJ (1989). Dietary protein requirements and body protein metabolism in endurance-trained men. Journal of applied physiology (Bethesda, Md. : 1985), 66(6), 2850–2856.
28. Sandler, RS, Halabi, S., Kaplan, EB, Baron, JA, Paskett, E., & Petrelli, NJ (2001). Use of vitamins, minerals, and nutritional supplements by participants in a chemoprevention trial. Cancer. 91, 1040–1045.
29. Sirico, F., Miressi, S., Castaldo, C., Spera, R., Montagnani, S., Di Meglio, F., & Nurzynska, D. (2018). Habits and beliefs related to food supplements: Results of a survey among Italian students of different education fields and levels. PLoS ONE. 13
30. Šterlinko Grm, H., Stubelj Ars, M., Besednjak-Kocijančič, L., & Golja, P. (2012). Nutritional supplement use among Slovenian adolescents. Public Health Nutrition, 15(4), 587–593.
31. Thomas, DT, Erdman, KA, & Burke, LM (2016). American College of Sports Medicine Joint Position Statement. Nutrition and Athletic Performance. Medicine and science in sports and exercise, 48(3), 543–568.
32. Tomanić M. (2016). Sports nutrition. Medical junior. 67(2), 13-19.
33. USDA/HHS. (2000). Nutrition and your health: Dietary guidelines for Americans. Home and Garden bulletin. Washington DC: Government Printing Office.
34. Wagenmakers, AJ., Beckers, EJ., Brouns, F., Kuipers, H., Soeters, PB., van der Vusse, GJ., et al. (1991). Carbohydrate supplementation, glycogen depletion, and amino acid metabolism during exercise. Am J Physiol. 260, 883-890.