

Nutritional supplement habits: the survey on a Sicilian group

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Abstract

Dietary supplements are extensively used among athletes as well as amateurs attending gyms. Regardless of very poorly investigated information about the effects of these products – both desirable and adverse – a wide range of population is used to take them. The aim of this study was to investigate the supplement consumption in Sicilia, Italy. An online questionnaire has been administered to 588 subjects (55% male and 45% female) aged between 15 and 53 years, frequenters and non-frequenters of gyms. The questionnaire showed that 75% of subjects practice (more or less regularly) physical activity 3-4 times a week, whilst the 25% did not practice any sport. Saline Supplements (Gatorade, Powerade, etc.), Branched Amino Acids (BCAAs) and protein supplements were the most frequently indicated dietary supplements (25.2%, 19.4% and 27%); carnitine and creatine the least (6.8% and 11.6%). Most of the practicing sport respondents administer nutritional supplements by themselves and they do not acknowledge any noticeable performance improvement. Therefore, even if there is no definite posology for the use of supplements, these should never be considered as an alternative to foods and a proper lifestyle.

KEYWORDS: dietary supplements, Sicilian people, questionnaire.

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Introduction

Numerous studies suggest the expansion of risky behaviours among physical exercise practitioners, at agonistic and amateur level, including phenomena such as doping and use and abuse of sports supplements. Concerning the latter, among amateur sportsmen, the percentage varies between 53 and 60% [8].

In Italy, the data provided by the National Institute of Health indicate that there are more than three millions of customers of food supplements with a profit from June 2012 to May 2013 of 1.939 millions of euro (+ 4.5% compared to the previous year) for a total of 142.8 millions of packets sold (+ 4.7% over the previous year). Food supplements for sports include a wide range of products (minerals, vitamins, energy nutrients, vegetable extracts, amino acids, proteins, ergogens, dietary products, integrators and “natural” or “healthy” products, etc.) sold in order to overcome the shortage of one or more nutrients caused by their inadequate intake with normal nutrition, aimed to prevent the onset of specific pathological conditions [23].

In sports this particular category of products has shown, in recent years, an increase in interest in particular in relation to improve athletic performance [16]. Many of the promoted substances are, in fact, compounds that are normally contained in foods. The main difference with the dietary food intake is mostly in dosages, which are usually abused, as well as the long-term effects on health there being discordant opinions and numerous doubts [5].

Supplements are used in the sports field in order to increase body weight and muscle mass but also

to increase muscle strength and promote energy production, lipid metabolism and recovery after sports activity [17].

Categories of supplements

Several supplements are used by athletes: they use a variety of substances including minerals, proteins, vitamins, energy drinks, carnitine, caffeine and other. Considering the ABCD Classification System adopted by the Australian sports commission, Glucose supplements belong to Group B vitamins, isotonic drinks, amino acids and derivatives, creatine and caffeine belong to Group A.

Often, athletic performance during a prolonged sport activity is compromised by the depletion of glycogen stores as well as by reduction of glucose blood concentration (hypoglycaemia) [12, 14]. In fact, glucose storage component of our body, muscle and hepatic glycogen, is present in extremely small amounts and only partially could cover the specific requirements that occur during physical activity.

Therefore, the low availability of carbohydrates in muscles is certainly what can limit sports performance and strongly affect the onset of fatigue. When blood glucose falls below the physiological limit of 70 mg/dl, there is a rapid deterioration in physical performance. Essentially two types of supplements, glucid supplements and group B vitamins, are used to overcome energy loss [18]. Glucose supplements are usually commercialized as beverage or bar ready-to-use. They are generally made up of monosaccharides such as glucose and fructose, disaccharides such as sucrose and polysaccharides such as maltodextrins that are widely used in resistance sports to provide short and middle-term energy, offering the advantage of gradually releasing the glucose itself.

Group B vitamins are water-soluble vitamins having a close connection to maintain sports performance as energy metabolism regulators. In particular, tiamin (Vitamin B1), pyridoxine (Vitamin B6) and cobalamin (Vitamin B12) are essential for the transformation of protein, fat and carbohydrates into energy [4, 11]. Their inadequate intake may result in a decrease in athletic performance and hamper the muscle tissue repair process, negatively affecting body repair ability. The risk of shortage, mainly concern all the athletes; mostly of these have to control their weight (e.g. gymnasts and ballet dancers).

Another form of supplement is sports drink that usually uses to replenish the hydro-saline balance lost as result of sweating. This type of supplement is mainly composed

of water and other nutrients that can generally be taken from foods. Usually these drinks contain carbohydrates and various electrolytes of which sodium is the main. Sports drinks are used to rehydrate the body and reduce the physiological stress resulting from exercise [21]. Maintaining the saline-water balance is essential for the proper functioning of the body; a 40 minutes physical activity results in depleting of carbohydrates, increase of body temperature, and reduction in circulating fluid due to sweat. Indeed, for example, the loss of 2% of the body's total body water volume alters thermoregulation while the loss of 5% involves the risk of cramping and is capable of causing a 30% reduction in sports performance [3, 13]. During exercise it is important to rehydrate electrolytes especially sodium, which is in the form of sodium chloride drinks: this stimulates intestinal absorption of sugar and water while maintaining the volume of extracellular fluid. Generally, sports drinks have a low content of electrolytes with sodium concentrations of ~ 20-25 mmol/l [21]. There are various types of sports drink based on the concentration of the electrolytes: the ones most used by athletes are the isotonic ones. These drinks have a concentration of electrolytes equal to that of the plasma and are quickly absorbed: they can be taken before, during and after the workout [15].

Hydrosaline Supplements of the most famous brands distributed in Italy, provide mineral salts per 100 ml of product, which is approximately: 52 mg/2.2 mEq of Sodium, 47 mg/1.3 mEq of Chloride, 12 mg/0.3 mEq of Potassium, 5 mg/0.4 mEq Magnesium.

There are also products aimed to integrate the amino acids and derivatives. These may be based on branched chain amino acids (BCAAs) (Leucine, Isoleucine and Valine) or based on amino acid derivatives (Creatine and L-carnitine). The BCAAs have particular characteristics: they make the nitrogen balance positive and stimulate protein synthesis when is slowed down. So the availability of exogenous BCAAs allows to limit the decrease of muscle proteins autolysis during work with considerable benefit for physical efficiency and performance. In any case the amount of daily intake should not exceed 5 g and leucine must represent the predominant component with a ratio of 2:1:1 respectively, between leucine, isoleucine and valine [20].

Creatine is an amino acid derivative, synthesized by the body from arginine, glycine and methionine, with the function of provide energy to muscles and optimization of the availability of adenosine triphosphate (ATP) necessary for muscle contraction. Creatine is a normal component of diet, which is found in high amounts (3-7 g/Kg) in skeletal muscle; the main food sources

are meat and fish. Creatine monohydrate is one of the most popular dietary supplements to increase strength and power in athletes and is also widely used in power and team sports that require in a very short time very expensive efforts, especially if repeated. A variety of synthetic creatine supplements have been developed including creatine pyruvate, creatine citrate, magnesium-chelate creatine, creatine ethyl ester and many others. Marketing attestations for these compounds include improved solubility and stability in solution, better absorption and bioavailability [22].

Protein supplements are mostly used to promote growth and maintain muscle mass. This is demonstrated not only in athletes but also in older people and therefore physically debilitated [1]. Most commonly used are whey and casein protein that are slower assimilated. However, the last frontier concerns vegan proteins, for those looking for an alternative to animal protein supplements, for examples: soy, rice or hemp proteins. The choice between amino acids and proteins depends on wanting to get more or less immediate help.

Although it has not been explicitly asked what the sample's habits are regarding coffee intake, it is well known that in Italy it is one of the most popular drinks. Until 2004, caffeine was among the forbidden substances on the WADA list due to its stimulant [6, 7], thermogenic properties [2] and its action on lipid metabolism, which could presumably lead to overall improvement in sports performance.

The excitatory action exerted by caffeine and coffee itself, stimulates the central nervous system by reducing the perception of fatigue and increasing the activation of motoneurons, thus improving the contraction. The consumption of about 5 mg/kg/bw, 1 h before physical activity, has been shown to improve performance during exercise [10].

Many studies on humans also support the hypothesis that coffee consumption induces weight loss by increasing thermogenesis. It is estimated that a regular consumption of 6 cups of coffee (i.e. 600 mg caffeine/d) causes an increase in energy expenditure (EE) of 100 kcal/d, which could lead to a significant weight loss [9]. Caffeine ingestion also increases fat metabolism by altering lipolytic hormones and skeletal muscle capacity to oxidize fats. Caffeine acts to inhibit phosphodiesterase in cells by releasing catecholamines and causing cAMP accumulation in skeletal muscles and adipose tissues. Therefore, caffeine ingestion, before exercise, improves the mobilization of fatty acids which are thus used as the main source of energy during resistance exercise while saving glycogen. In addition, it increases

the activity of lipase-sensitive hormone (HSL) and fat mobilization from skeletal muscles and fatty tissues, causing an increase in free fatty acids (FFAs) in the bloodstream. This leads to an increase in resistance and a delay in fatigue [19].

There are real caffeine supplements, distributed in the form of pills, which provide about 200 mg of caffeine per serving.

However, due to its "borderline" position and to the inability to really go to the source (voluntary or involuntary) and to calculate its concentration in blood, in 2004, the IOC (International Olympic Committee) decided to eliminate caffeine from the forbidden substances.

Material and Methods

For this study we provided a questionnaire, specifically created, to 588 Italian people (55% of men and 45% of women represents the sample). The average age was 27.3 years and the height varied from a minimum of 150 cm to a maximum of 194 cm (avg = 171.1 cm); moreover the weight varied from a minimum of 40 kg to a maximum of 120 kg (avg = 68.3 cm).

The questionnaire, consisting of 28 items, has been generated as a survey method and is divided into three sections: a first section on the anagraphic data, lifestyle and clinical history of the respondents; a second part on sport activity (type and duration dedicated weekly) and the third part dedicated to investigate the use of dietary supplements, and the possible psycho-physical effects of such substances. Inside the questionnaire was asked to "Do you usually practice physical activity?" and, on the basis of the affirmative answer, we selected a group of 439 people who represented the group we were looking for.

Results

In the Table 1 below there are synthesizes the answer to the main questions.

The 71% of individuals do not follow a precise diet regime. Among those who said to follow a specific diet, the highest percentage was for the Mediterranean diet (35%) and do not suffer from such diseases like celiac disease, Chron disease, lactose intolerance, etc. During the questionnaire administration 62.5% of the sample did not perform hematochemical examinations long since. The questionnaire showed that 75% of subjects practice more or less regular physical activity 3-4 times a week whilst the 25% did not practice any sport. About the third section of the questionnaire, 70% of respondents do not use food supplements and only 30% said they

Table 1. Synthesized questions and answers in questionnaire

Questions	Options	Yes	No
Do you usually practice physical activity?		75%	25%
Do you usually use supplement?		30%	70%
Which kind of supplement do you usually assume?	Saline Supplements Branched	25%	
	Amino Acids	19%	
	Protein Supplements Carnitine	16%	
	Creatine	7%	
	Mixed supplements	12%	
Who suggested you to use the supplements?	Himself	19%	14%
	Coach/Personal trainer	6%	
	Friends	3%	
	Websites	4%	
	Nutritionist	57%	
How did your feel during the performance change after eating cereal/carbs bar?	Did not respond		
	More energetic	59%	
	No change	35%	
	More tired	6%	

would use it. Among the subjects using these substances, 78% were male. When we asked “Who suggested you to use the supplements?” the 19% replied that it was by himself, 14 % suggested by the coach/personal trainer, 6% by friends, 3% from websites, 4% by nutritionist and 57% didn’t respond. Saline Supplements (Gatorade, Powerade, etc.), Branched Amino Acids (BCAAs) and protein supplements were the most assumed dietary supplements (25.2%, 19.4% and 27%); carnitine and creatine reported lower percentages (6.8% and 11.6%). The 15% of subjects claimed to have mixed different types of supplements on the same day. The highest percentage of the responders (62%) had no effect from the integration. Among the positive effects suggested there were increased performance, increased muscle mass, and increased strength. Among the adverse effects there were prevalence of general diseases (headache, diarrhea, etc.) and water retention.

Discussion

The present works have the aim to do an exploratory investigation to understand the uses of sports practitioners, that is how much and how many times they assume supplements, what kind of nutritional supplements and in which way they influence physical performance and whether they have decided to take them with or without medical supervision. The latter is the most serious thing because it shows a total non-curation of the possible side effects that they might have. Although no statistically significant results were reported indicating

an improvement or deterioration in performance or health status following the intake of supplements, we can still say that this is a very common practice. The lack of real negative effects, in a sense, leads the subject to take them even though he is aware of not getting any improvement, using it as a sort of substitute food that can balance bad food habits. Supplements become more psychological aid than physiological, like a volunteered self-administered placebo.

Conclusions

The results showed that among the 439 individuals who practice sports, only 30% reported using these substances and most of them are females. The results also showed that most of the subjects using supplements did it by themselves. The most widely used supplements, including those suggested, have been saline supplements (Gatorade, Powerade, etc.), BCAAs and protein supplements. Most of the subjects did not show any effect on the use of supplements, either positive or negative, while those with negative effects reported mainly general illness (headache, diarrhea, etc.) and water retention. Therefore, although there is no formal posology for the use of supplements, these should never be taken as alternative to food and to a healthy and active lifestyle.

References

1. Bell KE, Snijders T, Zulyniak M, Kumbhare D, Parise G, Chabowski A, et al. A whey protein-based multi-

- ingredient nutritional supplement stimulates gains in lean body mass and strength in healthy older men: A randomized controlled trial. *PLoS ONE*, 2017; 12(7): e0181387.
2. Belza A, Toubro S and Astrup A. The effect of caffeine, green tea and tyrosine on thermogenesis and energy intake. *Eur J Clin. Nutrition*, 2009; 63: 57-64.
 3. Earhart EL, Weiss EP, Rahman R and Kelly PV. Effects of oral sodium supplementation on indices of thermoregulation in trained, endurance athletes. *J Sports Sci Med*. 2015; 14(1): 172-178.
 4. Eskici G. The importance of vitamins for soccer players. *International Journal for Vitamin and Nutrition Research*. Hogrefe AG; 2016.
 5. Fardet A. Complex foods versus functional foods, nutraceuticals and dietary supplements: differential health impact. *Agro FOOD Industry Hi Tech*. 2015; 26(2).
 6. Ferré S. Mechanisms of the psychostimulant effects of caffeine: implications for substance use disorders. *Psychopharmacology*, 2016; 233(10): 1963-1979.
 7. Galvalisi M, Prieto JP, Martínez M, Abin-Carriquiry JA, Scorza C. Caffeine Induces a Stimulant Effect and Increases Dopamine Release in the Nucleus Accumbens Shell Through the Pulmonary Inhalation Route of Administration in Rats. *Neurotox Res*. 2017 Jan; 31(1): 90-98.
 8. Giammarioli S. Studi relativi all'utilizzo di integratori alimentari in Italia: il contributo dell'istituto superiore della sanità. *Notiziario dell'Istituto Superiore della Sanità*, 2013; 26(5): 3-6.
 9. Greenberg JA, Boozer CN and Geliebter A. Coffee, diabetes, and weight control. *Am J Clin Nutr*. 2006; 84: 682-693.
 10. Hodgson AB, Randell RK, Jeukendrup AE. The metabolic and performance effects of caffeine compared to coffee during endurance exercise. *PLoS-ONE*, 2013; 8(4): e59561.
 11. Kennedy DO. B vitamins and the brain: mechanisms, dose and efficacy—a review. *Nutrients*. 2016; 8(2): 68.
 12. Larson N, Laska MN, Story M and Neumark-Sztainer D. Sports and energy drink consumption are linked to health-risk behaviours among young adults. *Public Health Nutrition*. 2015; 18(15): 2794-2803.
 13. Maughan RJ, Shirreffs SM. Development of hydration strategies to optimize performance for athletes in high-intensity sports and in sports with repeated intense efforts. *Scand J Med Sci Sports*. 2010 Oct; 20 Suppl 2: 59-69.
 14. Ørtenblad N, Westerblad H, Nielsen J. Muscle glycogen stores and fatigue. *J Physiol*. 2013; 591.18, 4405-4413.
 15. Ostrowska A, Szymański W, Kołodziejczyk L, Bołtacz-Rzepkowska E. Evaluation of the Erosive Potential of Selected Isotonic Drinks: In Vitro Studies. *Adv Clin Exp Med*. 2016; 25(6): 1313-1319.
 16. Pasiakos SM, Lieberman HR, McLellan TM. Effects of protein supplements on muscle damage, soreness and recovery of muscle function and physical performance: a systematic review. *Sports Med*. 2014 May; 44(5): 655-670.
 17. Ricciardelli LA, Williams RJ. Use of supplements and drugs to change body image and appearance among boys and male adolescents. *Chemically Modified Bodies*. 2016; 13-30.
 18. Rowlands DS, Houltham S, Musa-Veloso K, Brown F, Paulionis L, Bailey D. Fructose–glucose composite carbohydrates and endurance performance: critical review and future perspectives. *Sports Med*. 2015; 45(11): 1561-1576.
 19. RyuSungpil, Sung-Keun Choi, Seung-Sam Joung, Heajung Suh, Youn-Soo Cha, Soochun Lee and Kiwon Lim. Caffeine as a Lpolytic food component increase endurance performance in rats and athletes. *J Nutr Sci Vitaminol*. 2000; 47: 139-146.
 20. Shimomura Y, Murakami T, Nakai N, Nagasaki M, Harris RA. Exercise promotes BCAA catabolism: effect of BCAA supplementation on skeletal muscle during exercise. *J Nutrition*; 2004; 134: 1583-1587.
 21. Shirreffs SM. Hydration in sport and exercise: water, sports drinks and other drinks. *Nutrition Bull*. 2009; 34: 374-379.
 22. Spillane M, Schoch R, Cooke M, Harvey T, Greenwood M, & Kreider R. The effects of creatine ethyl ester supplementation combined with heavy resistance training on body composition, muscle performance, and serum and muscle creatine levels. *J Int Soc Sports Nutrition*, 2009; 19; 6: 6.
 23. Temple NJ. Dietary supplements: navigating a minefield. *Nutrition Guide for Physicians and Related Healthcare Professionals*. 2017; 325-334; part of the *Nutrition and Health book series*.