



Sports-Related Nutrition Marketing and Its Performance Impact on Athletes in the Republic of North Macedonia

Gjorgjina Sherovska¹ 

Received: June 3, 2022

Accepted: July 7, 2022

Published: December 30, 2022

Keywords:

Sport;
Sports nutrition;
Athletes;
Sports marketing;
Performance



Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution-Non-Commercial 4.0 License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits non-commercial use, reproduction and distribution of the work without further permission.

Abstract: Nutrition is increasingly recognized as a key component of optimal sporting performance, with both the science and practice of sports nutrition developing rapidly. The sports nutrition market has witnessed robust growth in the past few years; it is gaining pace due to the increase in health awareness among the population, new product development, the rapid increase in urbanization, and growth in a number of sales outlets, health clubs, fitness centers and gyms. Athletes use a range of nutritional and diet strategies to improve sports performance. Nutrition plans need to be personalized to the individual athlete to take into account the specificity and uniqueness of the event, performance goals, practical challenges, food preferences, and responses to various strategies. A key factor is the related marketing used to reach the core aim of the athletes for specific sports nutrition so they can meet their energy and nutrient requirements, whether that is speed, endurance, recovery, or strength. The marketing strategies in the sports nutrition industry are wide. Companies understand the power of sports endorsement, the trending on social media, and after all the factors of advertisement, through the different marketing communication channels impacting the athletes' behavior for the final decision-making process of purchasing the product. In this paper the purpose is to investigate the effect of sport-related nutritional marketing as a communication strategy reaching athletes, and, its second relationship, the effect of the marketed sport-related nutritional products impact on athlete's performance, from the athlete's aspect. The importance of this paper is to examine a new topic of a connection between sports nutritional marketing and the eventual performance effect on a particular sub-category of athletes because very little research is being conducted on this topic of interest. The research framework used in this paper will help to guide future research and improve marketing communication strategies with great insight on what are the key methods to reach out to short and distance athletes from a marketing point of view, as well as the key factors that make marketed sport nutritional products impact on athlete's performance.

1. INTRODUCTION

Nutrition is increasingly recognized as a key component of optimal sporting performance, with both the science and practice of sports nutrition developing rapidly, explains Beck et al., (2013). Every time we eat we have an opportunity to nourish our bodies. The sports nutrition market is gaining pace due to the increase in health awareness among the population, new product development, the rapid increase in urbanization, and growth in a number of sales outlets, health clubs, fitness centers and gyms. Beck et al. (2013) define the "Athlete" as individuals competing in a range of sport types, such as strength and power (e.g., weightlifting), team (e.g., football), and endurance (e.g., marathon running). Athletes and active people should choose nutrient-dense foods as often as possible to support their bodies' increased nutrient requirements. Athletes often expend more energy and therefore have higher energy requirements, so they may

¹ University American College Skopje; Treta makedonska brigada nr. 60, 1000 Skopje, North Macedonia

need to consume more serves of each of the food groups to meet their energy and nutrient requirements, it is concluded in the research developed by Food Standards Australia New Zealand (2010). Nutrition is determinant in achieving adequate sports performance, which is defined by three variables: training, rest, and feeding. The sports nutrition market in Europe is expected to grow by USD 2.01 billion from 2021 to 2026, progressing at a CAGR of 8.01% as per the latest market report by Technavio (2022).

2. SPORTS-RELATED NUTRITION MARKETING COMMUNICATION STRATEGIES

According to Kotler & Armstrong (2011, p. 12), “the company’s marketing strategy outlines which customers it will serve and how it will create value for these customers. Companies need to do well in their marketing strategies. The marketing program builds customer relationships by transforming the marketing strategy into action. It consists of the firm’s marketing mix, the set of marketing tools the firm uses to implement its marketing strategy”.

Sports nutrition products supply carbohydrates, proteins, minerals and fluids. Examples are sports drinks and sports bars. Ergogenic supplements claim to enhance performances in one way or another. Examples are caffeine, creatine and ginseng according to The Norwegian Directorate of Health (2005). Corresponding to Titchenal (2001), based on product type, the sports nutrition market can be categorized into sports food, sports drink and sports supplements. The sports nutrition segment includes energy drinks, powders, liquid meal replacements, energy bars, creatine supplements and the like. These products are marketed as supplements before, during and after physical exercise. This delimitation is central because the market for food supplements, of which sports nutrition products are only a small subcategory, is enormous, stresses Ånestad (2009). Sports nutrition products are offered in all shapes and sizes; such as ready-made drinks, bars, tablets, capsules, gel form and powder that can be mixed with milk as well as water. There are products suggested for gaining muscles and weight, while other products promise to help you control your weight. Products aimed at training and competition promise to increase achievements by giving prolonged endurance, others may help with recovery of the body after training, explains Bjerck et al. (2009). They also state that there are many different sales channels for sports nutrition products. While some products are sold through grocery stores and in health food stores, others can only be bought in special stores for sports nutrition products and on various Internet sites. Internet is the central point of marketing strategy in the sports nutrition industry, it has become a new way to create value and build a relationship with the customers (Kotler, 2014), however, some physical placements and stores are making a change in the market.

Sports stores - sell items related to various forms of sports and exercise, among them are sports nutrition products. Sports stores are one of the most important sales channels for sports nutrition products (The Norwegian Directorate of Health 2005).

Healthy food stores - in general, are meant to provide healthy food supplements and ingredients and offer a wide range of sports nutrition products (The Norwegian Directorate of Health 2005).

Gyms – the focus on sports nutrition products is evident in the physical appearance of the gym; they sell different forms of sport nutrition products, starting with “sports water”, protein shakes, protein drinks, energy drinks, protein bars and energy bars (The Norwegian Directorate of Health 2005).

Internet sites – starting from small startups, up to larger companies including different health food stores, sports stores and gyms, in addition to private customers are present where usually information about the nutritional value of the product along with recommendations on usage is provided (The Norwegian Directorate of Health 2005).

Social media discount - another type of promotion made on the Internet is the online sales promotion which consists in doing a discount on the website [or the social platform account] and causing a desire which leads to the purchase, says Kotler (1999). These promotions are a consequence of the proportion of people buying their food supplements on the Internet (4 out of 5 people). As said, sport nutrition companies understand the importance of the Internet and want to maximize their profits on this support by using all the different online tools they have at their disposal.

Sports events - Companies selling sports nutrition products tend to be highly visible at sports events. For them, as for many other sports nutrition companies, the importance of sports events is not to sell directly to consumers, but to present the company and its products (The Norwegian Directorate of Health 2005).

Advertisement via influencers: An influencer, is an individual who influences an exceptionally large number of their peers, and forms standards of orientation, says Watts et al. (2007). Instagram has established itself as the most important social network for influencers as it enables the most effective interaction with their network and is the best channel for paid collaboration, writes Hashoff (2017). Research conducted by Pilgrim et al. (2019) ranked the accounts that publish posts in German according to the total number of followers, excluding brand and company profiles. For the sample definition, relevant accounts communicating nutrition and exercise were identified. In order to generate a sense of the wording used on Instagram in this context, the research team examined the 100 most frequently used hashtags worldwide. The findings identify three categories of communication goals that had to be clearly distinguished from each other. On the one hand, influencers try to position themselves as experts by rhetorical means and specifically selected content. The goal is to increase the total engagement on the account. On the other hand, the majority of observed communication was intended to increase the personal appeal (of the influencer) in the eyes of the followers. The influencer consciously intended to create or increase the perceived similarity between her/him and her/his followers, as well as perceived familiarity and sympathy.

Word of mouth - As untraditional marketing and sales strategy, the sports nutrition market, in addition, is operating with recommendations, usually from traditional users of sports nutrition products. This availability increases the probability that more people encounter the products, explain Carlson et al. (2008).

3. SPORT-RELATED NUTRITIONAL MARKETED PRODUCTS AND THEIR PERFORMANCE IMPACT ON ATHLETES

The athletes' nutrition should be developed for individual athletes based on their size, sex, body composition, activity levels, individual preferences and sport-specific requirements. For example, some athletes may prefer or require more carbohydrate-rich wholegrain foods, while others require more protein-rich meat and alternatives; it is concluded in the research developed by Food Standards Australia New Zealand (2010). In sports involving strength and power, athletes

strive to gain fat-free mass via a program of muscle hypertrophy at specified times of the annual macro-cycle. Whereas some athletes aim to gain absolute size and strength per se, in other sports, in which the athlete must move their own body mass or compete within weight divisions, it is important to optimize power to weight ratios rather than absolute power, say Stellingwerff et al. (2011). Thus, some power athletes also desire to achieve low body fat levels. In sports involving weight divisions (e.g. combat sports, lightweight rowing, weightlifting), competitors typically target the lowest achievable body weight category, while maximizing their lean mass within this target. Other athletes strive to maintain a low body mass and/or body fat level for separate advantages, explain O'Connor et al. (2011). Distance runners and cyclists benefit from a low energy cost of movement and a favorable ratio of weight to surface area for heat dissipation. Team athletes can increase their speed and agility by being lean, while athletes in acrobatic sports (e.g., diving, gymnastics, dance) gain biomechanical advantages in being able to move their bodies within a smaller space. In some of these sports and others (e.g., body building), there is an element of aesthetics in determining performance outcomes. Although there are demonstrated advantages to achieving a certain body composition, athletes may feel pressure to strive to achieve unrealistically low targets of weight/body fat or to reach them in an unrealistic time frame, states Sundgot-Borgen et al. (2013). Such athletes may be susceptible to practicing extreme weight control behaviors or continuous dieting, exposing themselves to chronic periods of low energy availability and poor nutrient support in an effort to repeat previous success at a lower weight or leaner body composition. Extreme methods of weight control can be detrimental to health and performance, and disordered eating patterns have also been observed in these sports scenarios, as concluded in both research studies Sundgot-Borgen et al. (2011), (2013). Nutrition goals and requirements are not static. Athletes undertake a periodized program in which preparation for peak performance in targeted events is achieved by integrating different types of workouts in the various cycles of the training calendar. Nutrition support also needs to be periodized, taking into account the needs of daily training sessions (which can range from minor in the case of “easy” workouts to substantial in the case of high-quality sessions, e.g. high intensity, strenuous, or highly skilled workouts) and overall nutritional goals. Nutrient needs and the practical strategies for meeting them pre, during, and post-exercise depend on a variety of factors including the event (mode, intensity, duration of exercise), the environment, carryover effects from the previous exercise, appetite, and individual responses and preferences, state Thomas et al. (2016). Athletes with poor nutritional habits will not reach their full potential. Adequate nutrients are important for tissue growth and repair which is required for athletes to have full recovery between practices and competitions, stresses Beck (2015). However, the main objective of sports nutrition must be preserving the health of the athlete, which can be achieved with an adequate intake adapted to the type of training performed. Arcusa et al. (2019) point out that optimal nutrition provides the energy necessary to perform physical exercise while reducing injury rate, a factor that together makes sports performance increase by itself. Nutrition plans need to be personalized to the individual athlete to take into account the specificity and uniqueness of the event, performance goals, practical challenges, food preferences, and responses to various strategies. A key goal of training is to adapt the body to develop metabolic efficiency and flexibility while competition nutrition strategies focus on providing adequate substrate stores to meet the fuel demands of the event and support cognitive function, conclude Thomas et al. (2016).

Van Loon (2014) states that while protein consumption before and during endurance and resistance exercise has been shown to enhance rates of muscle protein synthesis, a recent review found that protein ingestion alongside carbohydrates during exercise does not improve time-trial performance when compared with the ingestion of adequate amounts of carbohydrate alone.

3.1. Fluid and Electrolytes

Evidence is emerging on the increased risk of oxidative stress with dehydration, explain Hillman et al. (2014). Sawka et al. (2007) explain that fluid consumption before exercise is recommended to ensure that the athlete is well-hydrated before commencing exercise. Especially sodium losses linked to high temperature can be substantial, and in events of long duration or hot temperatures, sodium must be replaced along with fluid to reduce the risk of hyponatremia.

3.2. Dietary Supplementation

Australian Institute of Sport in 2015 examined that performance supplements that show to enhance performance include caffeine, beetroot juice, beta-alanine (BA), creatine, and bicarbonate. Sinclair et al. (2000) state “Results of studies reported over the last five years strongly indicate that caffeine effectively increases athletic performances in endurance events”. Athletes ranging from long distance runners to those participating in strength and power competitions benefit from caffeine consumption. Caffeine is a powerful ergogenic aid that may be beneficial in training and athletic performance. “It can exert its effects on both the central nervous system and the peripheral tissues, resulting in a number of physiological effects that might improve performance”, says Powers (2004).

According to Murphy et al. (2014), beetroot juice is used as a supplement because of its high inorganic nitrate (NO_3^-) content, a compound found naturally in vegetables and in processed meats, where it is used as a preservative. The findings reflect the importance of supplementation with NO_3^- or nitrate salts to increase the bioavailability of NO in order to influence muscle function improving exercise performance, mainly in aerobic metabolism state Lansley et al. (2011).

β -Alanine (BA) is a non-essential amino acid synthesized in the liver, explains Matthews et al. (1987). It is also found naturally occurring in animal products such as pork, chicken or red meat, say Artioli et al. (2010). The effect of BA on performance has been attributed to its capacity to increase carnosine synthesis. Carnosine promotes the sensitivity of muscle fibers to calcium, enhancing muscle excitation-contraction, emphasizes Dutka (2014). These effects have determined that BA supplementation improves performance at exercise efforts of duration from 6 to 60s, stress Van Thienen et al. (2009).

Creatine supplementation has been shown to increase the glycogen replenishment rate, which may help those athletes who perform at prolonged submaximal effort (65–75% peak of the maximum rate of oxygen consumption – $\text{VO}_{2\text{max}}$), explains Van Loon (2004). Greydanus et al. (2010) state that creatine supplementation increases lean body mass as well as strength, power, and efficacy in short-duration, high-intensity exercises.

The use of alkaline substances has been widely employed in various sports modalities and high-intensity exercise protocols, trying to improve performance by decreasing muscular fatigue, explain Krustup et al. (2015). The sodium bicarbonate (NaHCO_3) intake increases the blood concentration of sodium bicarbonate, which favors the hydrogen ion (H^+) and lactate efflux of the muscle cell and, in this way, decelerate the acidification process, say McNaughton et al. (2018). Buffer systems or physico-chemical mechanisms reduce the blood's pH deviation through their ability to neutralize acids or bases, states Apostu (2010). For this reason, athletes try to block acidity and prolong exercise capacity by drinking sodium bicarbonate whose structure allows excess lactate buffering.

4. METHODOLOGY

The market for sports nutrition products is expanding but is nevertheless a quite new research field in the Balkan countries. There is a lack of available statistics on the segment. The guidance for the development of this questionnaire adapted to the environment being researched, was from the thesis of Clemo M.P., “The relationship between nutrition knowledge and performance measures in British Collegiate of American football athletes”, February 2014 and the thesis of Basso G. and Moulin A. “The marketing influence of sports nutrition in the fitness market. The case of France”, May 2017.

The questionnaire had 34 questions and it was divided into four sections, the first one representing general knowledge of the athlete, followed by questions regarding the nutritional supplement and their performance impact on the athlete, and the third one focusing on the communication strategies used for marketing the nutritional supplements. The last section was regarding the demographic information of the respondents. The questionnaire for this research included athletes from the running community, who are speedsters, endurance and combo runners – based on how they respond to training and racing, reaching responsiveness of 58 respondents conducted online, during October and November 2021 in the Republic North of Macedonia. The analysis was conducted using the statistical program SPSS. A qualitative research method was used to quantify the problem by generating data that can be transformed into useable statistics, especially for longitudinal research such as the one presented in this paper.

5. DISCUSSION OF RESULTS

All of the respondents unitedly voted that in fact they are practicing running as a sport. More than half of them practice running more than four times a week and running three times a week was chosen as a second most voted option. The most frequent discipline they classified they are running with 69% was a half marathon, followed by 10.000 meters and thirdly a full marathon. The rest of the disciplines were less frequently voted. Between 4-7 years the respondents had a history of running, while from 1-3 years was the second option voted. Only a small percentage was from 7-10 years of running. At this stage, most of the respondents, over 70% are at a competitive phase of their running process. Over 90% said they do have rest days as athletes. 75% of the respondents consider their healthy everyday diet to be pretty healthy on average. The perception of the athletes considers to be a nutritional supplement, from all provided answers, and the dominant answer was “protein powders” with over 70%, “multivitamins” with almost 60% and “BCAA’s, glutamine, etc.” as a third option near 50%. To this question, multiple answers were allowed. Over 90% classify themselves as athletes who do take nutritional supplements. The reason why they decided to consume nutritional supplements was mostly to improve exercise recovery and increase the energy in the body. Increasing the endurance was also at a large scale presented as a reason, as well as to enhance the overall athletic performance. Protein in fact is considered to be the main energy source while having high intensity training. Most athletes consider carbohydrates to be beneficial for their athletic performance and are not sure if creatine as supplementation is providing effective results in improving their endurance. It was followed by a small difference between disagreeing and not being sure whether consumption of caffeine as supplementation can decrease the perception of effort. The athletes were certainly not sure if sodium bicarbonate will help them in preventing the delayed onset of muscular fatigue. However, they do agree that the nutritional supplements increase the amount of training they do and have an impact on their energy flow, along with the fact that nutritional supplements help

them cope with pain. A large percentage of the athletes as nutritional products stated they use “multivitamins” with 81%, “proteins” with 74% and amino acids with 33% as most frequently voted. To this question, multiple answers were allowed. 45% of them ranked they do feel nutrition is important for sports performance while only 25% out of all consider being the most important. The answers considering when they use the nutritional supplements vary in small percentages, between, consuming just before and after the event itself, adequate daily consumption as well as changing the pattern of intake at the time of completion. In regards to naming the top 3 nutritional supplements that increase their performance highly voted was “Protein” alongside “Creatine”, different types of multivitamins and amino acids. Only one athlete stated beetroot juice as an option. Regarding how they have noticed an increased performance after using the above-named nutritional supplements, most of them stated they have a better recovery process, have achieved new personal best results and have a higher level of endurance. The athletes do not find any criteria related to food supplements that would stop them from doing sports. Considering the information obtained regarding nutritional supplements, the athletes chose to be the “Internet” with 58% as one of the highest voted resources alongside 52% from “Teammates or colleague”, adding a Coach or a Fitness trainer as a third option with only 36%. To this question, multiple answers were allowed. Almost all the athletes buy their nutritional supplements from specialized shops and the Internet as a second option, which is seen in percentages is extremely close to personal selling as an option. They do research about the supplement before buying it. As well a large percentage does read the nutritional facts appointed on the label of the product. The highest quality product was chosen as the first option in terms of what are the top reasons, they choose to purchase nutritional supplements from this type of retailer, varying from only 2% to the option of “the best option for serious athletes”. Having purchased a product from that retailer is also a highly voted option, alongside having the best product for their age. The least voted option was that the retailer was socially responsible. Word of mouth has the biggest influence on where to buy nutritional supplements, for athletes together with social media is the second biggest influencer. The least influence they get from sponsoring products. If the brand of the nutritional supplement is being reviewed by an established athlete, the respondents are highly likely to buy it. Also, if it is a well-known name or if there is a special offer or promotion for it. The most valid criteria they look for in a nutritional supplement is from the person who recommended the product to more than half of the athletes. If the desired results from consuming the product are previously shown they would also take that as a good criterion while buying. The price has also a solid impact. Most of the athletes that responded to this questionnaire were male 69% versus women 31%, at the age between 35-44 years old, and almost all of them were employed.

6. FUTURE RESEARCH DIRECTIONS

There are three important future directions in this study before the future lines of research. The first one is an actual in-depth analysis of the athletes done in the field with one-on-one interviews that will be based on facts taken from the reports presented to the researcher, with confidentiality using more sophisticated methods and technologies that will segment the athletes into groups in addition to socio-demographic data and performance index.

Future research could validate the study in other countries where marketing strategies are widely integrated into the athletics communities with a special accent on National Athletic Federation as an institution. Future research should investigate types of sports-related nutrition that are enabled by marketing strategies, and identify their consequences.

Additionally, future studies could supplement the current model presented and explore the omics technologies in professional sport practice which provides an opportunity for a personalized (personified) approach for various areas, including nutrition and impact on the marketing communication strategies as a holistic approach.

7. CONCLUSION

From the results of the analysis, it can be concluded that in such a small community as the running community in the Republic of North Macedonia word of mouth and personal recommendations are the top channels when it comes to choosing the nutritional supplement, contrary to the well-known factors such as brand names of food supplements; visual differentiation through packaging which impacts impressiveness and abstract display of elements/effects on the packaging. A successful marketing strategy would be product presentation – communication-related to certain products and advice for their positive characteristics using a “third party”. As expected social media, although not the first choice, has been proven as an important marketing channel for advertising and building marketing strategies for nutritional supplements that athletes very frequently refer to.

REFERENCES

- Ånestad S. E., (2009). Sports Nutrition Products, [Nordic Council of Ministers
Apostu, M. (2010), Biochimie, Editura Moroșan, București, pp. 141-143
Arcusa Saura, R., Pilar Zafrilla Rentero, M., & Marhuenda Hernández, J. (2019). Sports Nutrition and Performance. In Nutrition in Health and Disease - Our Challenges Now and Forthcoming Time. IntechOpen
Artioli G.G., Gualano B., Smith A., Stout J., Lancha A.H. Jr. (2010). Role of beta-alanine supplementation on muscle carnosine and exercise performance. *Med Sci Sports Exerc.*;42(6):1162–73
Australian Institute of Sport (2015). ABCD Classification System [webpage on the Internet] Bruce, Australian Capital Territory: Australian Sports Commission; 2015. [Accessed July 12, 2021]. Available from: <http://www.ausport.gov.au/ais/nutrition/supplements/classification>.
Baines P, Fill C, Page K (2011). Marketing, 2nd edition, Oxford University Press, Italy.
Beck K.L, Thomson JS, Swift R.J, von Hurst P.R., (2015). Role of nutrition in performance enhancement and postexercise recovery. *Open Access J Sports Med.* 6():259-67
Bjerck, M., Ånestad, S. E., Jacobsen, E., & Schjøll, A. (2009). The Nordic market for sports nutrition products. Nordic Council of Ministers.
Burke LM, Meyer NL, Pearce J. (2013). National Nutritional Programs for the 2012 London Olympic Games: a systematic approach by three different countries. *Nestle Nutr. Inst. Workshop Ser.* 2013; 76():103-20.
Carlson, A., Bittmann F., Greil H., Kuphal M., Schweigert F. M., (2008). “Qualität der Kohlenhydratund Eiweißzufuhr im Nachwuchsleistungssport“, *Deutsche Zeitschrift für Sportmedizin*, Nr. 5-2008
Cave, A., & Miller, A. (2015, June 23). The importance of social media in sport. *Sunday Telegraph*. Retrieved from <https://www.telegraph.co.uk/investing/business-of-sport/social-media-in-sport/>
Dutka T. L, Lamb G. D. (2004). Effect of carnosine on excitation-contraction coupling in mechanically-skinned rat skeletal muscle. *J Muscle Res Cell Motil.* 25:203–13

- Food Standards Australia New Zealand, (2010). Australian Food Composition Tables, Canberra, ACT: Food Standards Australia New Zealand, retrieved from www.foodstandards.gov.au/consumer/nutrition/transfat/Pages/default.aspx
- Froiland, K., Koszewski, W., Hingst, J., Kopecky L., (2004). Nutritional supplement use among college athletes and their sources of information. *International journal of sport nutrition and exercise metabolism*, 14(1), 104-120.
- Gadiraju G.K, (2016). Impact of social media in sports marketing, Insitituo Univeristario de Lisboa
- Goston, J. L., Correia, M. I. T. D. (2010). Intake of nutritional supplements among people exercising in gyms and influencing factors. *Nutrition*, 26(6), 604-611.
- Greydanus D, Patel D. (2010). Sports doping in the adolescent: the Faustian conundrum of Hors de Combat. *Pediatr. Clin. North Am.* 57:729-750
- Hashoff. The most important social network for influencers 2017 [Available from: <https://de.slideshare.net/mobile/FilippPaster/hashoff-instagramdominates-influencer-marketing-report>]
- Hillman A.R., Turner M.C., Peart D.J., Bray J.W., Taylor L., McNaughton L.R., Siegler J.C., (2014). A comparison of hyperhydration versus ad libitum fluid intake strategies on measures of oxidative stress, thermoregulation, and performance, *Res. Sports Med.* 2013; 21(4):305-17.
- Krustrup P, Ermidis G, Mohr M. (2015). Sodium bicarbonate intake improves high-intensity intermittent exercise performance in trained young men. *J. Int. Soc. Sports Nutr.* 12(25):1-7
- Lansley K.E., Winyard P.G., Bailey S.J., Vanhatalo A., Wilkerson D.P., Blackwell J.R., Gilchrist M., Benjamin N., Jones A.M. (2011). Acute Dietary Nitrate Supplementation Improves Cycling Time Trial Performance. *Med. Sci. Sports Exerc.* 2011;43:1125–1131. doi: 10.1249/MSS.0b013e31821597b4
- Liang, H. (2015). Research on china's sports nutrition industry food development. Retrieved August 18, 2020, from Semantic scholar.org website: <https://pdfs.semanticscholar.org/5adc/d2616514ccdcbl4eb9f88bc70dd78117fabf.pdf>
- Matthews M.M, Traut T.W. (1987). Regulation of N-carbamoyl-beta-alanine amidohydrolase, the terminal enzyme in pyrimidine catabolism, by ligand induced change in polymerization. *J Biol. Chem.*;262(15):7232–7.
- Maughan, R. J. (2012). Quality Assurance Issues in the Use of Dietary Supplements, with Special Reference to Protein Supplements, 2. *The Journal of nutrition*, 143(11), 1843S-1847S.
- McNaughton L.R., Siegler J.C., Midgley A. (2008). The ergogenic effect of sodium bicarbonate. *Curr. Sport Med. Rep.* 7(4):230-6.
- Murphy M., Eliot K., Heuertz R., Weiss E. (2012). Whole Beetroot Consumption Acutely Improves Running Performance. *J. Acad. Nutr. Diet.* 2012;112:548–552. doi: 10.1016/j.jand.2011.12.002.
- O_Connor H, Slater G. (2011). Losing, gaining and making weight for athletes. In: Lanham-New S, Stear S, Sherriffs M, Collins A, eds. *Sport and Exercise Nutrition*. West Sussex, UK: Wiley-Blackwell; 210–232
- Pasiakos, S. M., Lieberman, H. R., & McLellan, T. M. (2014). Effects of protein supplements on muscle damage, soreness and recovery of muscle function and physical performance: a systematic review. *Sports Medicine*, 44(5), 655-670.
- Pilgrim, K., & Bohnet-Joschko, S. (2019). Selling health and happiness how influencers communicate on Instagram about dieting and exercise: mixed methods research. *BMC Public Health*, 19(1), 1054.
- Powers M. (2004). "Safety, Efficacy, and Legal Issues Related to DIETARY SUPPLEMENTS. " *Strategies* 18.1 (2004): 30-34. ProQuest Education Journals. ProQuest. Karl E. Mundt Library, Madison, SD. 22 Jan. 2009

- Sawka M.N., Burke L.M., Eichner E.R., Maughan R.J., Montain S.J., Stachenfeld, N.S., (2007). American College of Sports Medicine American College of Sports Medicine position stand. Exercise and fluid replacement. *Med. Sci. Sports Exerc.* 39(2):377–390
- Sinclair C., Geiger J. (2000). Caffeine use in sports: A pharmacological review. *Journal of Sports Medicine and Physical Fitness*, 40(1), 71-9. Retrieved October 30, 2009, from ProQuest Education Journals. (Document ID: 70976173)
- Technavio. (2022). Sports Nutrition Market in Europe to grow by USD 2.01 billion Accessed: <https://www.prnewswire.com/news-releases/sports-nutrition-market-in-europe-to-grow-by-usd-2-01-billion--technavio-301487679.html>
- Stellingwerff T., Maughan R.J., Burke L.M. (2011). Nutrition for power sports: middle-distance running, track cycling, rowing, canoeing/ kayaking, and swimming. *Journal of sports sciences*. 29(Suppl. 1):S79–89
- Sundgot-Borgen J, Garthe I. (2011). Elite athletes in aesthetic and Olympic weight-class sports and the challenge of body weight and body compositions. *Journal of Sports Sciences*. 29(Suppl. 1): S101–114.
- Sundgot-Borgen J, Meyer N.L., Lohman T.G., et al. (2013). How to minimize the health risks to athletes who compete in weight-sensitive sports review and position statement on behalf of the Ad Hoc Research Working Group on Body Composition, Health and Performance, under the auspices of the IOC Medical Commission. *British Journal of Sports Medicine*. 47(16):1012–1022
- Thomas, D., Burke L., Erdman K., (2016). Nutrition and Athletic Performance. *medicine and science*. 48. 543-568. 10.1249/MSS.0000000000000852.
- Titchenal C. (2001). Nutrition in Sport. *The American Journal of Clinical Nutrition*. 73. 135-135. 10.1093/ajcn/73.1.135.
- Van Loon L.J., (2014). Is there a need for protein ingestion during exercise? *Sports Med.* 44(Suppl 1):S105–S111
- Van Loon L.J., Murphy R., Oosterlaar A.M., Cameron-Smith D., Hargreaves M., Wagenmakers A.J., Snow R. (2004). Creatine Supplementation Increases Glycogen Storage but Not GLUT-4 Expression in Human Skeletal Muscle. *Clin. Sci. (London)* ;106:99–106. doi: 10.1042/CS20030116.
- Van Thienen R, Van Proeyen K, Van Eynde B, Lefere T, Hespel P. (2009), Beta-alanine improves sprint performance in endurance cycling. *Med. Sci. Sports Exerc.* 41:898–903
- Watts D.J., Dodds P.S. (2007). Influentials, networks, and public opinion formation. *J. Consum. Res.* 34(4):441–58
- Whitehouse, G., & Lawlis, T. (2017). Protein supplements and adolescent athletes: A pilot study investigating the risk knowledge, motivations and prevalence of use. *Nutrition & Dietetics*, 74(5), 509-515.
- Zion Market Research (2017). Nanomaterials Market (Metal Oxide, Metals, Chemicals & Polymers and Others) for Construction, Chemical Products, Packaging, Consumer Goods, Electrical and Electronics, Energy, Health Care, Transportation and Other Applications: Global Market Perspective. Sarasota: Zion Market Research, 2017. ID: ZMR-1979. Description available at: <https://www.zionmarketresearch.com/report/nanomaterials-market>.