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Original Article

Food Intake Evaluation in a Group of Elite Track and Field Athletes

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ABSTRACT

Introduction: Eating behaviours and nutritional status are key factors related to individuals' health. In athletes, diet optimisation has a key role in training adaptation achievement, injury prevention and good health status maintenance. However, nowadays it is still common to find diet behaviours not optimised with an increased risk of energy/nutrients deficiencies that can result not only in performance impairment but also in increased injury frequencies and malnutrition.

Aim: To evaluate food intakes of elite track and field athletes to evaluate the adequacy of their diet.

Materials and Methods: A total of 24 healthy elite track and field athletes, aged 18-30 years participated in the study. Anthropometric measurements were performed (weight, height, body circumferences, skinfold thickness) and Food Habits were evaluated using a seven days-food diary. Data were analysed through the WinFood® software, to obtain information about the basal metabolic rate and the energy expenditure of subjects. Moreover, information about macro and micro-nutrients were obtained both as percentage and grams. Statistical analysis was carried out in order to evaluate difference between male and female and between studied group's intakes and international nutritional guidelines (The International Society of Sport Nutrition (ISSN)'s guidelines and the Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine (ACSM) on Nutrition and Athletic Performance).

Results: From the analysis, it was observed that energy expenditure resulted higher than the caloric intake. On average, there was a difference of about 30% between the energy expenditure and the caloric intake. The amount of macronutrients daily assumed by athletes was lower than values suggested by the major international society of sport in case of carbohydrates especially in female. Proteins intake resulted to be adequate, on the other hand, lipids intake were higher than recommendations above all in female.

Furthermore, athletes did not assume adequate intakes of the most important micronutrients respect to the values suggested by guidelines especially for Calcium both in male and female and Iron in female.

Conclusion: These results underline the importance of nutritional education programs and of nutritional practitioner in order to optimise the diet with proper intakes of macro and micro-nutrients.

Keywords: Diet, Nutrients, Nutrition, Nutritional status, Sports

INTRODUCTION

Specific training, adequate rest and proper nutrition are key factors in athlete's health status and performance optimisation [1]. The role of nutrition is now supported by an increasing level of evidence both from science and practice, suggesting its key role [2]. Fundamental aims of a proper athlete diet are maximising functional and metabolic adaptation to training program in parallel with health status optimisation and injury prevention [3,4]. Moreover, the optimisation of diet has been demonstrated to have a positive impact not only on performance level but also on a more prepared mental state for competition [5]. The increased knowledge of exercise physiology and increased number of reports and studies lead to the construction of specific sport nutrition guidelines with The International Society of Sport Nutrition (ISSN)'s guidelines (2010) and the Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine (ACSM) of 2016 on Nutrition and Athletic Performance representing the most important reference documents where athlete's needs are underlined [1-3].

Diet strategies should address factors related to hydration, electrolyte balance, glycogen depletion, hypoglycaemia and gut comfort [3] with needs vary according to individual goals of athlete and program [6]. The two key aspects of sports nutrition are meeting nutritional body demands (both in terms of energy and nutrients) and improving body composition [6]. First of all, performing any kind of physical activity will increase the rate of energy expenditure and therefore, determine changes in individual needs [4]. In particular, athletes need to consume energy that is adequate in amount and timing of intake. Indeed, it has been clearly shown how ingesting an insufficient amount of calories may negatively affect athlete performance and training adaptations [1,3]. Low energy availability can result in unwanted decrease of muscle mass; hormonal imbalance and menstrual dysfunction; suboptimal bone density; increased risk of fatigue, injury, and illness; impaired adaptation; and a prolonged recovery process [3].

Along with energy intakes, macro and micro-nutrients are both of relevant importance when diet is planned [2]. Data have demonstrated an important role of both macro and micro-nutrient availability in regulating exercise-induced cell-signalling pathways that are thought to regulate skeletal muscle adaptations to exercise training [7]. In term of nutrients, athletes must firstly consume enough calories to balance energy expenditure and macronutrients must be optimised to improve training. Energy is mainly stored as fat and carbohydrates. Carbohydrate provides fuel for the brain and central nervous system and a substrate for muscular work supporting exercise over a large range of intensities due to its utilisation by both anaerobic and oxidative pathways. Consequently, the availability of carbohydrate as muscle substrate becomes a limiting factor in prolonged exercise sessions and an important factor in performance of short high intensity exercise [3,8]. Exhaustion in glycogen stores is accompanied by fatigue in the form of reduced work rates, impaired skill and concentration, and increased perception of effort. During intensified sport activities, diet has a crucial role in supporting the fuel demands avoiding energy deficit, fatigue and higher risk of illness and injuries maintaining a proper immune function and preventing overtraining [3,8-10]. Carbohydrate intakes are so strictly related to individual characteristics and goals and should be periodised and developed according to sport season and athlete needs. Moreover, the importance of the interplay of the three macronutrients leads the research to focus on proteins and lipids intakes. Dietary proteins influence exercise providing substrate for contractile and metabolic proteins' synthesis and enhancing structural changes. In recovery, they are important in facilitating muscle repair, muscle remodelling, and immune function. An optimal protein and amino acid intake are strictly related to strength in particular as a plastic substrate to ensure training adaptations [3]. In athletes, the role of proteins has been recognised and guidelines underline that requirements should be considered elevated in athletes involved in strength, speed but also endurance and ultra-endurance training [1,3,10,11]. Also, fat are important as they are a cornerstone of a healthy diet, providing energy, essential elements of cell membranes and facilitation of the absorption of fat-soluble vitamins. Parallel, micronutrients have a fundamental role on athletes' diet even if there is a lack of specific information about whether micronutrients requirements are greater for active people than sedentary and the low intakes of vitamins and minerals can impact the exercise capacity and performance [12,13].

Energy and macronutrients' metabolisms, tissue repair and oxygen transport involve micronutrients (minerals and vitamins) as key factors in numerous reactions related to physical activity [13,14]. Vitamins deficiencies could lead to different consequences for the athlete with possible muscle function impairment and reduced performance. In particular, decreased intakes of iron and vitamin B12 (associated with anaemia) can be linked to reduced endurance capacity and decreased Magnesium intake could impair metabolic capacity to face submaximal efforts [12]. Particular attention has also to be related to water and liquid intake. In addition to the usual daily water losses from respiration, gastrointestinal, renal, and sweat sources, athletes need to replace sweat losses. Now, several strategies are under investigation as proper water intake and hydration status contributes to optimal health, exercise performance and prevention of injuries [3,15]. In addition, special needs are related to different discipline or different activity (i.e., short high intensity vs. long lasting aerobic training) that requires different caloric uptake and different macronutrients proportions [1,3,16].

Sprint disciplines involve energy systems and metabolisms completely different from endurance. In endurance disciplines, trainings or competition usually last at least more than 60 minutes while sprinters perform all-out short efforts, from 60 to 400 m bouts of sprints, with relatively long rest periods between each other [17]. So, in these cases, performance relies primarily on anaerobic systems: phosphocreatine and, glycolytic, for longer events [17]. Carbohydrates represent an essential fuel for sprints and proteins, the fundamental substrate to build large and powerful muscles. Nutrient timing, especially during competitions becomes an extremely important factor to ensure adequate supplies and at the same time prevent any kind of discomfort for the athlete [18].

Evaluating athletes' food habits resulted so of fundamental importance. Collecting information on eating habits has proven to be a useful prevention tool for a range of chronic diseases and disorders [19]. Measuring dietary exposure can result in great difficulty; available tools nowadays are represented by self-reported methods and of biomarkers analysis. In the first case, the main limits are related to people perception of what they eat, accuracy on food diary completion and recall bias, since individuals are asked to report dietary intake retrospectively. Biomarkers utilisation also has its limitations and possible bias due to inter-individual factors like gender and age, tobacco smoking, medication [19,20]. Considering athletes and sport nutrition, the meta-analysis published by Capling L et al., show how over the past 37 years very few papers were published in this topic (dietary assessment) and how there is a large variability in the choice of recording method [21]. One of the most utilised tool to assess dietary intakes is food frequency questionnaire widely used since 1990s. The other main utilised tools for food consumption record are food consumption records, 24-hours dietary recall, dietary record and dietary history [19].

Studies regarding dietary assessment on athletes have shown that the intake of certain quantities of energy and nutrients is commonly below recommendations [13,22,23]. To date, studies have demonstrated how proteins intake usually meet the current guidelines while carbohydrates do not [24-26] and that elite athletes' intakes of total calories, carbohydrates and micronutrients are often not adequate [24,27]. Moreover, an emerging problem related to athletes is represented now by body image dissatisfaction. This phenomenon includes physiological, psychological and sociological components and it is related to self-esteem degree [28]. Some research underlined as sport-related weight pressures could be a contributor to body image concerns leading athletes, especially females, to force themselves to reach a continuously improved body condition leading to distortion of body image [29].

Now, correct dietary habits has become a crucial aspect and studies able to understand the most common dietary deficiencies and discipline-specific deficiencies would be of fundamental importance in order to be able to understand and improve possible wrong dietary habits. Nutritionist would be a key professional in athlete staff and knowing possible dietary mistakes would be important in order to optimise health status and performance of the individual focusing the attention not only on specific training and recovery but also on a proper diet able to support the athlete.

In this regard, the present study aimed to evaluate the body composition, the nutritional and hydration states of a group of elite athletes, in order to investigate if nutrients and caloric intake were appropriate taking into account the International Society of Sport Nutrition (ISSN), the American College of Sports Medicine (ACSM) and the Italian Reference Intake Level of Nutrient and Energy (LARN)' guidelines [1,3,11,30].

MATERIALS AND METHODS

An observational study was carried out on elite track and field athletes of a local team in San Benedetto del Tronto (AP) located in Le Marche region (Italy) from September 2016 to June 2017. Participant of this study were 24 elite track and field athletes aged between 18 and 30 years-old.

Participants

Inclusion criteria were being elite healthy track and field athletes free from pathologies and musculoskeletal injury. Exclusion criteria were being under 18-year-old, suffering from any kind of pathologies and musculoskeletal injury, being under any kind of pharmacological therapy. After an explanation of the study, athletes agreeing to participate in the study signed an informed consent. Subjects completed a basic demographic questionnaire elaborated by us, including identifying their sport's disciplines and the hours of training per week **[Annexure 1]**.

Measures

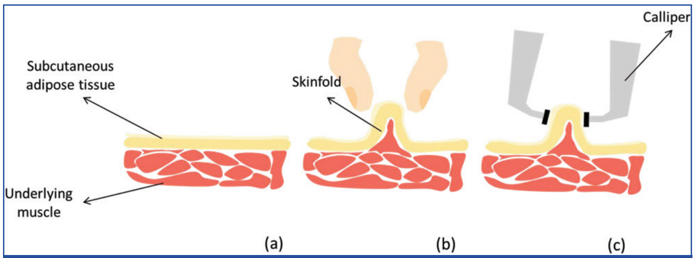
Body Composition

In order to evaluate athletes' body composition, anthropometric measurements were performed (weight, height, body circumferences, skinfold thickness) following standard procedures. In particular, Weight, Height, Skinfolds were collected for each subject. Weight was measured using a mechanical balance scale (Wunder RB200) with a precision of 0.01 kg. Height was measured shoeless using a stadiometer (Wunder HR1) with a precision of 0.1 cm. The measure was taken checking the correct position of the head in the standard position of reference Frankfurt plane.

Skinfold thickness were measured using a GIMA Skinfold Caliper with a precision of 0.2 mm, at different sites on the right site of the body: triceps, biceps, mid-axillary, chest, subscapular, abdominal, suprailiac, thigh, calf.

The procedure was carried out following guidelines on the National Health and Nutrition Examination Survey (NHANES) Anthropometry Procedure manual [31]. First, the selected site was marked with a skin pencil. The skinfold was pinched with the thumb and index finger. Caliper was then placed perpendicular to the pinched skinfold and measure was read after three seconds [Table/Fig-1]. Percentage of fat mass was estimated using first Jackson AS and Pollock ML, equations (both 3 and 7-sites) [Table/Fig-2] to obtain Body Density (BD) and then Siri equation [32,33]. In particular, BD was calculated as reported in [Table/Fig-2] [32]. From body density, percentage of fat mass was obtained by SIRI equation [33].

FAT={(4.95/BD)–4.5{x 100.



[Table/Fig-1]: Skinfold thickness measurement procedure. Representation of subcutaneous adipose tissue and underlying muscle (a); skinfold preparation for measurement (b); skinfold thickness measurement (c)

Jackson and Pollock equations (male)	
3-sites	BD=1.10938-(0.0008267×sum of chest, abdomen and thigh skinfolds in mm)+(0.0000016×square of the sum of chest, abdomen and thigh)-(0.0002574×age)
7-sites	1.112-(0.00043499×sum of skinfolds)+(0.00000055×square of the sum of skinfold sites)-(0.00028826×age), where skinfold sites (mm) are: Chest, Axilla, Tricep, Subscapular, Abdominal, Suprailiac and Thigh
Jackson and Pollock equations (female)	
3-sites	BD=1.0994921-(0.0009929×sum of triceps, thigh and suprailiac skinfolds)+(0.0000023×square of the sum of triceps, thigh and suprailiac skinfolds)-(0.0001392×age)
7-sites	BD=1.097-(0.00046971×sum of skinfolds)+(0.00000056×square of the sum of skinfold sites)-(0.00012828×age), where skinfold sites (mm) are: Chest, Axilla, Tricep, Subscapular, Abdominal, Suprailiac and Thigh

[Table/Fig-2]: Jackson and Pollock equations used to calculate body density [32].

Data were analysed using Winfood® software in order to obtain information about the Free-Fat Mass, the Fat Mass, the Basal Metabolic Rate (Harris-Benedict equations) and the Energy Expenditure.

Food Intake Assessment

Food intake was assessed using a seven days-food diary **[Annexure 2]**. Specifically, every subject was required to describe each meal describing also how food was prepared (e.g., boiled, roasted…), the time of day that they ate, use of any kind of condiments and serving portion. Moreover, each athlete should write all the beverages consumed during the day (amount, hour of consumption and description) and any kind of supplement used.

Data were analysed through the WinFood® software, specifically made to insert and analyse food diary intake in order to evaluate the amount of macronutrients and micronutrients both in percentage and in grams, the amount of water and other beverages consumed and the use of supplements.

Design and Procedures

Measurements were carried out in the morning, before the training session, the same day a seven day-food diary was given to each participant with the instruction to complete it in one week.

STATISTICAL ANALYSIS

Descriptive analysis of data, t-student test and Mann-Whitney test (for non-parametric sample) were performed using the Statistical Package for Social Sciences (SPSS Inc., an IBM Company, Chicago, Illinois, USA) version 24.0 p-value <0.05 was considered as significant.

RESULTS

Participants

A total of 24 track and field athletes, 5 female 19 male, aged 18-30 years, participated in the study. Average hours of training per week were 40-45 hours with 3-5 times per week of double training per day.

Measures

Body Composition

[Table/Fig-3] showed body weight and the percentage of fat mass both were using the 3-site and the 7-site Jackson and Pollock equation.

	Male (n=19)	Female (n=5)	p-value
Body weight (kg)*	72.37±6.10	58.20±2.39	0.0003
% Fat mass (7-site)*	5.26±0.73	11.80±0.45	0.0004
% Fat mass (3-site)*	5.21±0.53	14.20±0.84	0.0002

[Table/Fig-3]: Studied population characteristics according to gender.
Value expressed as mean±standard deviation; *Significant difference between male and female

Food Intake Assessment

The [Table/Fig-4] showed the daily energy consumed expressed as kcal over body weight. Both in male and in female, the average of kcal consumed during the day resulted to be lower than the recommended amount by ISSN guidelines. Indeed, in this case the average is of 31,60 kcal/kg/day for female and 31,68 kcal/kg/day for male against the 50-80 kcal suggest by ISSN in case of prolonged activities [Table/Fig-4,5].

ACSM guidelines suggested calculating the energy intake taking into account BMR and level of physical activity coefficient. As showed in [Table/Fig-4], both male and female consumed less kcal than suggested.

Macronutrient consumption are showed in [Table/Fig-6]. Intakes are expressed as grams per body weight per day. As it is possible to observe, proteins resulted to be in accordance with ISSN, ACSM and LARN guidelines. Lipids resulted to be higher above all in female and carbohydrate resulted below the suggested amounts, precisely 2.9 g/kg/day and 3.6 g/kg/day respectively for female and male against the suggested 1.5-2.0 by ISSN and 1.2-1.7 by ACSM.

Micronutrients intakes were compared with LARN guidelines [Table/Fig-7]. In this case, it is possible to observe that calcium resulted to be lower than suggested value both in male and female. Moreover, in female potassium and iron resulted lower. On the other hand,

	Male (n=19)	p-value (DCI kcal vs. EER)	p-value (DCI kcal/kg/day vs. ISSN	Female (n=5)	p-value (DCI kcal vs. EER)	p-value (DCI kcal/kg/day vs. ISSN	p-value (male vs. female)
BMR (kcal)†	1789.68±107.64			1395.80±29.79			0.0001
EER (kcal)†	3576.26±190.44			2456.40±66.52			0.0008
DCI (kcal)	2309.05±332.70*	0.0001		1831.00±664.37	0.3100		0.2000
DCI (kcal/kg/day)	31.68±5.35**		0.0001	31.60±11.87**		0.0004	0.6900

[Table/Fig-4]: Caloric intake and requirements of track and field athletes according to gender.
Value expressed as mean±Standard deviation; BMR=Basal metabolic rate; EER: Estimated energy requirement; DCI: Daily caloric intake; BW: Body weight; ISSN: International society of sport nutrition (guidelines); *Significantly different compared to the Estimated Energy Requirement; **Significantly different compared to ISSN guidelines, t-test for independent sample; †Significant difference between male and female

	ISSN					
	Energy		Carbohydrates	Proteins	Fats	
Physical activity level	kcal/kg/day	kcal/day	g/kg BW/d	g/kg BW/d	g/kg BW/d	%
General physical activity (30-40 minutes/day, 3 times a week)	25-35	1800-2400	3-5	0.8-1	0.5-1	30%
Moderate levels of intense training (2-3 hours/day, 5-6 times a week)	50-80	2500-8000	5-8	1.0-1.5		
High-volume intense training (3-6 hours/day, 1-2 sessions/day, 5-6 times a week)	50-80	2500-8000	8-10	1.5-2.0		
Elite athletes	150-200	Up to 12000				
Large athletes	60-80	6000-12000				

[Table/Fig-5]: Intensity based daily athletes' energy and macronutrients needs [1].

Sodium resulted to be higher than the upper limit suggested by LARN both in male and female. No one of the subjects used supplements constantly and daily but only sporadically. Due to this, supplements were not considered in the daily intake evaluation.

DISCUSSION

Diet is one of the most important factors that contribute to a good performance and also to a good health status of athletes. Energy intake and macro and micro-nutrients intakes should be optimised to improve training and performance [1]. An appropriate energy intake is the basis of the athletes' diet and it is interrelated to ideal body function and body composition [34]. Harmonising energy consumption with energy expenditure is critical to prevent an energy deficit or excess. In particular, energy deficits can cause fatigue, injury or illness and loss of muscle mass [35]. A study conducted on Canadian high-performance athletes showed that athletes did not consume adequate energy or carbohydrates based on self-reported food record submissions [27]. Another study, conducted on teenage female skaters found that they have relatively low energy intake and inadequate intakes of certain nutrients [36].

In a group of Elite Basketball players from Spain, inadequate intakes of carbohydrates and vitamin E were found, and almost half of the group reported not to drink before getting thirsty [25]. Studies demonstrated that it is common to find an energy intake in athletes lower that the recommended guidelines [22,23,25]. In accordance to this, from this study it was possible to observe that the caloric intake of the evaluated elite track and field athletes was not enough compared to the international guidelines. Although a significant differences between male and female is present in terms of estimated energy requirement, this differences cannot be found in the comparison between daily caloric intake in male and female that results both under the suggested values. It is demonstrated that it is common to find carbohydrates intake lower than the suggested ones and this occurs above all in female athletes, usually related to the control of body weight [23,37]. Carbohydrates contribute to meeting specific energy needs, to maintain glycaemia and recover glycogen reserves [23]. They are essential to replenish muscle glycogen storage [1] and an inadequate intake could result in the use of body protein as an energy source, impairing the growth and biological processes in both sexes [23,35].

On the other hand, proteins intakes result to be adequate although studies reported that it is common to find proteins intake greater than the suggested amount [22,25]. Lipids intake resulted to be higher above all in female. This is in contrast with data reported by Croll JK et al., where total fat intake is lower in particular in female [22]. On the other hand, in a study related to a group of Elite Spanish Basketball Players, the total fat resulted to be higher than the suggested amount [25]. Among micronutrients, calcium resulted to be lower respect to the adequate intake both in male and female. Surveys carried out on athletes commonly reported a low intake of calcium according to dietary recommendations [22,23,37,38].

Calcium intake is positively related to bone mass but despite the importance of calcium intake for bone development, numerous studies have confirmed that physically active females have inadequate calcium intakes [39]. In female, also Iron and Potassium are found to be lower than the recommendations. Inadequate iron intake among sport-involved females is relatively common [22,40] and is of particular concern for athletic females for exercise-related iron losses [22]. Sodium consumption resulted higher than the upper level designed by LARN both in male and female. This could be related to an increased amount of sodium need in case of prolonged exercise. Indeed, athletes are advised to increase sodium intake

	Male (n=19)	Female (n=5)	p value (male vs. female)	ISSN (High-volume intense training)	ACSM (endurance)	LARN
Carbohydrates (g/kg)†	3.60±0.97	2.92±0.77	0.04	8.0-10.0	6.0-10.0	
Carbohydrates (% of DCI)	44.67±8.89	38.86±9.41	0.33			45-65% of DCI
Proteins (g/kg)	1.79±0.33	1.73±0.23	0.94	1.5-2.0	1.2-1.4	1.2-1.4
Lipids (% of DCI)	35.60±7.71	45.44±13.32	0.18	25-35%	20-35%	20-35%

[Table/Fig-6]: Macronutrients intake of track and field athletes according to gender.
Value expressed as mean±standard deviation; DCI: Daily caloric intake; ISSN: International society of sport nutrition (guidelines); ACSM: American college of sports medicine; LARN: Livelli di Assunzione di Riferimento di Nutrienti ed energia (Italian reference intake of nutrients and energy); †Significant difference between male and female; non parametric test for independent samples

	Male (n=19)	LARN			Female (n=5)	LARN			p-value (male vs. female)
		PRI	AI	UL		PRI	AI	UL	
Calcium (mg)	900.37±317.44	1000			710.00±219.24	1000			0.3600
Sodium (mg)	3010.26±1354.63		1500	2000	2096.20±424.19		1500	2000	0.1000
Potassium (mg)	3835.16±959.94		3900		2912.80±633.42		3900		0.0500
Phosphorus (mg)	1733.37±485.79	700			1421.60±258.76	700			0.1000
Iron (mg)†	16.00±2.85	10			12.80±2.17	18			0.0200
Zinc (mg)	15.63±2.75	11			13.20±2.28	8			0.0600
Magnesium (mg)	244.79±128.24	240			225.40±97.13	240			0.6800

[Table/Fig-7]: Micronutrients intake of track and field athletes according to gender.
Value expressed as mean±standard deviation;PRI: Population reference intake; AI: Adequate intake; UL: Upper limit; LARN= Livelli di Assunzione di Riferimento di Nutrienti ed energia (Italian reference intake of nutrients and energy); †Significant difference between male and female; non parametric test for independent samples

before, during and after exercise to ensure a proper hydration, replace sodium lost in sweat and maintain performance [41].

LIMITATION

The limitation of this study can be represented by the lower number of involved athletes. However, due to the difficulties faced in involving elite athletes in the present county, obtained data can be important to have a first idea about the local situation. Increasing the number of athletes is one of the main aims of further studies. Moreover, it would be of fundamental importance to improve this study by monitoring athletes' nutrient intake over time combining body composition analysis to food intake evaluation in order to evaluate the possible impact of caloric intake and nutrients on body composition.

CONCLUSION

Importance of specific nutritional education was underlined by data obtained evaluating macro and micro-nutrient intakes of 24 elite track and field athletes. The importance of activities conducted by nutritionist in order to sensitise athletes regarding food habits and proper diet was underlined. Specific programs should be organised depending on athletes' age starting from young athletes (through the organisation of game-like activities) to adult/master athletes (through the organisation of conferences). Based on the outcomes of the present study, the importance of nutritional education and surveillance is highlighted, as it is still common to find wrong food habits and consequent nutritional deficiencies in athletes. In this regard, the role of nutritionist is the optimization and personalization of the diet in order to improve performance and health status avoiding key nutrient deficiencies.

REFERENCES

[1] Kreider RB, Wilborn CD, Taylor L, Campbell B, Almada AL, Collins R, et al. ISSN exercise & sport nutrition review: research & recommendations. J Int Soc Sports Nutr. 2010;7(1):7.
[2] Beck KL, Thomson JS, Swift RJ, von Hurst PR. Role of nutrition in performance enhancement and postexercise recovery. Open Access J Sports Med. 2015;6:259-67.
[3] Thomas DT, Erdman KA, Burke LM. Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and Athletic Performance. J Acad Nutr Diet. 2016;116(3):501-28.
[4] Maughan R. The athlete's diet: nutritional goals and dietary strategies. Proc Nutr Soc. 2002;61(1):87-96.
[5] Cockburn E, Fortune A, Briggs M, Rumbold P. Nutritional knowledge of UK coaches. Nutrients. 2014;6(4):1442-53.
[6] Burke LM, King C. Ramadan fasting and the goals of sports nutrition around exercise. J Sports Sci. 2012;30 Suppl 1:S21-31.
[7] Close GL, Hamilton DL, Philp A, Burke LM, Morton JP. New strategies in sport nutrition to increase exercise performance. Free Radic Biol Med. 2016;98:144-58.
[8] Burke LM, Kiens B, Ivy JL. Carbohydrates and fat for training and recovery. J Sports Sci. 2004;22(1):15-30.
[9] McCartney D, Desbrow B, Irwin C. Post-exercise Ingestion of Carbohydrate, Protein and Water: A Systematic Review and Meta-analysis for Effects on Subsequent Athletic Performance. Sports Med. 2018;48(2):379-408.
[10] Heaton LE, Davis JK, Rawson ES, Nuccio RP, Witard OC, Stein KW, et al. Selected In-season nutritional strategies to enhance recovery for team sport athletes: a practical overview. Sports Med. 2017;47(11):2201-18.
[11] Jager R, Kerksick CM, Campbell BI, Cribb PJ, Wells SD, Skwiat TM, et al. International Society of Sports Nutrition Position Stand: protein and exercise. J Int Soc Sports Nutr. 2017;14:20.
[12] Lukaski HC. Vitamin and mineral status: effects on physical performance. Nutrition. 2004;20(7-8):632-44.
[13] Volpe SL. Micronutrient requirements for athletes. Clin Sports Med. 2007;26(1):119-30.
[14] Mielgo-Ayuso J, Maroto-Sanchez B, Luzardo-Socorro R, Palacios G, Palacios Gil-Antunano N, Gonzalez-Gross M, et al. Evaluation of nutritional status and energy expenditure in athletes. Nutr Hosp. 2015;31 Suppl 3:227-36.
[15] Brancaccio P, Limongelli FM, Paolillo I, D'Aponte A, Donnarumma V, Rastrelli L. Supplementation of Acqua Lete(R) (Bicarbonate Calcic Mineral Water) improves hydration status in athletes after short term anaerobic exercise. J Int Soc Sports Nutr. 2012;9(1):35.
[16] Impey SG, Hearris MA, Hammond KM, Bartlett JD, Louis J, Close GL, et al. Fuel for the work required: a theoretical framework for carbohydrate periodization and the glycogen threshold hypothesis. Sports Med. 2018;48(5):1031-48.
[17] Tipton KD, Jeukendrup AE, Hespel P, International Association of Athletics F. Nutrition for the sprinter. J Sports Sci. 2007;25 Suppl 1:S5-15.
[18] Kerksick CM, Arent S, Schoenfeld BJ, Stout JR, Campbell B, Wilborn CD, et al. International society of sports nutrition position stand: nutrient timing. J Int Soc Sports Nutr. 2017;14:33.
[19] Shim JS, Oh K, Kim HC. Dietary assessment methods in epidemiologic studies. Epidemiol Health. 2014;36:e2014009.
[20] Naska A, Lagiou A, Lagiou P. Dietary assessment methods in epidemiological research: current state of the art and future prospects. F1000Res. 2017;6:926.
[21] Capling L, Beck KL, Gifford JA, Slater G, Flood VM, O'Connor H. Validity of dietary assessment in athletes: a systematic review. Nutrients. 2017;9(12).
[22] Croll JK, Neumark-Sztainer D, Story M, Wall M, Perry C, Harnack L. Adolescents involved in weight-related and power team sports have better eating patterns and nutrient intakes than non-sport-involved adolescents. J Am Diet Assoc. 2006;106(5):709-17.
[23] Coutinho LA, Porto CP, Pierucci AP. Critical evaluation of food intake and energy balance in young modern pentathlon athletes: a cross-sectional study. J Int Soc Sports Nutr. 2016;13:15.
[24] van Erp-Baart AM, Saris WH, Binkhorst RA, Vos JA, Elvers JW. Nationwide survey on nutritional habits in elite athletes. Part I. Energy, carbohydrate, protein, and fat intake. Int J Sports Med. 1989;10 Suppl 1:S3-10.
[25] Schröder H, Navarro E, Mora J, Seco J, Torregrosa JM, Tramullas A. Dietary Habits and Fluid Intake of a Group of Elite Spanish Basketball Players: A Need for Professional Advice? Eur J Sport Sci. 2004;4(2):1-15.
[26] Burkhart SJ, Pelly FE. Dietary intake of athletes seeking nutrition advice at a major international competition. Nutrients. 2016;8(10):638.
[27] Lun V, Erdman KA, Reimer RA. Evaluation of nutritional intake in Canadian high-performance athletes. Clin J Sport Med. 2009;19(5):405-11.
[28] Kantanista A, Glapa A, Banio A, Firek W, Ingarden A, Malchrowicz-Mos´ko E, et al. Body image of highly trained female athletes engaged in different types of sport. Biomed Res Int. 2018;2018:6835751.
[29] Varnes JR, Stellefson ML, Janelle CM, Dorman SM, Dodd V, Miller MD. A systematic review of studies comparing body image concerns among female college athletes and non-athletes, 1997-2012. Body Image. 2013;10(4):421-32.
[30] SINU L. Livelli di Assunzione di Riferimento di Nutrienti ed Energia per la Popolazione Italiana. 2014.
[31] National Center for Health Statistics. Data Sets and Related Documentation of National Health and Nutrition Examination Survey.
[32] Jackson AS, Pollock ML. Generalized equations for predicting body density of men. Br J Nutr. 1978;40(3):497-504.
[33] Guerra RS, Amaral TF, Marques E, Mota J, Restivo MT. Accuracy of Siri and Brozek equations in the percent body fat estimation in older adults. J Nutr Health Aging. 2010;14(9):744-48.
[34] Thomas DT, Erdman KA, Burke LM. American College of Sports Medicine Joint Position Statement. Nutrition and Athletic Performance. Med Sci Sports Exerc. 2016;48(3):543-68.
[35] Purcell LK, Canadian Paediatric Society PS, Exercise Medicine S. Sport nutrition for young athletes. Paediatr Child Health. 2013;18(4):200-05.
[36] Ziegler P, Sharp R, Hughes V, Evans W, Khoo CS. Nutritional status of teenage female competitive figure skaters. J Am Diet Assoc. 2002;102(3):374-79.
[37] de Assumpcao D, Dias MR, de Azevedo Barros MB, Fisberg RM, de Azevedo Barros Filho A. Calcium intake by adolescents: a population-based health survey. J Pediatr (Rio J). 2016;92(3):251-59.
[38] Cotunga N, Vickery CE, McBee S. Sports nutrition for young athletes. J Sch Nurs. 2005;21(6):323-28.
[39] Mehlenbeck RS, Ward KD, Klesges RC, Vukadinovich CM. A pilot intervention to increase calcium intake in female collegiate athletes. Int J Sport Nutr Exerc Metab. 2004;14(1):18-29.
[40] Manore MM, Patton-Lopez MM, Meng Y, Wong SS. Sport Nutrition Knowledge, Behaviours and Beliefs of High School Soccer Players. Nutrients. 2017;9(4):350.
[41] Turner MJ, Avolio AP. Does Replacing sodium excreted in sweat attenuate the health benefits of physical activity? Int J Sport Nutr Exerc Metab. 2016;26(4):377-89.

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Annexure 1.
Basic demographic questionnaire.

Basic demographic questionnaire

Name______________________ Surname______________________ Date of birthday____________

1] How many times per week do you train?

____

How many hours during the day? ____________

2] Specific sport disciplines: ______________________

3] Are you intolerant or allergic to some food? ________________________________

Supplements

4] Do you use supplements?
Yes No

If yes, which kind of supplement?____

Why?____

Annexure 2.
1 day model of 7-days Food-diary

Food Diary (Date: __/__/____)
Breakfasts:
Time:
Where:
Snack (mid-morning):
Time:
Where
Lunch:
Time:
Where:
Snack (afternoon):
Time:
Where
Dinner:
Time:
Where:
Snack (after-dinner):
Time:
Where: