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BMI and Nutritional Status in Physical Active Population Involved in Recreational Sport

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Abstract

Practice of sport, exercise or recreational physical activity increase the needs of energy and nutrients. Objectives are: 1) to evaluate BMI; 2) to assess the nutritional status; and 3) to test the association between BMI and KIDMED index. The study is realized on a sample of healthy young participants (N=101), aged 18 – 35, that do recreational sport activities such as: football (N=24), basketball (N=16), handball (N=15), volleyball (N=20), tennis (N=10), swimming (N=10) and martial arts (N=9). Body composition: height, weight, and BMI, were measured and calculated according to World Health Organization's manual. A 16-item KIDMED questionnaire was used to assess nutritional status. KIDMED index was calculated after the KIDMED questionnaire was administered to all participants. Spearman's rank correlation coefficient was applied to test the association between BMI and KIDMED index. We have assessed an optimal diet - medium quality, in physically active population that is involved in recreational sport such as: football, basketball, handball, volleyball, tennis, swimming and martial arts, and a normal healthy weight category based on BMI classification criteria of World Health Organization. In addition, we have found a weak positive association between BMI and KIDMED index in physically active population, that was not statistically significant. The outcome of the study indicates that most of the people that are regularly involved in physical activity have a decent nutritional awareness, as a result of the nutritional counseling they get from their coaches. It seems that recreational collective activities and sports, besides allowing people to gain knowledge about healthy eating skills and nutritional habits, also encourage them to bring the required changes in their diets. The impact of physical activity may be a promising area for future promotion of nutrition and health.

Keywords: *Assessment, BMI, KIDMED index, Nutritional status, Recreational sport*

Introduction

Practice of sport, exercise or recreational physical activity (PA) increases the needs of energy and nutrients (Close, Hamilton, Philp, Burke, & Morton, 2016; Meng et al., 2018). Proper nutrition and consuming highly nutritious food can help population that is involved in recreational sport, as well as professional athletes, to achieve their maximum performance, to reduce the risk of injury, and to ensure the best recovery and health (Close et al., 2016). Including food that contains proteins of high quality and bioavailability, a profile of fatty acids very favorable from a cardiovascular point of view, and vitamins and minerals that are involved in energy and protein metabolism - provides defense against oxidative stress and inflammation, as well as ensures cell growth and tissue repair (Sobaler, Vizuete & Ortega, 2017). In addition, Isenmann et al. (2019) demonstrate the importance of adequate protein and carbohydrate intake from foodstuffs following an exercise bout for the facilitation of muscle regeneration while minimizing the inflammatory response.

Adequate nutrition is essential for development and main-

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tenance of a healthy status throughout life, being an important determinant of human health (Gila-Diaz et al., 2020). It is well established that healthy nutrition and physical activity are key lifestyle factors that modulate lifelong health through their ability to improve body composition, musculoskeletal health, and physical and cognitive performance, as well as to prevent metabolic diseases including obesity, diabetes mellitus, and cardiovascular disease across the lifespan (Baranowski, 2004; Koehler & Drenowatz, 2019).

Dietary plans that enhance performance usually include intake of macronutrients, micronutrients, and fluids throughout the day (Volpe, 2006). Carbohydrate loading maximizes muscle glycogen stores prior to exercise, meaning a delayed onset of fatigue and improvement in performance (Beck, Thomson, Swift, & von Hurst, 2015; Gant, Stinear, & Byblow, 2010; Jentjens et al., 2004). Protein consumption prior to and during exercise has been shown to enhance rates of muscle protein synthesis (Koopman et al., 2006; Pennings et al., 2010; Van-Loon, 2014). Fats are source of essential fatty acids that the body cannot produce by itself (Volek, Noakes, & Phinney, 2015). Fats help the body to absorb micronutrients such as: vitamin A, vitamin D, vitamin E and vitamin K, which are fat-soluble, meaning that they can only be absorbed with the help of fats (Beck et al., 2015). Micronutrients play an important role in energy production, hemoglobin synthesis, maintenance of bone health, adequate immune function and protection of body against oxidative damage (Driskell & Wolinsky, 2006; Girgis, Clifton-Bligh, Hamrick, Holick, & Gunton, 2013; Taylor & Camargo, 2011). They assist with synthesis and repair of muscle tissue during recovery from exercise (Driskell & Wolinsky, 2006; Volpe, 2006). The most common micronutrients, i.e. vitamins and minerals found to be of utmost importance in diets of physically active people or recreational athletes, are: B vitamins, vitamin D, calcium, iron, zinc, magnesium, as well as some antioxidants such as: vitamins A, C, and E, β-carotene, and selenium (Lukaski, 2004; Powers, Deruisseau, Quindry, & Hamilton, 2004; Stockton, Mengersen, Paratz, Kandiah, & Bennell, 2011; Woolf & Manore, 2006; Zittermann & Prokop, 2014). The purpose of fluid consumption during exercise is primarily to maintain hydration and thermoregulation, because there is an increased risk of oxidative stress due to dehydration (Hillman et al., 2013). Thus, fluid consumption prior to exercise is recommended, in order to ensure good hydratation during exercise (Sawka et al., 2007). In addition, carefully planned hyperhydration prior exercise, may reset fluid balance, increase fluid retention, and consequently improve heat tolerance (Beck et al., 2015).

One study has found that a planned scientific nutritional strategy consisting of fluid, carbohydrate, sodium, and caffeine, compared with a self-chosen nutritional strategy, helped recreational runners to complete a marathon run faster (Hansen, Emanuelsen, Gertsen, & Sorensen, 2014). In addition, similar study has shown that a nutritional intervention helped trained cyclists to complete a time trial faster (Hottenrott et al., 2012). Whereas training has the greatest potential to increase performance, it has been estimated that consumption of a carbohydrate–electrolyte drink accompanied by relatively low doses of caffeine, may improve a 40 km cycling time trial performance (Jeukendrup & Martin, 2001).

The importance of individualized or personalized dietary plans has recently emerged. Diets and dietary strategies vary according to the individual training program, personal goals, and food preferences as well (Beck et al., 2015; Jeukendrup, 2014).

Health benefits of nutrition and PA were often studied singularly in the past. Nowadays, it is becoming more evident that the integration of nutrition and PA has the potential to produce greater benefits, instead of strategies focusing solely on one or the other (Baranowski et al., 2004; Close et al., 2016; Koehler & Drenowatz, 2019). A lot of studies examine the role of integrated diet and PA on sports performance and health-related outcomes (Bremer & Cairney, 2016; Meng et al., 2018; Robinson et al., 2015; Serra-Majem et al., 2004). Also, healthy dietary choices and sports participation are independently associated with motor competence, as an important contributor to active and healthy lifestyle (Drenowatz, & Greier, 2018).

Obtaining reliable data on nutritional status, and maintaining an adequate food consumption in individuals that do regular sport and PA, seems to be a key factor for performance enhancement, and a necessary tool for health promotion and disease risk prevention (Baranowski 2004; Gila-Diaz et al., 2020; Koehler & Drenowatz, 2019). The role of the 16-item KIDMED questionnaire in nutritional status assessment has been evidenced by numerous studies, since nowadays the Mediterranean diet is considered one of the healthiest and the best sport performance enhancing dietary models (Gila-Diaz et al., 2020). It is a self-administrated questionnaire, which provides information about the usual dietary intake that is time saving, cost-effective and easy to apply (Gila-Diaz et al., 2020; Koksal, Tek, & Pekcan, 2008).

Therefore, the main objectives of this study are: 1) to evaluate BMI; 2) to assess the nutritional status, and 3) to test the association between BMI and KIDMED index in population that is regularly engaged in PA and recreational sport. However, we hypothesised that there will be a negative association between BMI and KIDMED index based on what previous studies have reported (Lydakis et al., 2012; Martin-Calvo, Chavarro, Falbe, Hu, & Field, 2016).

Methods

Participants

The study is realized on a sample of 101 healthy young participants: (N=48) male, and (N=53) female, aged 18-35, that do regular PA and recreational sport activities such as: football (N=24), basketball (N=16), handball (N=15), volleyball (N=20), tennis (N=10), swimming (N=10) and martial arts (N=9). All participants that took part in the study gave a signed consent for their participation.

Instruments

In order to realize the particular aim of the study, we first performed an assessment of body composition: height, weight and BMI. Participants were measured barefoot and wearing light clothes, according to WHO manual (World Health Organization, 2007). Height is measured using a wall mounted stadiometer (SECA SE206). Weight is measured with a calibrated digital scale (TANITA TBF 300). BMI is calculated from height and weight as follows: Weight (kg)/Height(m)^2. The healthy status was evaluated according to WHO (World Health Organization, 2007) manual.

Next, we have applied the KIDMED questionnaire in order to assess the nutritional status (Koksal et al., 2008; Torun & Yildiz, 2013). It is a 16 item questionnaire that was created to estimate the healthy Mediterranean diet in children, young, and adults, based on the principles that sustain Mediterranean dietary patterns (Serra-Majem et al., 2004). KIDMED index was calculated as explained by Torun & Yildiz (2013), with the scores ranging from 0 to 12. Higher score indicates higher adherence to the healthy Mediterranean diet (with a maximum score of 12): a score ≥ 8 indicates high quality diet; a score between 4 and 7 indicates an optimal diet; while a score ≤ 3 reflects very poor diet quality (1). The questionnaire is shown in Figure 1.

KIDMED questionnaire	Scoring
Takes a fruit or fruit juice every day	+1
Has a second fruit every day	+1
Has fresh or cooked vegetables regularly once a day	+1
Has fresh or cooked vegetables more than once a day	+1
Consumes fish regularly (at least 2-3/week)	+1
Goes >1/week to a fast food restaurant (hamburger)	-1
Likes pulses and eats them >1/week	+1
Consumes pasta or rice almost every day (5 or more per week)	+1
Has cereals or grains (bread, etc.) for breakfast	+1
Consumes nuts regularly (at least 2-3/week)	+1
Uses olive oil at home	+1
Skips breakfast	-1
Has a diary product for breakfast (yoghurt, milk, etc.)	+1
Has commercially baked gods or pastries for breakfast	-1
Takes two yoghurts and/or some cheese (40g) daily	+1
Takes sweets and candy several times every day	-1

Note: Participants should mark the statements that are correct for them. KIDMED index: poor ≤ 3; medium 4-7; high ≥ 8;

FIGURE 1. KIDMED questionnaire and Mediterranean Diet Quality Index

Data analysis

SPSS 23 statistical package was used to perform statistical analysis. Normality of data distribution was tested by K-S test, Skewness and Kurtosis values. Appropriate statistical methods were used to calculate descriptive statistical parameters. Spearman's rank correlation coefficient was applied to test the association between BMI and KIDMED index in physically active population involved in recreational sport.

Results

Descriptive statistical parameters are presented in Table 1. According to it, data have a normal distribution, with a normal asymmetry considered when values for Skewness are in range between -1.00 to 1.00, and Kurtosis values between -3.00 to 3.00 (Kallner, 2013; Zeqiri, Stojmanovska, & Georgiev, 2020).

In addition, we present mean average and standard deviation of assessed parameters based on the recreational activity or sport participants have practiced (Table 2).

Figures 2 and 3 represent BMI and KIDMED index in physically active population, respectively. According to WHO (World Health Organization, 2007) BMI classification, physically active population included in the study belongs to the normal weight category, and based on KIDMED index classification, it has an optimal – medium quality diet.

Table 1. Descriptive statistical parameters in physical active population involved in recreational sport

	N (48M & 53F)	Min	Max	Mean	SD	Skewness	Kurtosis	K-S
Age	101	18	35	21.37	5.97	0.85	-0.23	p > .20
Weight (kg)	101	45.00	115.00	71.02	14.53	0.50	-0.50	p > .20
Height (cm)	101	153.00	192.00	175.69	8.53	-0.28	-0.36	p > .20
BMI	101	17.04	31.72	22.83	3.40	0.31	-0.84	p > .20
KIDMED index	101	1	12	7.11	2.41	-0.32	0.06	p > .20

Notes: N-sample size; Min-minimum; Max-maximum; SD-standard deviation; K-S -Kolmogorov-Smirnov test M-male; F-female

Table 2. Mean average and standard deviation in physical active population based on the recreational sport practiced

Type of PA / recreational sport	N	Mean±SD				
		Age	Weight (kg)	Height (cm)	BMI	KIDMED index
football	24	22.83±5.34	69.92±15.50	173.00±0.11	23.16±3.10	5.63±2.28
basketball	16	21.56±5.16	79.31±12.75	179.00±0.06	24.51±2.69	7.56±3.50
handball	15	22.67±6.55	74.13±12.13	175.00±0.07	24.95±3.31	7.93±1.91
volleyball	20	18.75±4.23	69.43±15.89	178.00±0.07	21.73±3.56	7.95±1.43
tennis	10	24.30±7.96	64.10±16.97	172.00±0.09	21.41±4.24	7.90±1.66
swimming	10	22.20±5.41	67.65±11.66	175.00±0.09	21.99±2.72	6.60±1.96
martial arts	9	21±5.57	69.00±12.06	178.00±0.08	21.90±3.66	6.67±2.55

Notes: PA-physical activity; N-sample size; SD-standard deviation

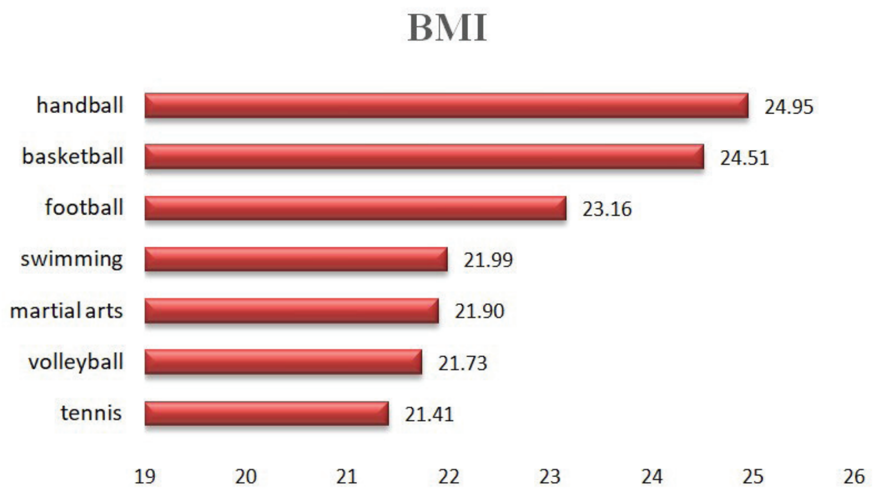

FIGURE 2. BMI of physical active population involved in recreational sport

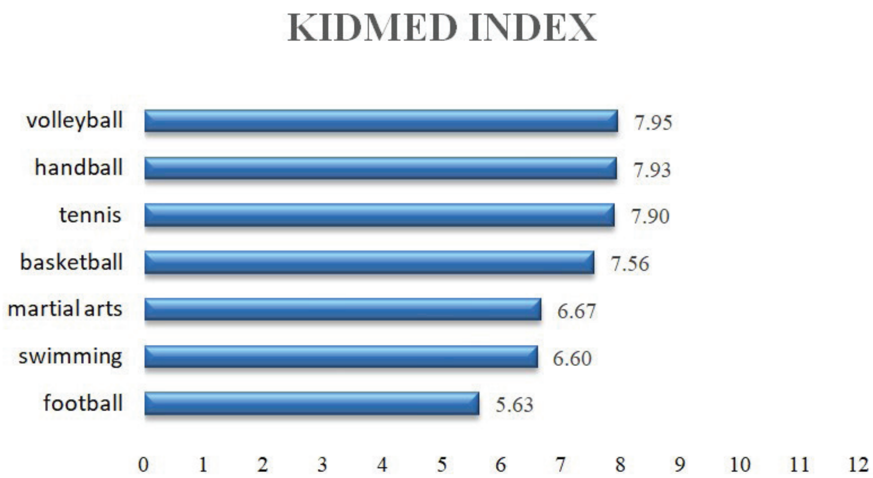

FIGURE 3. KIDMED index in physical active population involved in recreational sport

In Table 3, we present the association between BMI and KIDMED index in physically active population that do recreational sport. Spearman's rank correlation coefficient (ρ = 0.36) shows a weak positive association that was not statistically significant (p=3.91).

Table 3. BMI and KIDMED index association in physical active population involved in recreational sport

Spearman's ρ correlation coefficient	BMI	KIDMED index
BMI	1	0,36
KIDMED index	0,36	1
p-value = 3,91		

Discussion

Based on what is shown in Table 2 and Figure 2, participants that played basketball and handball in recreational way, have higher BMI than participants that play football, volleyball and tennis, or participants that do swimming and martial arts. Since BMI is not able to differ between body fat % and muscle mass % (Shukova-Stojmanosvka, 2009), we are limited to do strong conclusions, but we may point out the possible directions. Higher BMI in amateur/recreational basketball and handball players might be a consequence of a higher body fat percentage, or also a higher muscle mass percentage, since it is reported that basketball and handball players have bigger percentage of muscle mass than players from other sports due to the "greater contact" in between (Silva, Petroski, & Araujo Gaya, 2013). On the other hand, we must take in consideration that our population is not professional athletes like in the study of Silva et al. (2013) that train 6 times per week. Amateur/recreational athletes train 3-4 times per week only (Volpe, 2006), while it is reported that training frequency is an important factor that affects the hypertrophic response (Dankel et al., 2017). Opposing to this, a recent review has reported a strong evidence that training frequency does not significantly impact muscle hypertrophy (Schoenfeld, Grgic, & Krieger, 2018). Taking everything into consideration, we acknowledge the lack of body fat and muscle mass percentage (%) parameters following BMI, as a major limitation in this study. The inclusion of above mentioned parameters in addition to BMI seems necessary to discuss the present topic. Also, we must point out that the heterogeneity of the sample in terms of sex is another important limitation.

According to Table 2 and Figure 3 physically active population included in the study has an optimal – medium quality diet according to KIDMED index classification (Torun & Yildiz, 2013). This indicates to a moderate level of awareness about the importance of increased energy expenditure due to physical activity, and the nutritional factor in the process of muscle regeneration, anabolism and lean body mass increase, between physically active population, and recreational/amateur athletes.

Lowest value for the KIDMED index is presented in physically active population that plays recreational football (Figure 3). Football is a highly demanding game in which players are subjected to numerous actions that require overall strength and power production, speed, agility, balance, stability, flexibility, and the adequate level of endurance (Jovanovic, Sporis, Omrcen, & Fiorentini, 2011). Therefore, recreational/amateur players and people that play football regularly should be very cautious with the nutritional intake. Actions involved in football require muscle glycogen to produce ATP, thus the carbohydrate need of football players (even recreational/amateur ones) should be higher (6 - 10 g/kgBW) (El Gezrey & Abdelhaliem, 2018).

Recreational/amateur football players should be aware that low carb diet could limit regeneration of adenosine triphosphate (ATP) and limit the muscles' ability to contract with high force (El Gezrey & Abdelhaliem, 2018). Consumption of a carbohydrate meal solution after training enhances the rate of muscle glycogen repletion (Beck et al., 2015). Usually, 6 hours after exercise, carbohydrate stores are replenished for about 60-70%, but while consuming a carbohydrate meal after a workout session, carbohydrate stores can be replenished up to 90% (Beck et al., 2015; Knuiman, Hopman, & Mensink, 2015).

People who exercise regularly must be aware of the fact that attaining a proper nutrition and an adequate energy intake is a key factor for enhancing the sports performance, as well as sustaining a good physical appearance (Volpe, 2006). Increasing the protein intake by adding a liquid protein meal supplement to the diet may be also considered, since protein requirement for growth of lean muscle tissue is greater than the one for maintenance, possibly in the range of 1.5 to 1.8 g/kgBW (Benardot, 2006; Clark 2000).

In order to accurately assess energy requirements for recreational athletes or people that are regularly involved in PA - training volume, frequency, and intensity must be considered (Hills, Mokhtar, & Byrne, 2014). In general, it is recommended a dietary protein intake to be 1.5–1.8 g/kgBW (max. 2.2 g/kgBW) with a focus on sufficient protein at each meal (0.40–0.55 g/kg/meal) and an even distribution throughout the day (Shukova-Stojmanovska, 2014; Volpe, 2006). Further, minor benefits can be gained by consuming protein in close proximity to training sessions (1–2 hours pre-exercise and within 1–2 hours post-exercise) (Shukova-Stojmanovska, 2009; Pennings et al., 2010). Amino acids, especially essential amino acids stimulate the process of muscle protein synthesis (Beck et al., 2015; Koopman et al., 2006). While all amino acids provide the necessary "building blocks" for the synthesis of new tissue, the amino acid leucine is especially important as a "metabolic trigger" of muscle protein synthesis (Beck et al., 2015). Thus, a sufficient concentration of leucine is necessary to reach a "leucine threshold" which is required to maximally stimulate the protein synthesis in a muscle (Koopman et al., 2006).

Based on current evidence, it is reasonable to consume sufficient amounts of carbohydrates when practicing a sport, or when regularly involved in physical exercise, possibly in the range of 6–10 g/kgBW (Bartlett, Hawley, & Morton, 2015; Burke, Hawley, Wong, & Jeukendrup, 2011; Stellingwerff & Cox, 2014). Consuming carbohydrates immediately post-exercise would be a good strategy to maximize rates of muscle glycogen synthesis (Beck et al., 2015; Knuiman et al., 2015). In addition, 2 hours delayed feeding after glycogen-depleting cycling exercise, has reduced glycogen synthesis rates (Beck et al., 2015).

After calories have been devoted to carbohydrates (6–10 g/kgBW) and proteins (1.5–2.2 g/kgBW), the remaining calories should be allotted to fats (Shukova-Stojmanovska, 2014). Dietary fats should be consumed at moderate levels, neither too low nor high (0.8–1.5 g/kg/day), because they are essential nutrients that are involved in many functions in the body (Shukova-Stojmanovska, 2014), including building cell's membrane, absorption of fat-soluble vitamins, hormonal regulation and maintaining testosterone function (Beck et al., 2015; Volek et al., 2015). Fatty acids that might be of significant importance for physically active people and athletes are omega 3 and omega 6 (Shukova-Stojmanovska, 2014).

Also, it is recommended to consume a variety of fruits and vegetables in order to meet micronutrient needs, or to add a multivitamin/mineral supplement to emphasize diet, in order to prevent any micronutrient deficiencies (Girgis et al., 2013; Stockton et al., 2011; Taylor & Camargo, 2011; Zittermann & Prokop, 2014). Creatine (3–5 g/day) and caffeine (5–6 mg/kg) should be considered as well - as they can yield ergogenic effects for athletes (Bufford et al., 2007; Burke, 2008; Burke, Desbrow, & Spriet, 2013; Lane et al, 2013; Spriet, 2014). Beta-alanine (3–5 g/day) and citrulline malate (8 g/day) are dietary supplements that can be considered too, as they may potentially be of benefit for both - recreational and advanced athletes, depending on individual training regimens (Iraki, Fitschen, Espinar, & Helms, 2019). They have performance-enhancing functions such as: increasing the power output and working capacity, and decreasing the feelings of fatigue (Blancquaert, Everaert, & Derave, 2015; Quesnele, Laframboise, Wong, Kim, & Wells, 2014).

Finally, according to Table 3, we have found a weak positive association ($\rho=0.36$) between BMI and KIDMED index in physically active population, that was not statistically significant ($p=3.91$). Even though not significat, the direction of the association is opposite to what is reported in literature (Lydakis et al., 2012; Martin-Calvo et al., 2016). However, the targeted populations in previously mentioned studies were not involved in regular sport. We assume that the direction of the association in our results differ to what is previously reported, because of the type of the population sample included in our study. BMI does not differ between fat mass percentage % and muscle mass percentage % (Shukova-Stojmanosvka, 2009). Thus, higher BMI may be a result of a higher % of fat mass, but also may be a result of a higher % of muscle mass when targeting physically active population involved in regular sport. Spenst, Martin, & Drinkwater. (1993) found a statistically significant difference in muscle mass % between people involved in sport and ones that were not physically active, favoring the active ones. Due to this limitation, we are not able to do any further conclusions. However, we propose including additional parameters, such as: body fat % and muscle mass % in addition to BMI, especially when targeting physically active population that is involved in regular sport, in order to present a clearer and a more evident perspective. Another suggestion for future studies would be inclusion of larger sample size with a possibility of age and sex differentiation.

Conclusion

In conclusion, we have assessed an optimal diet of medium quality, in physically active population that is involved in recreational sport such as: football, basketball, handball, volleyball, tennis, swimming and martial arts, and a normal healthy weight category based on BMI classification criteria of World Health Organization (World Health Organization, 2007). We must point out that even if we are talking about recreational athletes in the present study, its outcome indicates that most of the people that do regular exercise have a decent nutritional awareness, as a result of the nutritional counseling they get from their coaches. It seems that recreational collective activities and sports, besides allowing people to gain knowledge about healthy eating skills and nutritional habits, also encourage them to bring the required changes in their diets. The impact of physical activity may be a promising area for future promotion of nutrition and health. In addition, we have found a weak positive association between BMI and KIDMED index (ρ = 0.36) that was not statistically significant (p=3.91). We assume this result to be a consequence of the population sample targeted in our study. Thus we propose including body fat % and muscle mass % in addition to BMI when targeting physically active population that is involved in regular sport, in order to get a clearer and a more evident perspective.

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Conflict of interest

Authors declare no potential conflict of interest.

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