Medicina Sportiva
Med Sport 17 (1): 18-23, 2013
DOI: 10.5604/17342260.1041883

ASSESSMENT OF DIET OF YOUNG MEDIUM- AND LONG-DISTANCE RUNNERS

Łukasz Tota[1] (A,B,D,G), Wanda Pilch[1] (F,C), Małgorzata Hodur[2] (B), Andrzej Sagalara[2] (E)

[1]Department of Physiology and Biochemistry, University School of Physical Education, Krakow, Poland
[2]Doctorate studies, University School of Physical Education, Krakow, Poland

Abstract

Introduction: Nutrition is one of the main factors influencing physical performance. Furthermore, a well-balanced diet is a key determinant of optimal biological development of young athletes.

Objective: To assess the diet of young medium- and long-distance runners.

Methods: An assessment of the diet of 45 athletes (20 adolescent females and 25 adolescent males) specializing in medium- and long-distance running in the junior and young junior categories was performed by examining dietary records for 6 consecutive days. The study was conducted in October 2010, towards the end of the low-intensity stage of the yearly training cycle. Calculations were performed using the Wikt-1 software. Obtained data were compared to norms for adolescent males and adolescent females engaging in rigorous physical activity.

Results: The daily caloric intake for the athletes participating in this research amounted to 3569 kcal for the males and 2654 kcal for the females - considerably lower than the norms proposed for this age group, i.e., 3900 kcal for adolescent males and 2900 kcal for adolescent females. Daily intake of protein and carbohydrates was lower than the recommended norm, while the daily intake of fats was slightly higher than the norm. Intake of energy with food was insufficient compared to the norms. When compared to the norm, an analysis of the daily intake of nutrients in the study's participants found insufficient amounts of Na, K, Ca, F, Mg and Fe, as well as vitamins B_1, B_2, PP, C, and D.

Conclusions: These results indicated that the diet of the athletes participating in this research did not meet the norms recommended by nutritional experts. A lack of appropriate balance in the daily nutrition in study participants meant that their intake of energy was too low to meet the energy expenditure stemming from daily training and participation in sports competitions.

***Key words**: diet, nutrients, track and field, sport*

Introduction

Both diet and the nutritious quality of food products consumed constitute important short-term and long-term factors for human health [1,2]. An optimal intake of energy and nutrients, appropriate for one's age, gender and physical activity, is one of the indicators of a rational human diet [3].

Dietary recommendations should be followed for an extended period of time, as the additional and tangible effects of proper nutrition, i.e., increased muscle strength, increased endurance and a general improvement of physical fitness, can occur no sooner than after several months [4,5].

It is important to remember that athletes have considerable need for energy, protein, vitamins, and minerals due to increased metabolism stemming from physiological development and intense physical activity [5,6]. Insufficient amounts of protein, carbohydrates, vitamins, and minerals in a diet may lead to excessive muscle damage during training as well as to harmful changes in metabolism [7]. In addition, if energy intake is insufficient for training and for participating in sports competitions, the amount of muscle cell glycogen decreases, resulting in decreased endurance [8,9]. On the other hand, excessive energy intake compared to bodily needs results in increasing amounts of fat tissue, meaning that the energy cost of physical activity increases [10].

Dietary regimens for physically active persons are developed to provide energy, resupply lost electrolytes, and prevent dehydration and gastrointestinal conditions [11,12].

An athlete's proper diet should encourage optimal development and training efficiency and is contingent upon following dietary recommendations throughout the year, appropriate to each stage of the training cycle [5].

Monitoring the diet of athletes and intensifying educational efforts may help prevent common dietary errors. Proper dietary regimens can delay and decrease the effect of factors responsible for exhaustion during both training and competition.

The aim of the study was to assess the diet of young medium- and long-distance runners.

Methods

Study participants comprised 45 athletes (25 adolescent males and 20 adolescent females) specializing in

medium- and long-distance running within the junior and young junior age categories (ages 15-17 years).

Before the assessment was conducted, the following anthropometric parameters were measured with the use of a Martin anthropometric kit: body height (BH) with 0.5 cm accuracy, body mass (BM) with 0.1 kg accuracy, percentage of fat tissue (%F), fat mass (FM), and fat free mass (FFM).

Body composition parameters were measured using an IOI 353 Jawon Medical body tissue analyzer (produced in Korea), by means of bioelectrical impedance analysis (BIA).

Study participants were members of the following sports clubs: AZS-AWF Kraków, WKS Wawel Kraków, ULKS Fajfer 2001 Łapanów, MLUKS Tarnów, ZKS Unia Tarnów, KS Cracovia Kraków, UKS Brzeszcze, UKS Bieganie.pl Wieliczka, UKS Budowlani Nowy Sącz, UKS Jedynka Skawina, and MKS MOSM Bytom.

Study participants belonged to sports class II and III. Laboratory tests performed on a treadmill found that the mean maximum oxygen consumption per minute was about 72 $ml \cdot kg^{-1} \cdot min^{-1}$ for the males and 58-59 $ml \cdot kg^{-1} \cdot min^{-1}$ for the females. The best individual score was 82 $ml \cdot kg^{-1} \cdot min^{-1}$ among the males and 67 $ml \cdot kg^{-1} \cdot min^{-1}$ among the females. Study participants comprised athletes of medium advancement in training, with training experience of at least 2 years. The participants included Polish representatives in the World Mountain Running Championships and the Youth Olympic Games in Singapore, and well as winners of the Polish National Youth Olympic Games and the Polish National Youth Olympics.

Assessment of the participants' diets was performed by examining dietary records for 6 consecutive days, including 1 day of the weekend. After the method was explained to the participants, they started noting down the type and amount of food, as well as the time of eating, on special forms on a 24-hour basis during a transition period within the yearly training cycle. The amount of food eaten was estimated based on the *Album of Photographs of Food Products and Dishes* [13].

Based on the obtained results, the nutritional values of the food products eaten were calculated according to the amount of protein, fat, and carbohydrates in g/6 days and in kcal/6 days using the Wikt 1 software (developed by Net-komputer in 2002), which operates based on the "Table of Nutritional Values of Food Products" [14].

Nutritional values were calculated taking into account the appropriate loss parameters due to technological processes. Mean values from 6 days were calculated for each study participant based on the obtained amounts of nutrients and energy value. During the study, the participants did not take any vitamin or mineral supplements.

Results

Mean BH of the participants was 172.9±6.2 cm for the males and 164.5±4.4 cm for the females. Mean BM was 61.2±8.2 kg for the males and 51.4±5.9 kg for the females. FM measured 5.1±1.3 kg in the males and 8.3±1.0 kg in the females. FFM measured 56.1±7.9 and 43.1±7.5, respectively (Table 1).

Obtained data showed that energy intake was insufficient in both the males and the females, which is an undesirable state for young athletes, as their energy needs are increased due to their engagement in sports and their physical development (Table 2).

Analysis of daily nutrient intake found insufficient amounts of protein (50±12.1 g/d in the males and 40±10.1 g/d in the females) compared to the recommended amount. Mean carbohydrate intake was also below the recommended value and measured 530±61.1 g/d in the males and 480±54.8 g/d in the females (Table 2).

Intake of fats was slightly above the norm proposed by Jarosz and Bułhak-Jachymczyk: it measured 101±18.1 g/d in the males and 480±54.8 g/d in the females (Table 2).

The percentage energy share of protein, fats, and carbohydrates of the total daily intake of energy in the males was also below the norm and measured 12%, 34%, and 54%, respectively. The percentage energy share of protein, fats, and carbohydrates in the females was 14%, 33%, and 53%, respectively (Table 2).

The results showed that the study participants did not follow diets recommended by experts. The intake of protein, carbohydrates, and fats did not meet the amounts required for contemporary sports (Table 2).

Analysis of daily nutrient intake found an excessive intake of sodium (2798 mg/d in the males and 2115 mg/d in the females) and an insufficient intake of potassium (2545 mg/d in the males and 3312 mg/d in the females) (Table 3). The analysis also found an insufficient intake

Table 1. *Anthropometric characteristics of the study group*

	Age[years]	BM[kg]	BH[cm]	%F[%]	FM[kg]	FFM[kg]
			$\bar{x}$ SD			
♂	16.42±0.85	61.2±8.2	172.9±6.2	8.4±1.7	5.1±1.3	56.1±7.9
♀	16.44±0.82	51.4±5.9	164.5±4.4	16.2±1.4	8.3±1.0	43.1±7.5

Table 2. *The average level of consumption of energy and nutrients (proteins, fats and carbohydrates) by athletes and female athletes*

Nutriens ↓ Gender →	Males		Females		Recommended nutritional norms*	
	$\bar{x}$	SD	$\bar{x}$	SD	♂	♀
Energy value [kcal]	3569±411		2645±379		3900	2900
Protein [g/d]	50±12.1		40±10.1		53.5	44.2
Fats [g/d]	101±18.1		112±12.7		97	100
Carbohydrates [g/d]	530±61.1		480±54.8		650	540
Percentage of energy from proteins [%]	12		14		15%	
Percentage of energy from fats [%]	34		33		25%	
Percentage of energy from carbohydrates [%]	54		53		60%	

* norms recommended for boys (body mass of 67 kg) and girls (body mass of 56 kg) aged 16-18 years engaging in rigorous physical activity (Jarosz & Bułhak-Jachymczyk, 2008)

Table 3. *Comparison of mean values of nutrients in the diets of the study participants*

Researchcategories	Amount $\bar{x}$ ± SD		Dietary norms*	
	♀	♂	♀	♂
Sodium (mg)	2115.7±117.4	2798.2±139.7	1500 mg/day	1500 mg/day
Potassium (mg)	3312.6±311.2	2545.1±199.7	4700 mg/day	4700 mg/day
Calcium (mg)	815.6±156.5	726.9±126.4	1300 mg/day	1300 mg/day
Phosphorus (mg)	1050.1±104.2	1176.7±120.8	1250 mg (RDA)	1250 mg (RDA)
Magnesium (mg)	257.6±18.9	211.9±16.7	360 mg (RDA)	410 mg (RDA)
Iron (mg)	13.1±1.3	10.8±0.9	15 mg (RDA)	12 mg (RDA)
Vitamin A (μg)	687.5±19.9	611.3±16.8	700 μg/person/day (RDA)	900 μg/person/day (RDA)
Vitamin B1 (μg)	1006.2±266.2	1076.7±241.1	1.1 mg (RDA)	1.2 mg (RDA)
Vitamin B2 (μg)	996.5±154.7	1165.9±201.8	1.1 mg/person/day (RDA)	1.3 mg/person/day (RDA)
Niacin (mg)	11.8±2.8	14.6±4.9	14 mg/person/day (RDA)	16 mg/person/day (RDA)
Vitamin C (mg)	61.6±10.5	69.8±11.8	65 mg/person/day (RDA)	75 mg/person/day (RDA)
Vitamin D (mg)	411.5±65.9	427.8±79.4	700 mg/person/day (RDA)	900 mg/person/day (RDA)

* norms recommended for boys (body mass of 67 kg) and girls (body mass of 56 kg) aged 16-18 years engaging in rigorous physical activity (Jarosz & Bułhak-Jachymczyk, 2008)

of calcium (726 mg/d in the males and 815 mg/d in the females) and an insufficient intake of phosphorus in the females (1050.1 mg/d) compared to norms proposed by Jarosz and Bułhak-Jachymczyk (Table 3).

Intake of magnesium was 211 mg/d in the males and 257 mg/d in the females, while the intake of iron was 10 mg/d and 13 mg/d, respectively. Intake of both magnesium and iron was considerably lower than the norms proposed by Jarosz and Bułhak-Jachymczyk (Table 3).

Further analysis showed that intake of vitamins did not meet the norms proposed by Jarosz and Bułhak-Jachymczyk. The mean daily intake of vitamin A was 611 μg in the males and 687 μg in the females (Table 2). The analysis also found an insufficient intake of vitamin D (411.0 mg/d in the males and 427.8 mg/d in the females) (Table 2).

Discussion

Today, many coaches and athletes recognize the importance not only of developing body fitness and sports skills, but also of following dietary recommendations, which were found to constitute a vital part of successful performance in sports [3,15-18].

A properly balanced diet contributes to an athlete's optimal training. An improperly balanced diet can cause frequent exhaustion or even a state of overtraining [19]. Athletes engaging in track and field should follow the rules of balanced nutrition in order to meet the requirements of intense physical activity during training and competition. The energy value of food products eaten should precisely meet energy expenditure. However, the nutritious value of food is determined not only by the amount of energy provided, but also by the quality of food [20].

Each sports discipline involves different methods of training and specific dietary requirements [5,21]. To ensure optimal training efficiency in medium- and long-distance runners, experts recommend a carbohydrate-rich diet that provides 60%-70% of energy demand as well as essential nutrients [5,22,33].

It seems that a sufficient intake of nutrients is appropriate for endurance training [6,24]. Athletes' diets should also take into account the type of physical effort required during training and competitions. If the aforementioned requirements are not met, training may not show expected adaptive effects [7].

The recommended energy intake for athletes depends on body mass, intensity of training, individual characteristics, and the need to reduce fat mass or increase muscle mass [3,16,21]. Available research indicates that the daily energy demand for medium- and long-distance runners should fall between 67 kcal to 70 kcal per kg of body mass [5]. Calculations performed for study participants found that this energy demand amounted to 4340 kcal/d for the males and 3620 kcal/d for the females. Norms proposed by Jarosz and Bułhak-Jachymczyk [21] for energy demand in males and females aged 16-18 engaging in physical activity are 3900 kcal for males and 2900 kcal for females. Analysis of the diet of the study's male and female participants showed an insufficient intake of energy compared to norms, which should result in decreased body mass. However, an individual assessment of study participants found that their somatic build was similar to the somatic build of other athletes specializing in medium- and long-distance running [22,23]. The share of fat mass of the total body mass constituted the most conspicuous difference between the male and female participants, amounting to about 8% in the males and about 17% in the females. The results of the individual assessments suggest that the proposed dietary norms for medium- and long-distance runners may be too high.

A sufficient intake of protein is crucial for athletes. Protein performs a primarily structural function, but some amino acids can be transformed in the liver into glucose, fatty acids, steroids, and other amino acids. During physical effort, 6%-18% of the energy produced by muscles comes from protein [24]. Many authors suggest that protein intake should measure between 1.0 to 1.8 g/kg of body mass [7,21,25-26].

The American Dietetic Association (ADA) and the American College of Sports Medicine (ACSM) recommend protein intake between 1.6-1.7 g/kg of body mass [7]. During the Consensus Conference on Foods, Nutrition and Sports Performance held in Lausanne in 1991, it was decided that protein should account for 12%-15% of total daily intake of energy, provided that the caloric intake meets energy demand [7].

Analysis of the diets of the female and male study participants showed an insufficient intake of protein compared to the amount recommended by Lemon [7], Ziemlański and Niedźwiedzka-Kącikowa [27], Słowińska-Lisowska [25], and Jarosz and Bułhak-Jachymczyk [21].

Carbohydrates are some of the primary nutrients and account for 60% of the total energy value in a diet. It is assumed that the daily intake of carbohydrates for an adult person amounts to about 600-800 g. Within this amount [28,29], monosaccharides and disaccharides account for about 30%; complex saccharides, composed mainly of starch, account for about 70%. The levels of carbohydrate reserves in muscles and the liver may significantly affect endurance [30,31].

The diet of athletes should include an amount of carbohydrates that is sufficient to meet the energy demand stemming from physical training and to replenish carbohydrate reserves between training sessions [3,25]. Available research indicates that a carbohydrate-rich diet, recommended for athletes, increases effort capacity [32].

However, the intake of carbohydrates in study participants was insufficient and considerably lower than the norm proposed by Celejowa [5], Ziemlański and Niedźwiedzka-Kącikowa [27], and Jarosz and Bułhak-Jachymczyk [21].

Fats in food are the most efficient source of energy, fat-soluble vitamins, and fatty acids required by the body [3].

The intake of fats by study participants was slightly above the norm proposed by Celejowa [5] and Jarosz and Bułhak-Jachymczyk [21].

The basic aim of a diet developed for athletes is to meet the additional demand for nutrition stemming from rigorous physical activity [5,8,12]. Analysis of diets of athletes who specialize in various disciplines often shows irrational dietary habits [18,29,32-38]. This study found an excessive intake of sodium in study participants compared to norms. The primary source of sodium was an excessive amount of kitchen salt and sodium glutamate in food products.

An athlete's performance during both competition and training depends on a properly balanced diet that should provide a proper amount of energy and all the necessary nutrients [4,5,8]. Our study found an insufficient intake of potassium, calcium, phosphorus, magnesium, and iron.

Fresh fruits and vegetables are the best source of vitamins and minerals. Results indicate an insufficient daily intake of vitamins PP, C, and D.

It was shown that study participants committed many errors in their dietary habits. However, it is important to note that the study took place in October, which had a significant impact on the results, as it is the period in which the frequency of fruits and vegetables (which are rich in vitamins and minerals) in the diet is lower.

Results show that study participants do not follow diets recommended by experts. Improperly balanced diets did not provide enough energy to meet actual energy demand.

During the International Olympic Committee's (IOC) Conference on Nutrition in Sports, which was held in Lausanne in 2003, participating experts proposed a framework for developing a comprehensive diet for individual athletes. Such a diet should be based on natural food products and should provide a sufficient amount of protein, carbohydrates, fats, vitamins, and minerals. It should also meet the energy demand stemming from physical activity characteristic for a given sports discipline and allow the body to recuperate after physical activity [25].

Conclusions

The diet of study participants did not meet the norms recommended by experts. The lack of a proper balance in the diet meant that the intake of energy was insufficient compared to energy expenditure of the study's participants. It can be assumed that an insufficient intake of protein and carbohydrates may lead to vitamin and mineral insufficiency and diet-dependent diseases. An excessive intake of sodium, combined with an insufficient intake of potassium, calcium, phosphorus, magnesium and iron, as well as vitamins A, B_1, B_2, PP, C and D, may be harmful to both one's health and one's body development, especially in medium- and long-distance runners.

Declaration of interest

The authors report no conflicts of interest.

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Accepted: March 15, 2013
Published: March 27, 2013

Address for correspondence:
Łukasz Tota
Department of Physiology and Biochemistry
University School of Physical Education,
Al. Jana Pawła II 78
31-571 Krakow
Poland
+4812 6485222
lukasztota@gmail.com

Pilch W.: wanda.pilch@awf.krakow.pl
Hodur M.: ghodur@gmail.com
Sagalara A.: a.sagalara@gmail.com