ASSESSMENT OF DIETARY INTAKE AND ANTHROPOMETRIC PARAMETERS AMONG RUGBY UNION PLAYERS

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Abstract. The purpose of this study was to evaluate the energy, macronutrient an selected micronutrient intake of second league Rugby Union players and to assess the anthropometric characteristic of this group. Players (n = 44) were divided into forwards (n = 20) and backs (n = 24), who differed significantly in weight (92.6 vs 80.8 kg), BMI (28.6 vs 24.5 kg/m^2) and percentage of body fat (22.0 vs 13.3%). The dietary intake was assessed using 3-day dietary recalls. There were no significant differences in dietary intake related to player position. Athletes reported a mean daily energy intake of 3613.4 ±942.6 kcal (carbohydrates 41.4%, protein 17.8%, fats 39.3%). The mean intake of carbohydrates and protein were on a level of 4.8 and 1.9 g/kg of body weight/day, respectively. Although the mean daily intake of minerals and vitamins met recommendations, some players did not reach the requirements, especially for potassium (61.4%) and vitamin C (22.7%). The differences in body compositions of the players suggest differences in the type of training and the specificity of the player's position. These improper proportions of dietary nutrients within the study group may decrease opportunities to achieve optimum results during matches.

Key words: rugby, diet, nutrition, dietary recall, body composition

Introduction

The name rugby comes from a poor, working-class provincial town in the West Midlands of England, and more specifically from the primary school located on its outskirts. As one of the oldest and most prestigious of England's public schools, Rugby School had at its disposal extensive grounds on the surrounding meadows, which created ideal conditions and allowed sport in Rugby to grow deep roots. Students went out every day to fresh grass covered playing fields, where several games of football were going on (Jones 1976; Ryan 2008).

It was during one of these matches, in 1823, that the game of rugby was born. When 16 year-old William Webb Elis picked up the ball and ran with it towards his opponents' goal line. This act represented the beginning of the creation of a new type of game – rugby football (Collins 2009). A series of new breaches of the rules association football, due to creative inventiveness of Elis's schoolmates, led to the emergence of more and more sophisticated elements, leaving only the original football kicks. Soft grass surrounding the playing fields led to the incorporation of various forms of flipping or tackling on the ground. Therefore, it can be said that today's rugby is the result of the exuberant finesse of an unorganized group of testosterone and endorphin charged teenagers (Ryan 2008). Webb Elis is not only celebrated as the 'inventor' of the game but also has the World Cup trophy named after him. The local craftsman observed the actions of the boys and created a new ball for them, which was an egg-shaped pig bladder filled with air. It was not only oval, but also very light. Introduced in 1851, for the first time at the Universal Exhibition in London, Gilbert's ball was considered so perfect that it received one of the first awards. Although the Gilbert family is no longer involved in the making of the ball, the name lives on as the brand that is the most famous purveyor of balls for high level international matches (Ryan 2008; Sommerville 1997).

Many schools played rugby, but as each of them played by its own rules, it was difficult to find agreement. Therefore, over the years, there were numerous conceptions and conferences dedicated to the unification of the rules (Collins 2009; Jones 1976). From 1871, the paths of football and rugby began to lead their own separate ways. In the same year, the first international match between England and Scotland, was played in Edinburgh. Each team played 20 players: 3 defenders, 1 center, 3 halves and 13 forwards. This was a significant reduction in the number of players, as matches between school classes or entire schools, had seen up to 100 players on each side (Ryan 2008; Sommerville 1997).

Rugby became more and more spectacular with some clubs, mainly in the Midlands, having the best players in England (Collins 2006). According to the Rugby Football Union (RFU) in rugby the most important had to be courage, bravery, honor and loyalty, but not payment for the match. However, the players were amateurs and since they had to sacrificed their job for rugby they wanted to receive money for playing for the team. Because it was against the RFU rules, in 1893 took place a General Assembly of RFU member clubs. However no compromise was reached. In 1895, clubs from the north of England resigned from membership in the RFU and formed their professional fee-league Northern Rugby Union (North Union), which later came to be called Rugby League (and so it is today). The League, wanting to make the game more spectacular, conducted a major change in the regulations including reducing the number of competitors per side to thirteen. Rugby League, owing to its working-class character, gained popularity in the north of England and in some regions of Australia, New Zealand, the South of France and the Pacific islands. It's counterpart, Rugby union was adopted by six countries as their de facto national sport; Fiji, Georgia, New Zealand, Samoa, Tonga and Wales (Collins 2006; Collins 2009; Jones 1976).

Rugby Union became a professional sport in 1995, but in Poland it is still a minority sport, played mainly at amateur level. A great deal of research (Duthie et al. 2003; Gabbett and Ryan 2009; Nicholas 1997; Reilly 1997) has been carried out investigating the anthropometric and physical profile of professional rugby players in countries where rugby has evolved to a high level, but still there is a lack of satisfactory data on the composition of the diet of these athletes.

It is well known that nutrition plays a vast role in the improvement of sporting performance, and that better achievement is possible when following specific eating patterns, that are a fundamental factor in the restitution of the body (Celejowa 2008). A properly balanced diet affects the body's energy reserves, which during training or competition, largely determine the ability to exercise. Adequate nutrition also affects the rate of the regenerative processes of the body after training or a match (Kunachowicz et al. 2007; Ziemlański 2001).

The diet of athletes must have an optimal energetic and nutritional value to protect the needs of the organism and to neutralize the negative effects of overexertion during training (Bean 2008). A very important role is played by the distribution of macronutrients such as proteins, carbohydrates and fats which are closely associated with a metabolism characteristic for given type of training (Biesalski and Grimm 2012; Celejowa 2008). In the case of strength-speed sports, of which rugby is one, it is important to provide a proper intake of protein and carbohydrates. This helps to maintain or obtain a positive nitrogen balance, as to increase the amount of muscle glycogen, thus ensuring the efficient work of muscle tissue during a match (Bean 2008; Celejowa 2008).

The purpose of this study was to evaluate the energy, macronutrient and selected micronutrient intake of second league Rugby Union players, and to assess the anthropometric characteristics of this group. The present study was the first to determine normative data on the anthropometric characteristics and dietary intake of rugby players in Poland.

Material and methods

The study group included 44 amateur, male Rugby Union players (24 backs and 20 forwards), aged 19–34 years, from the Wrocław second division club, KS Rugby Wrocław. After a presentation of the objectives and procedures of the experiment, the players gave their informed consent to participate in the study, which was a condition for their participation in the research. Injured players undergoing active rehabilitation were also included. The study was conducted in the run-up to the league season (January 2014).

Body composition analysis was performed by determining the bioelectrical impedance using the Body Composition Analyzer Tanita BC-418 MA (Japan). Height was measured using an anthropomethr and waist and hip circumferences; by a non-strech measuring tape. BMI (body mass index) and WHR (waist to hip ratio) were computed based on the aforementioned measurements.

Assessment of dietary intake was based on three-day dietary recalls. Subjects were asked to keep a food diary recording all food and drink consumed using household measures to quantify serving sizes. Both written and verbal instructions were given to the subjects, including an example of a dietary entry, to demonstrate the level of detail required. The food diaries were kept during three days: training day, non-training day and the weekend day. On completion, diaries were checked by a trained interviewer and, if necessary, data was further clarified during the interview. The food diaries were analyzed using Food Processor SQL – a nutrition software with a Polish food database (Kunachowicz et al. 2005). The adequacy of macro- and micronutrients was assessed by comparison with the Polish recommendations on EAR (Estimated Average Requirement) or AI (Adequate Intake) levels (Jarosz 2012). The highest tolerable level of cholesterol intake was assumed at 300 mg, while recommended intake of dietary fiber was 25 g per day. All food and beverages were analyzed, including carbohydrate and protein powders, liquid meal supplements, sport drinks and diet bars. Vitamin and mineral supplements (pill or tablet) were excluded. Where specialized sport foods were not listed in the nutrient database, the nutrient composition was obtained from the product label or from manufacturer.

Data was examined for the whole group, and forwards versus backs to determine whether their specialized role within the game led to differences in both physical characteristics and dietary intake. The results were reported as a mean ± standard deviation (SD). Statistical analysis was done using Statistica 10.0 PL, from Statsoft Inc. USA. Comparisons between backs and forwards was done using a non-parametric U Mann-Whitney test for independent variables. A Chi^2 test was used to compare differences in parametric variables. Differences were considered statistically significant at $p < 0.05$.

Results

The anthropometric characteristics of the two main groups of players (backs and forwards) are summarized in Table 1. There were no statistically significant differences between age, height and muscle mass of the athletes depending on the position they play. However forwards had a significantly higher percentage of body fat then the backs, which resulted in significantly higher BMI among the forwards than the backs. Significantly more forwards than backs had a BMI > 24.9 kg/m^2. The forwards also had significantly higher waist and hip circumferences and WHR ratio than the backs.

Table 1. Characteristics of the study group (n = 44) divided into forward and backs players

Parameters		Forwards (n = 20)	Backs (n = 24)	P-value
Age (years)	Mean ± SD	24 ±4.3	22 ±1.7	Ns[a]
Height (m)	Mean ± SD	1.80 ±0.06	1.82 ±0.08	Ns[a]
Weight (kg)	Mean ± SD	92.6 ±14.7	80.8 ±8.6	0.001753[a]
BMI (kg/m^2)	Mean ± SD	28.6 ±5.0	24.5 ±1.4	0.000081[a]
<18.5 (kg/m^2)	% (n)	0 (n = 0)	0 (n = 0)	0.0016[b*]
18.5–24.9 (kg/m^2)	% (n)	15 (n = 3)	62.5 (n = 15)	
25.0–29.9 (kg/m^2)	% (n)	60 (n = 12)	37.5 (n = 9)	
>30.0 (kg/m^2)	% (n)	25 (n = 5)	0 (n = 0)	
Muscle mass (kg)	Mean ± SD	68.4 ±7.8	66.9 ±8.0	Ns[a]
% body fat	Mean ± SD	22.0 ±4.6	13.3 ±3.1	<0.0001[a]
Waist (cm)	Mean ± SD	94.4 ±9.8	83.6 ±4.8	0.000057[a]
Waist < 94 (cm)	% (n)	50 (n = 10)	100 (n = 24)	<0.0001[b]
Waist > 94 (cm)	% (n)	50 (n = 10)	0 (n = 0)	
Hips (cm)	Mean ± SD	109.3 ±8.4	102.1 ±4.0	0.000465[a]
WHR	Mean ± SD	0.86 ±0.05	0.82 ±0.04	0.003477[a]
WHR < 1.0	% (n)	100 (n = 20)	100 (n = 24)	–
WHR > 1.0	% (n)	0 (n = 0)	0 (n = 0)	–

SD – standard deviation; BMI – body mass index; WHR – waist to hip ratio; Ns – no significant differences;
[a] – U Mann-Whithey test; [b] – Chi^2 test; * – difference between players with BMI > 24.9 kg/m^2 vs BMI ≤ 24.9 kg/m^2.

Table 2 presents the macronutrient intake of all subjects, as well as of the subgroups. The mean daily energy intake of the whole study group amounted to 3,613.4 kcal. There were no significant differences in energy and macronutrient intake between forwards and backs. Only the ratio of polyunsaturated fatty acids n-6/n-3 was significantly higher among the forwards than the backs (8.3 vs 6.6). Of the total energy intake, the mean intake of macronutrients for all subjects was improper and accounted as follows: proteins, carbohydrates and fats 17.8%, 41.4% and 39.3%, respectively. The structure of fatty acid intake was also improper. Saturated fatty acids (SFA) accounted for 14.6% of energy, monounsaturated fatty acids (MUFA) 15.3%, and polyunsaturated fatty acids (PUFA) 6.6%. The average content of cholesterol in the diet of athletes was very high and amounted to 641.8 mg/day, what was much higher than the maximum limit allowed. Although the average intake of dietary fiber amounted to 30.3 g/day, as many as 39% of athletes did not fulfill the recommended value of 25 g/day of fiber.

Table 2. Energy and nutrient intake (mean ± SD) in the study group (n = 44) divided into forward and backs players

Nutrient	Forwards (n = 20)	Backs (n = 24)	All players (n = 44)	Forwards vs backs (P-value)*
		Energy		
kcal/day	3604.4 ±1082.3	3621.0 ±832.7	3613.4 ±942.6	Ns
		Protein		
g/day	156.1 ±59.4	159.0 ±45.3	157.7 ±51.6	Ns
g/kg b.w.	1.7 ±0.7	2.0 ±0.7	1.9 ±0.7	Ns
% of energy	17.9 ±6.1	17.8 ±4.0	17.8 ±5.0	Ns
		Carbohydrates		
g/day	408.2 ±142.8	401.4 ±118.2	404.5 ±128.4	Ns
g/kg b.w	4.5 ±1.8	5.0 ±1.6	4.8 ±1.7	Ns
% of energy	42.1 ±8.4	40.8 ±6.7	41.4 ±7.5	Ns
Fiber (g)	31.1 ±12.8	29.7 ±10.4	30.3 ±11.4	Ns
		Fat		
g/day	156.4 ±61.3	160.0 ±44.3	158.3 ±52.1	Ns
g/kg b.w.	1.7 ±0.7	2.0 ±0.6	1.9 ±0.7	Ns
% of energy	38.5 ±8.4	39.9 ±7.3	39.3 ±7.8	Ns
		SFA		
g/day	59.4 ±27.9	58.9 ±18.0	59.2 ±22.8	Ns
% of energy	14.4 ±3.6	14.7 ±3.3	14.6 ±3.4	Ns
		MUFA		
g/day	59.3 ±22.2	63.0 ±20.3	61.3 ±21.0	Ns
% of energy	14.7 ±3.5	15.8 ±4.1	15.3 ±3.8	Ns
		PUFA		
g/day	26.5 ±14.5	26.7 ±14.9	26.6 ±14.5	Ns
% of energy	6.6 ±3.2	6.6 ±2.9	6.6 ±3.0	Ns
n-6 : n-3	8.3 ±4.1	6.6 ±4.6	7.4 ±4.4	0.008869
Cholesterol (mg)	675.7 ±230.4	613.5 ±298.8	641.8 ±268.7	Ns

SD – standard deviation; b.w. – body weight; SFA – saturated fatty acids; MUFA – monounsaturated fatty acids; PUFA – polyunsaturated fatty acids; Ns – no significant differences; * – U Mann-Whithey test.

Intake of selected vitamins and minerals in the diets of the study group is presented in Table 3. There were no significant differences in the content of vitamins A, C, E, sodium, potassium and magnesium in the diets of forwards and backs. The average content of these compounds was close or even greater than recommended values. However, about 23% of the players did not consume sufficient amounts of the vitamin C. More disquieting was, that the diets of about 2/3 of the players did not contain the required amount of potassium.

Table 3. Vitamin and mineral intake in the study group (n = 44) divided into forward and backs players

Nutrient	EAR/AI	Forwards (n = 20)			Backs (n = 24)			All players (n = 44)			
		mean ± SD	median	% of the EAR/AI	mean ± SD	median	% of the EAR/AI	mean ± SD	median	% of the EAR/AI	% of diets below the EAR/AI
Vitamin A (µg)	630[a]	2008.8 ±1218.1	1869.2	318.9	1409.4 ±706.5	1300.1	223.7	1681.9 ±1006.8	1500.4	267.0	9.1
Vitamin C (mg)	75[a]	171.3 ±135.5	136.2	228.4	168.0 ±138.0	124.8	224.0	169.5 ±135.3	136.2	226.0	22.7
Vitamin E (mg)	10[b]	20.9 ±9.1	20.7	209.1	21.5 ±10.9	19.1	215.2	21.2 ±10.0	19.9	212.4	9.1
Sodium (mg)	1500[b]	3405.7 ±1346.3	3068.4	227.0	3339.3 ±1458.5	3300.3	222.6	3369.5 ±1392.8	3285.8	224.6	6.8
Potassium (mg)	4700[b]	4750.8 ±1671.6	4433.0	101.1	4645.2 ±1289.0	4370.9	98.8	4693.2 ±1458.1	4370.9	99.9	61.4
Calcium (mg)	800[a]	1135.8 ±444.6	1103.1	142.0	1467.1 ±560.3	1333.0	183.4	1316.5 ±532.1	1207.7	164.6	13.6

[a] – EAR – Estimated Average Requirement, [b] – AI – Adequate Intake, SD – standard deviation.

Discussion

The team sport of rugby is classified as an intermittent high contact, dynamic sport, in which players are involved in high and low intensity activities (Gabbett 2005). Standing still, walking, jogging, side and backwards stepping, are seen as tasks that do not require intensive energy input, but do involve the aerobic system. Rugby matches also include sport specific activities such as rucking, mauling and scrimmaging. When rugby players are running, sprinting or performing these high intensity activities, their anaerobic systems provide the required energy (Duthie et al. 2003; Nicholas 1997).

The effects of diversified type of physical activity during the match between forwards and backs caused significant differences in body composition (mainly fat mass), and BMI between them. Forwards are heavier and have a greater proportion of body fat than backs. Differences in body fat composition between forwards and backs, as was expected, were also observed in the study herein. This suits the role of forward where greater mass provides momentum to break through tackles and gain ground. They have to complete more high intensity activities than do backs, with shorter periods of low intensity activity between them, which makes the anaerobic glycolytic system of prime importance for them (Duthie et al. 2003). Total work over the duration of the game is lower in backs compared with forwards. Forwards spend more time in physical contact, while backs spend more time free running, allowing them to cover greater distances (Reilly 1997).

The training undertaken by rugby players calls for a high-energy diet. Lundy et al. (2006) assessed the nutrient intake of Australian rugby players, in which the mean daily energy intake of the forwards and backs was 4,309 kcal and 4,142 kcal, respectively. In comparison with the previous study (Lundy et al. 2006), the mean energy intake of forwards (3,604.4 kcal/day) and backs (3621.0 kcal/day) in the present study, were lower.

Among energetic dietary compounds, insufficient intake was observed for carbohydrates. They are the predominant source of energy in sports like rugby, and that is why carbohydrate depletion is often a reason for fatigue during exercise. Carbohydrate intake should provide about 60% of all dietary energy, yet the calories from a carbohydrate intake at a level of 404.5 kcal/day, noted in this study, provided only about 41% of dietary energy. Such an amount of carbohydrates was almost 160 g lower than those observed by Lundy et al. (2006).

According to Charzewska et al. (2010), the percentage of energy from carbohydrates in athletes during training and match activity, should be maintained at 60–70%. This means that the supply of carbohydrates should be sustained at a level of 6 to 10 g per kg of body weight, when the players are in the period of preparation, i.e. the development of physical fitness (strength, speed, power). Burke et al. (2001) suggested that athletes who trained at average intensity, for less than 60 minutes, should consume 5–7 g of carbohydrates per kg of body weight daily. If the exercise is more intensive, and their duration is extended to 3 hours, the intake of carbohydrates should be increased to 7–10 g per kg of body weight (Burke et al. 2001).

An adequate intake of carbohydrates in the diet of athletes is extremely important for maintaining proper blood glucose level during exercise, and to supplement the loss of glycogen after exercise. The high expenditure of scarce ATP resources in the human body (almost 100 g) during physical exercise, forces a constant renewal of its resources at the expense of phosphocreatine, muscle, fatty and liver glycogen; resulting in the accumulation of metabolic waste products, which can lead to a reduction of psychomotor performance (Klich 2013). Furthermore, as a result of anaerobic processes, the accumulation of lactic acid in the muscles, is said to be a cause of exercise-induced muscle pain (Pawlak 2013).

The time after which fatigue appears is directly related to the initial concentration of glycogen in the muscles (Charzewska et al. 2010). Athletes who consume a high-carbohydrate diet on a regular daily basis, are characterized by higher muscle glycogen (Eberle 2000), which results in better body condition and delays the appearance of fatigue. No matter the size of fat reserves in the body, if muscle glycogen stores are depleted, fatigue will occur and the intensity of effort will diminish. Daily consumption of a diet containing 6–8 g of carbohydrate per kg of body weight, accelerates the biological regeneration after exertion, and protects the immune system, relieving stress caused by the lowering of blood sugar levels (Eberle 2000; Szukała 2000). The range of carbohydrate intake at mean levels (4.8 g/kg of body weight), assessed in the herein study, fell below sports nutrition recommendations. The insufficient intake of carbohydrates is the main reason for the underdeveloped physical endurance maintained by athletes at an amateur level.

Fiber intake met the recommendations but was about 6 g lower in comparison with the Lundy et. al (2006) study. Increased fiber content in the diet causes a slower release of carbohydrates into the blood, resulting in a more sustained energy release (Biesalski and Grimm 2012).

Analyzing the impact of diet on physical performance, it is believed that the diet of athletes should take into account an increased supply of carbohydrates, while reducing intake of fats (Celejowa 2008; Ziemlański 2001). Excess fat in the diet can prolong the process of digestion, impair the process of blood flow within the blood vessels, weaken the utilization of nutrients by the body and lead to many metabolic diseases (Kunachowicz et al. 2007).

Mean fat intake in rugby players was very high, representing about 40% of total energy, by far surpassing the recommendations of 20–25% of daily caloric intake, which Manore et al. (2000) considered as optimum. According to Eberle (2000), a diet containing approximately 1 g of fat per 1 kg of body weight stimulates the synthesis of enzymes in the muscles required to metabolize fat during exercise. Consumption by the players 1.9 g fat per kg of body weight is unfavorable and only hinders their general performance. Chylomicronemia which occurs after excessive intake of fat, adversely affects the speed of blood flow and this, in turn, impairs muscle function (Celejowa 2008).

Fat cannot be completely eliminated from the diet, since this would lead to the occurrence of symptoms associated with a deficiency of essential fatty acids (EFAs), as well as impaired absorption of fat soluble vitamins. An important consideration should be the adequate quality of dietary fats. When analyzing the diet of athletes, it is important to pay attention to factors such as the contribution of SFA, MUFA, PUFA, n-6 to n-3 ratio and cholesterol intake.

A percentage of energy from SFA amounting to 14.6% is greater than the national target which suggest less than 10% energy from SFA (Kłosiewicz-Latoszek et al. 2008; Ziemlański 2001). Their increased contribution to the diet adversely affects the coagulation system by increasing platelet aggregation and fibrinogen activity. This causes strong atherogenic changes in the walls of the coronary arteries and has a pronounced effect on promoting the development of coronary heart disease, and thus compromises the efficiency of muscle work (Jarosz 2012).

The majority of fats in the diet should provide MUFA, the consumption of which can reach even 20% of the total energy (Kłosiewicz-Latoszek et al. 2008). MUFA intake by respondents was consistent with this recommendation. The necessary fraction of dietary fats are also PUFA, both of n-6 and n-3, but in a proportion which cannot exceed 4–5 : 1 (Biesalski and Grimm 2012; Kłosiewicz-Latoszek et al. 2008). Among them are EFAs that the body cannot synthesize itself and must be provided in the diet.

The ratio of PUFA n-6 to n-3 is extremely important, as it plays a crucial role in regulating the permeability of cell membranes, gene expression and lipid levels in blood plasma. An adequate intake of PUFA is very important. At least 6% of dietary energy should come from PUFA, but the consumption of these substances should not be higher than 10% of total energy, due to their high content of unsaturated bonds that may encourage prooxidant activity (Biesalski and Grimm 2012; Kłosiewicz-Latoszek et al. 2008). Among the study group PUFA intake was rather low (6.6%), while the ratio of n-6/n-3 was too high. Improper intake of these fatty acids can lead to difficulty in blood flow, as well as cause inflammation, making it difficult to process after workouts (Biesalski and Grimm 2012; Kłosiewicz-Latoszek et al. 2008).

When analyzing the nutritional needs of the body, attention should be paid to the supply of cholesterol. According to current knowledge, the supply of cholesterol in the diet of healthy individuals should not exceed 300 mg per day (Jarosz 2012). An analysis of diets of the study group showed cholesterol intake more than twice in excess of that requirement. An excessive supply of this compound can cause an increase in blood serum cholesterol , with the resulting hypercholesterolemia and undesirable changes in the cardiovascular system (Jarosz 2012).

Although the protein itself does not play a significant role in meeting the energy requirements of rugby, its adequate supply in the diet is essential. According to Tarnopolsky (2008), the minimum intake of protein needed to optimize muscle recovery after a workout should be 0.8 g per kg of body weight. In the case of an amateur athletes, the minimum functional protein is at a level of 1.0 g/kg of body weight, with half being from animal sources (Kunachowicz et al. 2007). In the case of endurance sports, Charzewska et al. (2010) recommended a protein intake in the amount of 1.2–1.4 g/kg of body weight, while in strength disciplines 1.2–1.7 g/kg of body weight. A protein intake of 1.9 g of body weight exceeds those standards, especially when it comes to the amateur level. The percentage of energy from proteins for the athletes studied should be maintained at 10–15%. This is a sufficient to maintain mass and to aid recovery, but to not cause excessive acidity of the body, which can lead to decreased physical performance and many diseases.

Rugby players require a vast amount of vitamins and minerals in order to aid recovery and to maintain the body's natural functions. As a result of intense anaerobic exercise, the production and accumulation of excessive amount of free radicals is increased, and therefore antioxidant defense in the organism becomes insufficient (Finaud et al. 2006). During oxidative stress, if antioxidant defense is poorly developed and antioxidant supply from diet is too low, significant deterioration in physical capacity and ability to regenerate may arise. The more severe the formation of reactive oxygen species (ROS) in the course of training, the higher the level of oxidative damage to cells.

Daily delivery of dietary antioxidant vitamins C, A, E, relieves muscle damage and improves the physical capacity of the body to prevent the lowering of oxidative protection and reduce the formation of ROS. Specific needs for vitamins present in the post-training when it comes to enhanced re-synthesis of proteins, hence deficiency can slow down the process of reconstruction (Sadowska-Krępa and Kłapcińska 2005). Too small consumption of fruits and vegetables and the associated vitamin deficiencies can lead to fatigue, tendency to injury, weakening the immune system and increased the time required for regeneration of the body (Watson et al. 2005).

Although the average consumption of antioxidant vitamins by athletes surveyed exceeded the recommended intake, 23% of them did not have an adequate intake of vitamin C. A deficiency of ascorbic acid, which is a catalyst in the transformation of intermediate carbohydrates (as well as a component in the process of amino acid metabolism and trace elements in the transformation of tissues under the influence of heavy-duty physical) reduces efficiency and adaptation to changes in temperature (Sadowska-Krępa and Kłapcińska 2005).

Rugby, as a high contact sport, exposes its players to the increased risk of bone fracture. Many additional injuries also observed such as, soft tissue damage, and bruising by heavy contact and tackling. Therefore, athletes should pay particular attention to the content of calcium in the diet, because the appropriate development and maintenance of the skeletal system is conditioned mainly by this mineral (Czeczelewski et al. 2013). Insufficient intake of calcium has become a trend in very young athletes, so it is necessary to provide adequate amounts of this micronutrient to prevent the weakening of the skeleton and injury. What is more, calcium is involved in muscle contraction and diastole is responsible for conduction of nerve, blood clotting, and determines the proper heart function (Czeczelewski et al. 2013).

During periods of increased muscle work, the body loses significant amounts of sodium and potassium, and therefore they are an essential element of proper post-workout recovery. These elements are involved in the maintenance of proper excitability of nerve and muscle cells and regulate the permeability of cell membranes (Celejowa 2008). Sodium and potassium loss also leads to a disturbed regulation of the acid-base system during exercise, resulting in severe metabolic acidification in key muscles, which causes fatigue in athletes. Because sodium and potassium are alkalizing elements, their adequate intake after exercise affects the speed of the regeneration process (Bean 2008). In the players studied, a significant insufficient intake of potassium was observed, although the average fulfillment of recommendations was satisfactory, about two-thirds of subjects did not reach the required level.

Although a well-balanced diet does not guarantee victory, poor eating habits can impede the building of physical form, inhibit the development of sports achievements and decrease capabilities that lie in the body of the player.

Conclusions

1. The diets of the studied rugby players were improperly balanced, mainly because of insufficient intake of carbohydrates and excessive intake of fats and protein.

2. The improper proportion of nutrients in the diets of the study group may decrease the endurance and strength of the players, and therefore decrease the opportunities to achieve good results during matches.

3. The energy value of the diets of rugby forwards seems to be too high compared to the energy expenditure of these players.

4. The energy and nutrient value of the diets of rugby forwards and backs did not differ. Therefore, the higher BMI and percentage of body fat in forwards compared to backs, indicates the differences in the type of training and the specificity of the player's position within these two groups, which should be included in the dietary guidelines.

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