FOOD PRINCIPLES PROVIDING MUSCULAR ACTIVITY ENERGY IN THE SPORTS TRAINING OF STUDENTS PRACTICING POWERLIFTING

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DOI: 10.35189/iphm.icpesk.2019.10

Abstract. *This article represents the theoretical analysis of the literature, which mentions the value and necessity of an adequate nutrition in order to ensure the energy expenditures for the multitude of activities to which the modern student is subjected. The article reflects information about student life, which is largely characterized by not following the diet and also by insufficient nutrition both in quantitative and qualitative sense, insufficient sleep, limitation of free time and others. Most of these situations are caused by study activities and lifestyle that lead to anxiety, high levels of psycho-physical stress. There has been formulated a set of food principles in the theoretical study that can be used in the sports training of students practicing powerlifting and being strictly followed transform ordinary food into a nutrition for athletes as a basic condition for avoiding the state of malnutrition. The second part of the research reflects the theoretical synthesis of a number of authors that elucidates the mechanism of establishing the energy system that participates in the physical activity, the energetic assurance of the muscle activity, the calorimetry and the way of estimating the energy necessary for the Basal Metabolism, the specific dynamic action of food and adjustable energy expenditure, which, combined and properly used, can promote success in the sports training of students practicing powerlifting.*

Keywords: *food principles, energy, kilocalories, powerlifting, students.*

Introduction

Nutrition is an extremely important factor for the human body, which, systematically, meets the daily needs of energy and matter. It serves as an energy source for the functioning of all body systems, renewing tissues.

In the opinion of several authors (Bodyukov, 2008; Nastinova, 2013; Bogdan, Cazan, & Rusu, 2014; France, 2011), nutrition is considered one of the biological needs of the body and once a process of consumption and use of food for body development, obtaining energy and restoring vital reserves. Nutrition supplies the person with energy, as well as the substances necessary for the development and regulation of metabolism, the maintenance of life. In the same context, Byankin (2007) states that the body can exist due to the absorption and assimilation of substances and energy that are obtained from the outside and compensates for the losses caused by its activity, a process called nutrition.

Opopol, Obreja and Ciobanu (2006, pp. 9-12) suggest an idea that food is consumed for energy and/or matter input, but also because of its organoleptic, emotional and sociological quality, but in meeting more needs, life requires permanent energy consumption. The author points out that the most important are: the synthesis of substances necessary for the growth and development of the body, the muscular activity, the voluntary and involuntary contractions of the striated and smooth muscles, the maintenance of the constant temperature of the organism, recovery and others.

Bagnetova (2009, pp. 80-81) states that rational, balanced nutrition is a prerequisite for a healthy lifestyle. Furthermore, it provides daily activities and human body development, physical and intellectual performance, resistance to negative effects induced by various external factors.

Opopol et al. (2006) characterise the nutrition theory proposed by Ugolev (1991), stating that one of the key points on which this theory is based is: “Nutrition maintains molecular composition and compensates for energy and plastic expenditures for basal metabolism, body development, and everyday human activity” (p. 9).

Awareness of rational nutrition principles allows people involved in physical training to change body parameters, optimise the functional state of the body, improve motor skills without compromising their psycho-physical health, without experiencing energy deficiencies, deficit of vitamins, minerals and other nutrients. Ability to use rational nutrition principles based on personal characteristics, understanding individual body needs and reactions to different diets can greatly determine health and sport performance. Rationally built on a scientific basis, nutrition provides the amount of nutrients needed for proper growth and body formation, contributes to maintaining health, life extension, etc. (Bagnetova, 2009; Bodyukov, 2008).

France (2011, p. 115) reports that sports performances can only be achieved by fully understanding of food principles but athlete who will follow a proper diet will have less trauma and higher performance.

Marti and Tomescu (2015) emphasise that food has a huge impact on sports by providing energy to the body.

In his work, Bodyukov (2008) mentions the specialists Laputin (1990) and Ozolin (2003), who think that proper nutrition is the most important condition for life, the condition of the body and physical training. In the same context, the nutrition of a student practicing a sports activity must cover all the energy expenditure associated with the activities combined with the sports activities.

In the opinion of Gilyov (2007, pp. 100-101), nutritional culture plays a significant role in shaping a healthy lifestyle for students. Every student can and should know the principles of rational nutrition – this is nothing more than a nutritional, physiological, complete intake, considering gender, age, nature of work and other factors.

Purpose of the research

Highlighting the food principles and energy characteristic of muscle activity in the sports training of students practicing powerlifting

Research objectives

Emphasising the most important food principles for students practicing sport; elucidation of the energy process of muscle activity in the sports training of students practicing powerlifting

Methods

In the paper, we analysed the theoretical and practical-methodical sources of the literature. The solution of the proposed objectives was possible through methods of theoretical research: analysis and synthesis, induction and deduction, idealisation, comparison and generalisation.

Results

Kapilevich (2011) mentions that, in the practice of sports training, besides the pedagogical methods, there are also the medical-biological ones, which include the rational alimentation, which contributes to the restoration of the energetic reserves and other parameters of the exhausted body after various activities.

Physical exercise requires significant energy expenditure (Harrast & Finnoff, 2012, p. 125), so building powerful and resistant muscles without a rational diet is impossible. Rational nutrition implies observance of an energetic balance according to the following law: the amount of energy ingested by the diet must correspond to the energy spent by the organism (Borisova, 2007).

Smolenskij and Mihajlova (2014) state that the inclusion of a rational nutritional diet appropriate to the training program stimulates the faster adaptation of the body to the training tasks and prevents over-training symptoms. The authors mention some components that, in their view, allow optimisation of the training process and quicker achievement of sports results through appropriate nutritional assistance. These components are: providing the athlete with a sufficient amount of calories in accordance with his calorie needs; consuming macronutrients (proteins, carbohydrates, lipids) in optimal proportions, according to the type of training; the food intake (during the day) and the composition of ingested foods can play a key role in achieving sports performance (Smolenskij & Mihajlova, 2014).

Karkishchenko et al. (2014, p. 39) launch the idea that, in organizing the basic nutrition of athletes, there are certain mandatory food principles. Compliance with or application of these principles turns simple nutrition into the so-called “nutrition for athletes”.

The analysis of the literature allowed us to identify other authors, as well as those mentioned above, which recommend certain food principles for athletes and can also be applied in the sports training of students practicing powerlifting. In our opinion, the most important are:

- The principle of adequate nutrition, in both quantitative and qualitative terms, which will provide the person with the amount of energy required for everyday activities, but also for sports activities (Bogdan et al., 2014 pp. 52-56; Bagnetova, 2009, pp. 81-82; Byankin, 2007, p. 24; Kapilevich, 2011, p. 74; Nastinova, 2013, p. 63; Tokaev, 2010, p. 5). For this reason, the nutrition of the representatives of sports strength events (including powerlifting) will be different from the diet recommended for other sports events through higher protein and amino acid consumption (Zaborova, 2011, p. 57; Karkishchenko et al., 2014, p. 39; Tokaev, 2010, pp. 33-34).
- The principle of full nutritional value for athletes involves the presence in the consumed products of all the main nutrients (macro-, micro-nutrients) in sufficient quantities to maintain a high level of metabolism in the body

and to ensure a higher rate of bioenergetic processes in muscle activity (Bodyukov, 2008, pp. 139-140; Kapilevich, 2011, p. 74; Karkishchenko et al., 2014, p. 40; Nastinova, 2013, p. 63; Tokaev, 2010, p. 33).

- The principle of balance in athlete nutrition shows that the content of basic nutrients and their structural components in consumed foods must be strictly defined (Opopol et al., 2006, pp. 40-41; Byankin, 2007, p. 30; Grigor'ev & Davidenko, 2009, p. 106; Nastinova, 2013, p. 63).
- Saturation principle means that essential nutrients must be present in sufficient quantities in the nutritional products of athletes to meet their vital needs (Bogdan et al., 2014, pp. 52-56; Byankin, 2007, p. 24; Grigor'ev & Davidenko, 2009, p. 106; Tokaev, 2010, p. 5). This principle is mainly put into practice by the use of dietary supplements (Karkishchenko et al., 2014, p. 41).
- The principle of assimilation. Using culinary techniques that will facilitate the maximum absorption of nutrients or their consumption in a natural state (Bogdan et al., 2014, pp. 52-56; Bagnetova, 2009, p. 82; Kapilevich, 2011, p. 74).
- The principle of following the diet (Opopol et al., 2006, p. 117; Byankin, 2007; Nastinova, 2013, p. 63; Smolenskij & Mihajlova, 2014, p. 160) and the number of meals per day. For the representatives of the strength events, it is recommended to divide the food ration into 4-6 sessions per day (Bodyukov, 2008, p. 138; Grigor'ev & Davidenko, 2009, p. 106; Zaborova, 2011, p. 59; Kapilevich, 2011, p. 74; Karkishchenko et al., 2014, p. 227; Smolenskij & Mihajlova, 2014, p. 156). Grigor'ev and Davidenko (2009, p. 106) state that protein intake should not be more than 30 g for each meal, and the same opinion is shared by Nastinova (2013, p. 64), only that the values are between 30-50 g.
- The principle of the enzymatic level assumes that the composition of foods must correspond to the characteristics and activity of the body's digestive enzyme system. As a result of an imbalance thereof, the non-assimilation of nutrients will increase. For increasing the percentage of food proteins in the feed ration, it is possible to consume various digestive ferments (mezim, fistal, etc.) (Opopol et al., 2006, p. 117; Kapilevich, 2011, p. 70; Karkishchenko et al., 2014, p. 40).

Moldovan, Tarcea and Ruța (2015, p. 10) mention that, in the insufficiency of food intake that does not meet metabolic needs, the state of "malnutrition" develops, which has the following causes: inappropriate quantitative and qualitative intake; digestive disorders, absorption, chronic diseases of the digestive tract; dysfunctional metabolic processes; increased excretion of essential nutrients.

In order to not develop the malnutrition condition, which, for various reasons, often signals to students (especially the first year of studies), it is recommended that they follow the above principles and realize that individuals who combine sport and intellectual activity to meet the energy needs of the body caused by both sports and intellectual activity. In this context, Bodyukov (2008, p. 107) mentions that learning or intellectual activity is the main factor determining a specific state of a person – a reaction of exhaustion (fatigue), which means reducing the body's ability to continue its successfully intellectual activity. The author also mentions a number of factors that do not directly lead to the exhaustion state, but it favours its occurrence, including irrational nutrition. But Gilyov (2007, pp. 44-48) argues that continuing to work in a state of fatigue will lead to the state of over-fatigue, which is detrimental to the organism as a disease and has a longer recovery period. Among the methods of removing this symptom, the author proposes for students to perform systematic training, which will lead to the relaxation of neuropsychological tension and rational nutrition in correlation with other factors of the daily regime. The author (Gilyov, 2007, p. 105) also mentions that a particular case is the students practicing performance sports, which require a special planning of the study regime in combination with the sports activity.

A number of authors (Bompa, 2016, p. 4; Gilyov, 2007, pp. 78-80; Samsonova, 2011, pp. 82-85; Harrast & Finnoff, 2012, p. 120; Rodriguez, Di Marco & Langley, 2009, pp. 711-712) mention that the energy providing the muscle activity is achieved by using the energy obtained in ATP hydrolysis, preferably by the three ways of restoring it. Because the reserves of ATP in the muscles are very small, the hydrolysis gives an energy that allows performing a very intense muscular activity, but for a very limited time of 1-2 seconds. For this reason, in order to perform a longer muscular activity, it is necessary to supplement the ATP reserves in the muscles. Formation of ATP directly during muscle activity is called ATP resonance. Thus, two simultaneous processes work in muscles carrying a muscular activity: hydrolysis of ATP that provides energy for muscular activity and resynthesis of ATP, which restores the loss of this substance.

According to Kapilevich (2011), the resynthesis of ATP is accomplished through the Anaerobic Oxidation and Aerobic Oxidation processes. Depending on the substrate, there are two different anaerobic pathways for ATP resynthesis: Creatine phosphate (creatinine kinase, alactacid) and Glycolysis (glycolysis, lactic acid). In the first case, creatine phosphate interferes with the second glucose. The aerobic pathway represents the third pathway for the ATP re-stimulation mentioned above, as a substrate can interfere with various substances (when using this method for a long time > 20 min subcutaneous fats are used as a substrate), but with the mandatory participation of oxygen.

Creatinphosphate pathway – the source shows creatine phosphate, working time at maximum power is 8-10 sec with 900-1000 cal/min/kg. The advantage is the high intensity of the muscular effort. The disadvantage is short action times.

The glycolic pathway – the source shows muscle glycogen and glucose in the blood stream, the maximum working time is 2-3 minutes with 750-850 cal/min/kg. Advantages are oxygen-free flow. The disadvantages are the lack of economy and the accumulation of lactate in the muscles.

The aerobic pathway – various sources (including fat reserves), peak power time is tens of minutes with 350-450 cal/min/kg. Advantages are economy, long time of action etc. Disadvantages are the mandatory use of oxygen, low intensity of muscle work and others (Kapilevich, 2011).

In his work, Bompa (2016, p. 4) suggests the idea that the energy providing intense but short-lived muscular activity involves the glycolytic system. If the activity continues, another system is used, namely lactic acid system. Thus, if the duration of the physical effort is prolonged, the energy of the muscular activity will be ensured by the Oxidative (Aerobic) System. The author (Bompa, 2016, p. 4) proposes the following table (Table 1):

Table 1. *Synopsis of relationships between physical activity duration, dominant energy systems and the physical qualities to be trained for each category of activity*

Physical activity time	Dominant energy system	Dominant physical qualities
< 15"	Alactacid	Maximum force; maximum speed/phosphagen; strength; agility
30-45"	Lactic acid	Lactic acid strength; Lactic acid speed; Lactic acid force; Lactic acid agility
1-3/5'	Lactic acid/Oxidative	Lactic acid/Oxidative speed; Lactic acid strength; Lactic acid force
6-15'	Oxidative/Lactic acid	Oxidative strength; Lactic acid strength; Oxidative force
> 20'	Oxidative	Oxidative strength; Oxidative force

Karkishchenko et al. (2014, p. 16) suggest the following table (Table 2):

Table 2. *Providing energy in maximal physical effort*

Duration of physical effort	System providing energy	Energy source
1-4 sec	Anaerobic Alactacid	ATP
4-20 sec	Anaerobic Alactacid	ATP + CF
20-45 sec	Anaerobic Lactic acid	ATP + CF + Glycogen
45-120 sec	Anaerobic Lactic acid	Glycogen + Glucose
120-240 sec	Aerobic + Anaerobic Lactic acid	Glucose + Glycogen
240-600 sec	Aerobic	Glucose
>30 min.	Aerobic	Glucose + fat

Taking into account the fact that powerlifting is a strength event where there is an intense effort but for a short time and according to the above tables, it can be seen that energy providing the muscle activity in the given sport event is assured by the Alactacid and Lactic acid system.

France (2011) defines energy as "the power used to work or to produce heat or light" (p. 114). The author also states that chemical energy is used to make such substances as energy-producing proteins, carbohydrates and fats.

Kleiner et al. (Harrast & Finnoff, 2012, p. 115) advance the paradigm of sports nutrition that suggests: Eat more often - Get energy - Train intensely - Increase muscle mass - Burn the fat.

In order to maintain the energy balance in the body, it is necessary to calculate the kilocalories spent throughout the day. Nastinova (2013) highlights the way to calculate the kilocalorie needs according to the method proposed by Dr. Oldridgi:

Consequence of actions	For women	For boys

1.	Number	65.1	66.5
2.	Add to it the weight in pound (0.453 kg), multiplied by	9.6	13.8
3.	Add the height in inches (2.54 cm), multiplied by	1.8	5
4.	Decrease the age, multiplied by	4.1	6.8

The author also notes that, depending on the level of activity, this value will increase (both for women and men): in days with low physical activity by 5%; 10% medium physical activity, 20% high physical activity; very high physical activity by 30% (Nastinov, 2013, pp. 62-68).

According to several authors (Marti & Tomescu, 2015; Moldovan et al., 2015, p. 22; Borisova, 2007; Rodriguez et al., 2009, p. 712), the energy balance is based on a series of components that, when analysed correctly, help in calculating energy needs. These components are: Basis change of substances or basal metabolism, specific dynamic action of foods, adjustable energy expenditure. Basal metabolism (BM) is understood to be the energy required to maintain human body systems and body temperature at rest, in size of 60-80% (Borisova, 2007), while other authors suggest 60-75% (Bogdan et al., 2014; Moldovan et al., 2015, p. 22) of total human energy expenditure. Borisova (2007) launches the idea that this percentage is much smaller in athletes, because up to 2000 kcal a day can be spent on physical activity. Muscle mass is characterised by a higher rate of metabolic activity. Male basal metabolism is usually higher than that of women and depends on age, body weight and others. There are several methods of theoretical determination of the BM value.

For calculating the calorific needs related to BM, some authors (Costea & Răileanu, 2014, pp. 13-14; Opopol et al., 2006, p. 12) propose, for a healthy adult, the value of 1 kcal/kg body/hour, and other authors (Bogdan et al., 2014; Moldovan et al., 2015, p. 29), l kcal/h/kg body for men, and for women, 0.9 kcal/h/kg body. Opopol et al. (2006, p. 12) mention that BM up to the age of 25 is 1.5-1.7 kcal/kg body/hour.

There are also some formulas for calculating BM, namely:

- The Harris-Benedict formula **–** based on age, gender, weight and height:

men - BM = 66.47 + 13.75 (wt) + 5 (ht) - 6.67 (age),

women - BM = 665.1 + 9.56 (wt) + 1.85 (ht) - 4.68 (age),

where BM is Basal metabolism (kcal), wt is weight in kg, ht is height in cm, age is age in years (Moldovan et al., 2015, p. 27; Borisova, 2007).

- The Miffrin - St. Jeor formula – for adults 19-78 years:

women - BM = (10 x G) + (6.25 x I)-(5 x V)-161,

men - BM = (10 x G) + (6.25 x I) - (5 x V) + 5,

where BM is Basal metabolism (kcal), G is weight in kg, I is height in cm, A is age in years (Moldovan et al., 2015, p. 27; Harrast & Finnoff, 2012, p. 125).

The specific dynamic action of foods includes energy expenditure associated with splitting, transformation, absorption, transport of nutrients, etc., as well as energy expenditure from the sympathetic nervous system activity that accompanies the food consumption process. Energy consumption for the specific dynamic effect of food is expressed as a percentage of the energy value of the products consumed. These depend on the amount of energy consumed by the ratio of the main nutrients in the food ration. Energy expenditure for the specific dynamic effect of food represents about 10% of total energy expenditure (Opopol et al., 2006, p. 12; Borisova, 2007).

- Adjustable energy expenditure. In the opinion of several authors, they represent 10-50% (Bogdan et al., 2014; Moldovan et al., 2015, pp. 24-25), 20-30% (Opopol et al., 2006, p. 12) of total energy. Borisova (2007) mentions that different authors have different opinions in determining energy needs for the same physical activity and most research, publications on energy needs for a particular muscular activity can be considered as merely indicative; the above author also suggests introducing the concept of general physical activity (daily activity, homework, walking, driving, etc.) and specific activity (directly related to sports activities).

Bogdan et al. (2014, pp. 3-5), as well as Moldovan et al. (2015, p. 28), mention that, for a person with a body mass of 70 kg, the energy consumption is: sleep 1.2 kcal/min; rest 1.3 kcal/min; washing and dressing 3.4 kcal/min; domestic activities (ironing, cooking, etc.) 2.9-3.5 kcal/min; easy exercise (walking) 3.1 kcal/min; climbing stairs 10-18 kcal/min; car driving, sewing, playing cards 2.5 kcal/min and others.

Moldovan et al. (2015, p. 27) propose, for the calculation of energy consumption (EC), the formula: EC = BM x PA, where PA (physical activity coefficient) is multiplied by the BM values (Table 3).

Table 3. *Physical activity ratio required to calculate daily energy consumption*

Physical activity	Physical activity coefficient (PA)	
	Men	Women
Easy	1.55	1.56
Medium	1.78	1.64
Intense	2.10	1.82
Very intense	3.5-5	2.5

Tokaev (2010, p. 33) mentions that, for force samples, the energy consumption may reach 66-70 kcal/kg body.

Student activity is hardly related to the intellectual activity that predisposes the body to certain energy expenditure. In this context, some sources (Bogdan et al., 2014; Opopol et al., 2006, p. 13) labels this activity as medium intensity with appropriate energy consumption. Kapilevich (2011, p. 71) mentions a series of activities characteristic to students and their caloric needs, including: listening to lectures 1.5 Kcal/kg/hour; performing laboratory work 2.4 Kcal/kg/hour; preparation for oral examinations of 1.4 Kcal/kg/hour; preparation for written examinations 1.5 Kcal/kg/hour, and Gilyov (2007, p. 101) adds that during the exam session, under the action of various factors, accelerates protein breakdown that considerably increases the energy needs.

Conclusion

In the paper, there were established the basic food principles for students who practice powerlifting, which, according to the authors, being strictly complied transform the usual food into “sports nutrition”. Following the analysis of the literature, the peculiarities of the energy providing of the muscular activity were elucidated, and in the same context, the ways for calculating the kilocalories necessary for the students practicing the sport were established.

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