

Research of the Energy Status of Military Personnel During Complex Tactical Exercises

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Abstract— This paper presents a study among cadets from the Vasil Levski National Military University of their energy status during complex tactical exercises. Their energy intake and energy expenditure were studied, using the methods of tabular timing and food intake history. The values of the studied quantities were compared with the national physiological norms for nutrition of the population of the Republic of Bulgaria. The energy status of the cadets during complex tactical exercises was determined by comparing the studied energy expenditure and energy intake.

Keywords— energy expenditure, energy intake, energy status, military personnel, macronutrients.

I. INTRODUCTION

The nutrition of military personnel of the Armed Forces of the Republic of Bulgaria is an important factor in maintaining the physical health of the personnel of the military formations and, respectively, conducting the combat training of the formations at a high level, which guarantees the fulfilment of the main tasks of the Armed Forces. The nutrition is always an essential part not only of the daily activity and training, but in real fighting circumstances also. This statement is proved by the fact that provision of food as an element of support and services for personnel is integral point of each Warning, Operational and Fragmentary order, issued in priority and in time of the battle. [1]

There are different formulations of the importance of nutrition for humans, but they are all related to the indisputable fact that without nutrition, regardless of whether it is rational, balanced, unbalanced, dietary (therapeutic), preventive or related to specific eating habits (vegetarianism, veganism or raw foodism), it is not possible to maintain the vital functions of the body. In the scientific space, there are numerous studies on human nutrition issues, various concepts of nutrition have been developed, specialized textbooks and collections have

been issued, scientific articles and reports have been published, books have been proposed for the general public, but the theses that underlie them are scientifically based. Scientific evidence is what must be followed by nutritionists when compiling and balancing nutrition menus, taking into account the characteristics and factors affecting different groups of eaters or individual individuals. [2]

A. National physiological norms for nutrition of the population of the Republic of Bulgaria

Physiological nutritional norms are used in determining the national nutrition policy of the population, assessing individual nutritional intake and the nutritional intake of population groups, developing recommendations for healthy nutrition of individuals and population groups, planning and control of organized nutrition of population groups and include:

- Average energy needs - the estimated average values of energy dietary intake, minimizing the risk of exceeding and/or underestimating the levels of energy intake, balancing the respective energy expenditure of individuals from the population group,
- Recommended dietary intake of protein, carbohydrates, vitamins and minerals - an average daily level of dietary intake that provides the need for a particular nutrient for almost all (97.5%) healthy individuals in individual groups, differentiated by age, sex and physiological state (pregnancy and lactation). The recommended dietary intake is equal to the "average nutrient requirements" for the group plus two standard deviations,
- Adequate dietary intake of protein, total fat, fatty acids, total carbohydrates, dietary fibre, vitamins, minerals and electrolytes, when a recommended dietary intake cannot be determined -

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recommended average daily intake of nutrients, representing the level of their average intake (median value) in a group of healthy individuals, determined on the basis of scientific research, which is assessed as adequate for all individuals in the group. It is used when average nutrient needs cannot be estimated and a recommended dietary intake can be determined on this basis,

- Adequate dietary intake of water,
- Upper Dietary Intake Limits for Vitamins, Minerals and Electrolytes - (ULNI) is the highest daily dietary intake level that is not associated with adverse health effects in nearly all individuals in a given population group. If intakes are higher than the ULNI, there is an increased risk of adverse health effects,
- Recommended dietary intake ranges for protein, total fat, fatty acids, total carbohydrates, and dietary fibre - the values associated with a low risk of chronic diseases provided adequate intake of essential amino acids, essential fatty acids, vitamins, and minerals.

Energy requirements are defined as average energy requirements, expressed in MJ and kcal per day for population groups differentiated by age and sex; at reference height and weight; estimated for different levels of physical activity and represent the average daily requirements for a period of at least one week.

The level of physical activity was also recorded, which was divided into the following levels:

- low activity lifestyle,
- moderately active lifestyle,
- active lifestyle,
- very active lifestyle. [3]

TABLE 1 RECOMMENDED/ADEQUATE INTAKE OF MACRONUTRIENTS

Age	Recommended/Adequate Intake					
	Protein (g/day)		Fat (g/day)		Carbohydrates (g/day)	
	M	W	M	W	M	W
19 - 29	58,1	46,5	72-126	56,2 - 98,3	367,5-490	286,7-382,2
30 - 59	59,7	49,8	72-126	56,2 - 98,3	367,5-490	286,7-382,2

II. MATERIALS AND METHODS

The study has been conducted among cadets from Vasil Levski National Military University, which was established 147 years ago as the first governmental institution in Bulgaria and has been functioning. Moreover, the organization has a primary role in the military educational system of the country, and it has been educating trainees for the regular and reserve component of the Bulgarian Armed Forces. [4]

The study has been conducted with cadets majoring in Motorized Infantry and Tank Troops, during their

participation in a tactical exercise in summer conditions. A total of 13 (thirteen) cadets were studied, of which 11 (eleven) were men and 2 (two) were women. The average age of the cadets was 20 (twenty) years. The present study used the method of individual tabular timing, which accurately records the time spent on an activity. The tabular timing method accurately records the time spent on a given activity. The data obtained using energy consumption tables for different types of activities allow the determination of the individual's daily energy consumption. Initially, the time spent on the daily activities of an individual is measured, fixing their duration. A disadvantage of this method is the difficulty of predicting all activities throughout the day, and therefore the researchers believe that the error in this method is up to 15%. The advantage of the method is its general accessibility and simplicity. [5]

For the purposes of the study, an individual timekeeping table was developed for each cadet with certain fixation points for the individual activities and part of the day. They were given detailed instructions and the weight of each participant in the study was measured with an electronic scale with an accuracy of 0.1 kg. Before starting the study, preliminary training was carried out with the participating cadets on the features of filling out the individual timekeeping table. The types of loads related to the preparation of the cadets were recorded by measuring their duration in minutes. Based on the results of the five-day recording of the described types of physical and mental activity, the duration of each of them was determined for each student. The energy expenditure per unit of time (kcal/min) was determined using the indirect calorimetry method. The minute energy expenditure at rest was determined according to data from the World Health Organization, based on data on gender, age and weight. The value of the energy expenditure for one minute was multiplied by the duration of the specific physical activity during the day. The results obtained reflect the individual daily energy expenditure spent on each type of physical or mental activity. The obtained daily energy expenditure for the individual activities was summed to obtain the total value of the energy expenditure of each cadet during one day. To obtain the average value of the total daily energy expenditure, the corresponding individual values for men and women were summed and divided by the number of cadets studied. The following methods can be used to study energy consumption:

- record of the food consumed by the serviceman for a certain period - as a quantity of food products. The main energy suppliers are proteins, fats and carbohydrates (macronutrients). In order to determine the energy intake as kilocalories, the quantity of macronutrients consumed by the serviceman under study must be established. This can be established from the content of macroelements in the amount of food consumed. The content of macroelements can be obtained from the manufacturer or from the "Tables of the composition of Bulgarian food products". To

summarize these data, the tools of the Microsoft Excel software product are used,

- use of the prepared weekly menu for the servicemen's nutrition during their training. The data processing is in the same way described above.

III. RESULTS AND DISCUSSION

After the actual processing of the data from the study, the following results were obtained for the energy expenditure of the participants:

- for male trainees - average energy expenditure for the period - 4305 kcal,
- for female trainees - average energy expenditure for the period - 3460 kcal.

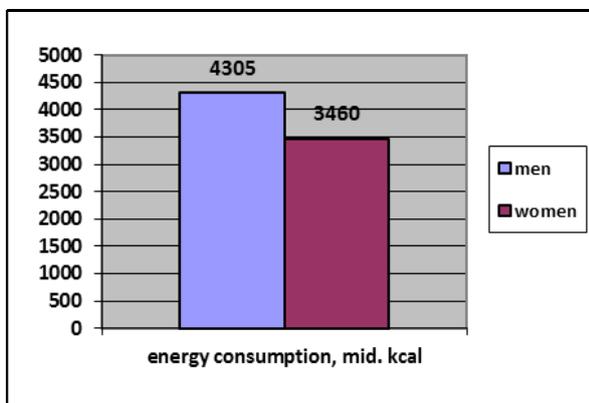


Fig. 1. Cadets' energy expenditure values.

Complex tactical training is characterized by prolonged movement over rough terrain and significantly less time for rest (sleep). The highest energy expenditure is shown by the cadets when moving over rough terrain with equipment and performing various tactical tasks on the terrain, as well as during physical exertion when building field camps.

In order to determine the energy intake, it is necessary to calculate the macronutrients consumed by the trainees during the study period. Macronutrients are nutrients that are necessary to maintain important functions of the human body. These include proteins, fats and carbohydrates.

Growth and development depend on the increase in the number of cells in the body. The main role in this important process is played by proteins. They participate in the construction and increase in the number of cells in the body. Proteins are made of amino acids, which are the main building blocks in the body. Carbohydrates provide most of the energy needed for the body to function. Fats are a concentrated form of energy and the form in which much of the body's energy reserves are stored. Fats are important for building cell membranes and are also involved in the absorption and use of some vitamins. [6]

The nutrition of the personnel of the BA is organized in accordance with the conditions and procedure for the

provision of food, announced in a regulatory act of the Minister of Defence. The main regulatory document of 02.04.2015 is Regulation No. H-5 on the conditions, procedure and norms for providing free food and refreshments to military personnel and civilian employees of the Ministry of Defence, structures directly subordinate to the Minister of Defence and the Bulgarian Army and to cadets in higher military schools in peacetime. The regulation specifies energy and substance norms for balanced nutrition for one feeding day, where the values for macronutrient intake for field training are as follows: proteins - 150-170 grams, fats - 160-175 grams and carbohydrates - 510-560 grams.

For those categories of military personnel who work under conditions of great physical and nervous stress or are subject to the influence of adverse factors, an additional requirement is placed on the rations - to influence the normalization of the disturbed physiological state and contribute to increasing the body's resistance to the relevant adverse influences. [7]

The norms in Regulation No. 1 of January 22, 2018 on the physiological nutritional standards of the population in Bulgaria are the starting point for determining the composition of the daily food ration of military personnel, as no other modern specialized study is known for the Bulgarian Army. [8]

The regulation specifies recommended ranges for the intake of total protein, total fat, fatty acids and total carbohydrates as a relative share of the energy value of food (E %). The values for the age group from 19 to 65 years for the intake of these nutrients are as follows: total protein - 10-20 (E%), total fat - 20-35 (E%) and total carbohydrates - 45-60 (E%).

Proper nutrition ensures normal development of military personnel, promotes disease prevention, prolongs life, improves efficiency and creates conditions for adequate adaptation to the environment. An important stage in rationalizing decisions related to the intake of nutrients and energy by cadets is a study of the energy intake and nutritional status of students at the National Military University. [9]

The cadets were given food products for the period of field training, some of which were: pork shoulder, chicken leg, sausages, sausage, bacon, yellow cheese, cheese, butter, "Dobruja" bread, yogurt, eggs, beans, fresh cabbage, oranges, bananas, apples, waffles, croissants, various types of canned food products, vegetables, spices, etc.

After processing the data, the following results were obtained:

- during the training period, the cadets were provided with daily food with the following average macronutrient content - proteins - 203 grams, fats - 188 grams and carbohydrates - 637 grams,

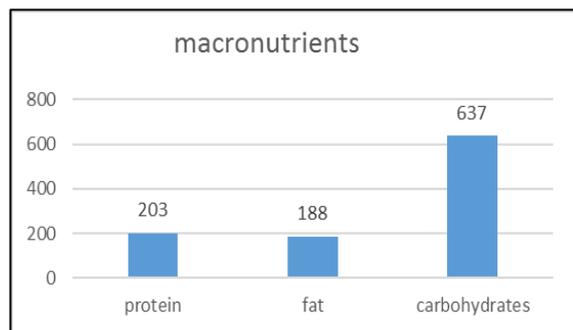


Fig. 2. Macronutrient content in grams.

- for the study period, macronutrients provided the cadets with the following average energy through the food they consumed - proteins - 832 kcal, fats - 1750 kcal, carbohydrates - 2611 kcal.

The largest energy carriers of food products provided daily for the trainees are - bread - 1775 kcal, meat - approximately 440 kcal, fish - approximately 308 kcal, sausages - approximately 300 kcal.

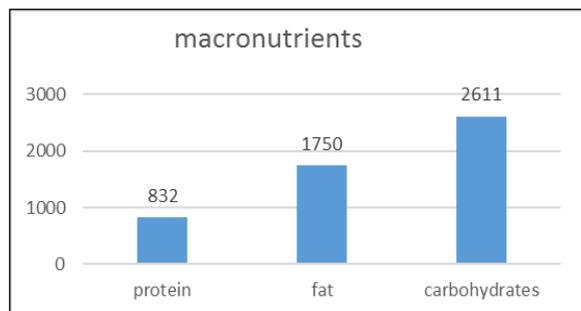


Fig. 3. Energy provided by macronutrients in kcal.

After comparing the results obtained for the intake of macronutrients by the cadets for the study period with the recommended intervals for the intake of total protein, total fat, fatty acids and total carbohydrates as a relative share of the energy value of food (E %) from Regulation No. 1 of January 22, 2018 on the physiological norms for nutrition of the population, the following is obtained: the total protein from the food provided to the cadets is 16.02% of the energy value, fats are 33.7%, and carbohydrates are 50.28%.

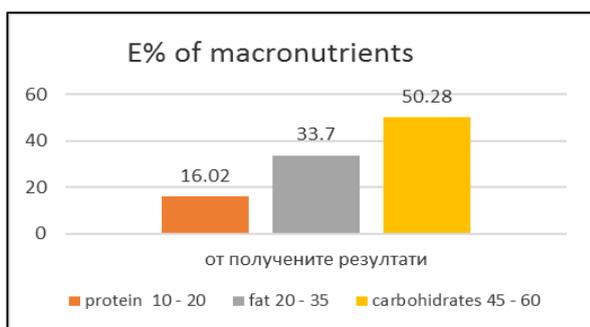


Fig. 4. It is a % ratio of macronutrients.

The results indicate that the intake of macronutrients largely corresponds to the physiological nutritional standards of the population in Bulgaria.

In percentage terms, macronutrients correspond to the physiological nutritional standards of the population, but when comparing them by intake in grams, things are as follows:

- for proteins - the recommended daily intake in grams for men is from 81.4 to 162.8, and for women it is from 63.7 to 127.4. The amount provided to the cadets is 203 grams,
- for fats - the recommended norms in grams are from 72 to 126 for men and from 56.2 to 98.3 - for women. The amount provided is 188 grams,
- for carbohydrates - the recommended intake in grams is from 367.5 to 490 for men and from 286.7 to 382.2 - for women. The quantity provided to the trainees is 637 grams.

TABLE 2 RECOMMENDED INTAKE AND MACRONUTRIENTS PROVIDED

	Protein	Fat	Carbohydrate
Recommended intake - men	81,4-162,8	72-126	367,5-490
Recommended intake - women	63,7-127,4	56,2-98,3	286,7-382,2
Macronutrients provided	203	188	637

After determining the energy expenditure of the studied group, we should determine the energy status.

During the tactical exercise, the servicemen were provided with food according to the appendices of the current nutrition regulation, which includes a basic application plus supplements required for various activities, such as exercises, increased energy expenditure, etc.

Based on the prepared menu-layout for the purposes of the exercise, the servicemen were provided with macronutrients, providing an average energy intake of 5184.25 kcal. per day per person.

After comparing the values, an imbalance is obtained between the energy intake of the servicemen and their energy expenditure. The average values show a difference of nearly 900 kcal in favour of energy intake in men and about 1700 kcal - in women.

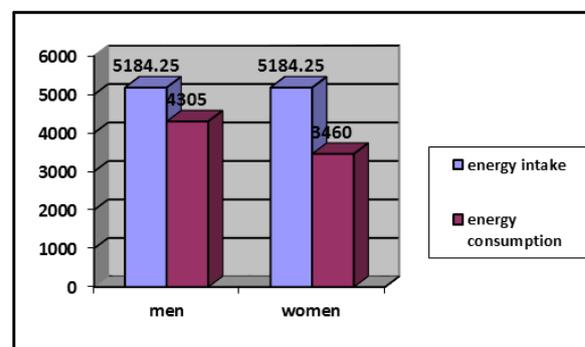


Fig. 5. Energy status.

IV. CONCLUSIONS

From the results obtained, it can be concluded that the nutrition of cadets during tactical exercises, in particular - the intake of macronutrients, is in extreme imbalance according to the nutritional standards of the population in Bulgaria. In this situation, it is advisable to develop new standards for the nutrition of cadets during tactical exercises, adequate to the needs.

From the results obtained for the energy status of military personnel during complex tactical exercises, it is again evident that their nutrition is in imbalance compared to their needs. Here too, it is necessary to propose a new set of food products that would ensure a balance in the nutrition of military personnel during complex tactical exercises.

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