

FAT MASS INDEX AND DIETARY BEHAVIOURS OF THE POLISH BORDER GUARD OFFICERS

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ABSTRACT

Background. Due to specific requirements of service, Border Guard officers should be characterized by good health. Whereas there is lack of studies assessing nutritional status as well as dietary behaviours among Polish Border Guard officers.

Objective. The aim of the study was to assess the impact of dietary behaviours of the Polish Border Guard officers on the Fat Mass Index.

Material and methods. The study was carried out with participation of 250 Border Guard officers (187 men and 63 women), aged 37±6; years of service: 12±6. Nutritional status was determined with the electrical bioimpedance method using the TANITA MC-780 analyzer. According to the calculated Fat Mass Index value each person was qualified to one of the following groups: fat deficit, normal fat or excess fat. The Border Guard officers were asked to fill in the original questionnaire containing questions about nutritional behaviours in line with the recommendations of the Swiss Food Pyramid for Athletes in the basic version.

Results. The excessive amount of fat in every third officer of the Border Guard and numerous irregularities in eating behaviours were found. According to the food pyramid the smallest scale of rational dietary choices (especially regularity of meals, fruit and vegetable consumption) was characteristic of officers with excess fat. In addition, officers from the excess fat group obtained, on average, a lower sum of points for compliance of nutritional behaviours with the recommendations of the Swiss Food Pyramid than those from other groups (49% vs. 59% and 56%, p=0.002).

Conclusions. There is a need for nutritional education and further monitoring of both the nutritional status and dietary behaviours of Border Guard officers.

Key words: *nutritional status, Fat Mass Index, dietary behaviours, food pyramid, border guards*

STRESZCZENIE

Wprowadzenie. Z uwagi na specyfikę służby funkcjonariusze Straży Granicznej powinni charakteryzować się dobrym stanem zdrowia. Tymczasem brakuje badań na temat stanu odżywienia, jak również zachowań żywieniowych funkcjonariuszy Straży Granicznej w Polsce.

Cel. Celem badań była ocena wpływu zachowań żywieniowych na Wskaźnik Tkanki Tłuszczowej funkcjonariuszy Straży Granicznej pełniących służbę w Polsce.

Material i metody. Badania przeprowadzono w 2018 roku z udziałem 250 funkcjonariuszy Straży Granicznej (187 mężczyzn i 63 kobiet) w wieku 37±6 lat, pełniących służbę od 12±6 lat. Stan odżywienia oceniono metodą elektrycznej bioimpedancji z użyciem analizatora TANITA MC-780. Na podstawie obliczonej wartości Wskaźnika Tkanki Tłuszczowej każdą z osób zakwalifikowano do jednej z następujących grup: zbyt niska ilość tkanki tłuszczowej, prawidłowa ilość tkanki tłuszczowej lub nadmierna ilość tkanki tłuszczowej. Funkcjonariuszy poproszono o wypełnienie autorskiego kwestionariusza ankiety, zawierającego pytania na temat zachowań żywieniowych zgodnych z rekomendacjami szwajcarskiej piramidy żywienia dla sportowców w wersji podstawowej.

Wyniki. Stwierdzono nadmierną ilość tkanki tłuszczowej u co trzeciego funkcjonariusza Straży Granicznej oraz liczne nieprawidłowości w zachowaniach żywieniowych tych osób. W odniesieniu do piramidy żywienia najmniejszą skalą racjonalnych wyborów żywieniowych (w szczególności dotyczącą regularności posiłków oraz spożycia owoców i warzyw) charakteryzowali się funkcjonariusze z nadmierną tkanką tłuszczową. Ponadto, funkcjonariusze z nadmierną ilością tkanki

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tłuszczowej uzyskali średnio niższą sumę punktów za zgodność zachowań żywieniowych z zaleceniami szwajcarskiej piramidy żywienia niż badani z pozostałych grup (49% vs 59% i 56%; $p=0.002$).

Wnioski. Istnieje potrzeba edukacji żywieniowej oraz dalszego monitorowania zarówno stanu odżywienia jak i zachowań żywieniowych funkcjonariuszy Straży Granicznej.

Słowa kluczowe: stan odżywienia, wskaźnik tkanki tłuszczowej, zachowania żywieniowe, piramida żywieniowa, straż graniczna

INTRODUCTION

Proper nutrition along with appropriate level of physical activity are key factors for keeping good health. Irregularities in the diet are correlated with occurrence of diet-related metabolic diseases such as diabetes, dislipidemia, obesity and hypertension and other cardiovascular diseases [3, 16, 21]. Disorders in the nutrition manner have also been associated with an increased risk of osteoporosis and cancer [24, 36]. Diet-related metabolic diseases, although they do not manifest in a rapid course, can result in serious health consequences such as heart attack and stroke, which can not only lead to elimination of a patient from professional and social life, but often make a direct threat to life, as the main cause of death in Poland [35].

Keeping a good health condition is crucial, especially for officers of uniformed services, including officers of the Border Guard (BG). Numerous tasks of this formation created in 1991, defined by the Legislator in art. 1. of the Act of 12 October 1990 *on the Border Guard* [34] include varied activities for border protection and border traffic control in the Republic of Poland. Due to the shape of state borders, fulfillment of the above tasks is related to realization of activities in diverse geographical conditions, from sea activities to high-mountain ones, therefore BG officers should be characterized by good health and high level of physical fitness. Irregularities in nutrition of officers manifested in occurrence of overweight, obesity or underweight may result in difficulties in fulfillment of service tasks, and due to further health consequences, may be an indirect cause of early elimination from the service for health reasons [28].

The current issue of irregularities in the nutritional status of Border Guard officers and their possible health consequences may be provided by epidemiological data obtained from occupational medicine examinations. In the group of BG officers examined in 2012-2018 ($n=54303$), 23% were diagnosed with specific diseases, among which cardiovascular diseases, obesity and type 2 diabetes accounted for 20%, 28% and 1.7% of cases respectively (own data unpublished). These data indicate occurrence of health disorders associated most probably with abnormal nutritional behaviours of the examined officers.

Due to the limited number of scientific publications addressing the nutritional status of uniformed services

officers, this publication attempts to assess the impact of dietary behaviours of Border Guard officers on the protein and energy nutritional status expressed as the Fat Mass Index (FMI). Association between value of the FMI index and degree of BG officers compliance with the principles of proper nutrition in relation to recommendations contained in the nutrition pyramid developed by the Swiss Society for Nutrition for athletes was also tested. [4]. Due to the nature of service, including need to maintain high level of psychophysical fitness by the BG officers, the work refers to the Swiss Pyramid of nutrition for sportsmen in the basic version.

MATERIAL AND METHODS

The research was conducted from June to October 2018 with participation of 187 male and 63 female officers of the BG, aged from 21 to 54. To carry out the tests approval of the Bioethics Committee at the Military Institute of Hygiene and Epidemiology in Warsaw was obtained (1/XXI/2016). All guards officers, after getting acquainted with the information about conducted research, voluntarily gave their written consent to participate in the study.

Nutritional status was determined using the electrical bioimpedance method with the TANITA MC-780 analyzer. In order to determine the correctness of fat content of the subjects, for each person the Fat Mass Index (FMI): $FMI [kg/m^2] = \text{fat mass}/\text{height}^2$ was calculated. Then, the subjects were qualified to one of the following groups: fat deficit: male <3 , female <5 ; normal fat: male 3–6, female 5–9; excess fat: male >6 , female >9 , according to the Kelly et al. classification [17].

The subjects were asked to fill in the original questionnaire containing questions about nutritional behaviours in line with the recommendations of the Swiss Food Pyramid for Athletes in the basic version, i.e. intended for use in the general population, without taking into account additional portions of selected food products groups in connection with sport training taken above 5 hours per week [4]. During preparation of the survey, this questionnaire was modeled on research conducted in this field by other authors among various groups of athletes [8-12]. The Swiss Food Pyramid was validated using 168 menus prepared in accordance with established recommendations [23].

Table 1. Adherence of Border Guard officers to the recommendations of the Swiss Food Pyramid for Athletes (the basic pyramid) according to the Fat Mass Index classification

Recommendation	FMI [%]			p
	Fat deficit (n=31)	Normal fat (n=139)	Excess fat (n=80)	
1-2 liters of liquids a day	74	81	91	0.045**
Hydration with mineral water and other non-sweetened beverages	87	91	88	0.591
Hydration during exercise	90	92	90	0.857
Variable diet	55	50	36	0.134
Eating regularly (every 3-5 hours)	57	42	26	0.012**
At least 3 meals per day	87	89	79	0.164
At least 5 servings of fruits and vegetables per day	23	16	10	0.226
At least 2 servings of fruits per day	70	56	37	0.002**
At least 3 servings of vegetables per day	26	18	9	0.056*
Raw vegetables at least once a day	52	52	43	0.430
At least 3 servings of whole grain or legumes	39	40	33	0.571
Whole grain cereals at least twice a day	48	37	33	0.185
1 serving of meat, fish, eggs, cheese or tofu per day	77	79	70	0.307
Fish 2 times per week	33	24	18	0.104
3 servings of dairy products per day	29	42	41	0.383
3 servings of plant-based oils per day	48	53	35	0.042**
1 serving of nuts per day	32	14	10	0.013**
Reduced intake of animal fats	45	51	44	0.510
Reduced intake of sweets	61	47	50	0.380
Reduced intake of salted snacks	74	62	61	0.397
Reduced intake of fast-food products	74	76	60	0.047**
Reduced intake of carbonated beverages	81	84	78	0.590
Reduced intake of energy drinks	90	92	85	0.382
Average	59	56	49	0.002 ^{KW}

Fat deficit: male <3, female <5; normal fat: male 3–6, female 5–9; excess fat: male >6, female >9

* statistical tendency: Chi^2 test, $0.05 \leq p \leq 0.10$

** statistical significance: Chi^2 test, $p < 0.05$

^{KW} statistical significance: *Kruskal-Wallis* test, $p < 0.05$

The subjects were asked to answer “yes” or “no” to each of 23 selected statements describing dietary behaviours according to the pyramid of nutrition, such as: hydration methods and preferences, frequency and regularity of meals, frequency consumption of recommended food products, avoidance of foods that are non-recommended in rational diet. The next part of the questionnaire contained questions about personal information (sex, age, years of service and education).

The analysis of the results was carried out using the STATISTICA ver. 13 program. Compatibility of distribution of variables with normal distribution was assessed using the Shapiro-Wilk test, assuming the significance level of $\alpha=0.05$. Correctness of nutritional behaviours depending on correctness of the Fat Mass Index was assessed using the Kruskal-Wallis test. The *Mann-Whitney U* test was used to compare Fat Mass Index values depending on declaration of specific recommendations fulfillment. For specified

statistically significant statements, a two-way analysis of variance was additionally performed in order to check whether there is an interaction of influence of two factors, i.e. compliance with the recommendation and gender of the subjects. The *Spearman's* correlation test was used to assess relationship between the Fat Mass Index values among the subjects and the sum of points obtained for statements consistent with the recommendations of the food pyramid. In the carried out analyzes, the significance level of $\alpha=0.05$ and the level of statistical tendency for p in the range from 0.05 to 0.10 were assumed.

RESULTS

The average age of examined Border Guard officers amounted to 37 ± 6 years, and the average period of serving was 12 ± 6 years. Over 3/4 of subjects (79%) were higher educated, while others – secondary

educated. The FMI values calculated for officers ranged from 1.3 to 13.0 kg/m² and for the fat deficit, normal and excess fat groups 12%, 56% and 32% of subjects were classified respectively.

The percentage of responses given by Border Guard officers, which were consistent with the principles of proper nutrition in relation to the Swiss Food Pyramid, varied widely and ranged from 15 to 91% (Figure 1). The subjects met the recommendations to the smallest extent for consuming 5 portions of fruit and vegetables every day (15%), as well as consuming one portion of nuts per day (15%), three portions of vegetables every day (16%) and fish twice a week (23%). The highest percentage of subjects implemented recommendations regarding hydration during training (91%), preference for water and unsweetened drinks for general hydration (90%) and reducing limiting consumption of energy drinks (90%). The majority of subjects consumed at least 3 meals a day (86%), but only 39% of officers consumed these meals regularly, maintaining a 3-5 hour interval. Only every second subject used a varied diet.

There were statistically significant differences for answers given to 6 out of 23 statements regarding nutritional behaviours and a summary of the average number of correct behaviours between groups

distinguished due to the FMI classification (Table 1). The highest differences were noted in answers given to the question about consuming at least two portions of fruit per day ($p=0.002$), then eating meals regularly ($p=0.012$) and eating a portion of nuts daily ($p=0.013$). The affirmative answers to these questions were given by 70%, 57% and 32% of officers from the fat deficit group, 56%, 42% and 14% from the normal fat group and 37%, 26% and 10% from the excess fat group respectively. It was also shown that officers with excessive fat were less likely to eat 3 servings of plant-based oils per day ($p=0.042$) and to a lesser extent limited consumption of fast-food products ($p=0.047$), and more often than others drank 1-2 liters of liquids a day ($p=0.045$). In addition, officers from the excess fat group obtained, on average, a lower sum of points for compliance of nutritional behaviours with the recommendations of the Swiss Food Pyramid than those from other groups (49% vs. 59% and 56%, $p=0.002$).

A negative correlation was found between the FMI and the sum of points obtained for correctness of nutritional behaviours ($p=0.015$, $R=-0.15$). A detailed analysis, after separating new subgroups due to the sex of the subjects, confirmed statistical significance only among men (men: $p<0.001$, $R=-0.24$, women: $p=0.479$, $R=-0.09$).

Table 2. Fat Mass Index according to the adherence of Border Guard officers to the recommendations of the Swiss Food Pyramid for Athletes (the basic pyramid)

Recommendation	Not complying					Complying					p
	X	SD	Me	Min	Max	X	SD	Me	Min	Max	
1-2 liters of liquids a day	5.42	1.71	5.13	2.37	9.06	5.81	2.09	5.63	1.30	12.9	0.342
Hydration with mineral water and other non-sweetened beverages	5.85	2.07	5.44	2.59	11.4	5.73	2.04	5.58	1.30	12.9	0.778
Hydration during exercise	6.23	2.51	5.82	2.58	12.9	5.70	1.98	5.56	1.30	11.9	0.473
Variable diet	6.04	2.16	5.82	2.30	12.9	5.40	1.84	5.33	1.30	11.6	0.038**
Eating regularly (every 3-5 hours)	5.99	2.12	5.83	2.25	12.9	5.37	1.86	5.14	1.30	11.6	0.023**
At least 3 meals per day	6.21	2.13	6.15	2.25	11.4	5.67	2.02	5.48	1.30	12.9	0.114
At least 5 servings of fruits and vegetables per day	5.79	2.04	5.63	1.30	11.9	5.27	1.67	5.38	1.53	8.63	0.272
At least 2 servings of fruits per day	6.05	2.06	5.92	1.30	12.9	5.49	2.00	5.37	1.53	11.9	0.037**
At least 3 servings of vegetables per day	5.82	2.05	5.64	1.30	12.9	5.33	1.93	4.96	1.53	10.5	0.188
Raw vegetables at least once a day	5.74	1.98	5.70	1.30	11.4	5.74	2.15	5.38	1.53	12.9	0.711
At least 3 servings of whole grain or legumes	5.81	1.99	5.74	1.30	11.9	5.63	2.12	5.36	1.53	12.9	0.345
Wholegrain cereals at least twice a day	5.87	2.03	5.66	1.30	11.9	5.58	2.08	5.38	1.53	12.9	0.359
1 serving of meat, fish, eggs, cheese or tofu per day	5.82	2.06	5.89	2.25	11.2	5.72	2.03	5.51	1.30	12.9	0.553
Fish 2 times per week	6.00	2.04	5.78	2.25	12.9	4.99	1.86	4.77	1.30	9.38	0.001**
3 servings of dairy products per day	5.72	2.18	5.42	1.30	12.9	5.76	1.83	5.65	1.53	11.9	0.499
3 servings of plant-based oils per day	5.87	2.02	5.64	1.30	11.2	5.60	2.05	5.54	1.53	12.9	0.258
1 serving of nuts per day	5.81	1.97	5.66	1.30	12.9	5.37	2.36	4.68	1.53	11.9	0.053*
Reduced intake of animal fats	5.75	2.03	5.60	1.30	12.9	5.72	2.04	5.57	1.53	11.9	0.827
Reduced intake of sweets	5.83	1.95	5.57	2.25	11.9	5.66	2.12	5.58	1.30	12.9	0.464
Reduced intake of salted snacks	5.89	1.94	5.71	2.37	11.9	5.66	2.09	5.52	1.30	12.9	0.293
Reduced intake of fast-food products	5.94	1.91	5.95	2.30	11.4	5.66	2.09	5.35	1.30	12.9	0.131
Reduced intake of carbonated beverages	5.96	2.25	5.63	2.44	11.4	5.70	1.99	5.57	1.30	12.9	0.624
Reduced intake of energy drinks	5.81	2.05	5.98	2.59	10.2	5.74	2.04	5.55	1.30	12.9	0.807

X – arithmetic average, SD – standard deviation, Me – median, Min – minimum, Max – maximum

* statistical tendency: *Mann-Whitney U* test, $0.05 \leq p \leq 0.10$

** statistical significance: *Mann-Whitney U* test, $p < 0.05$

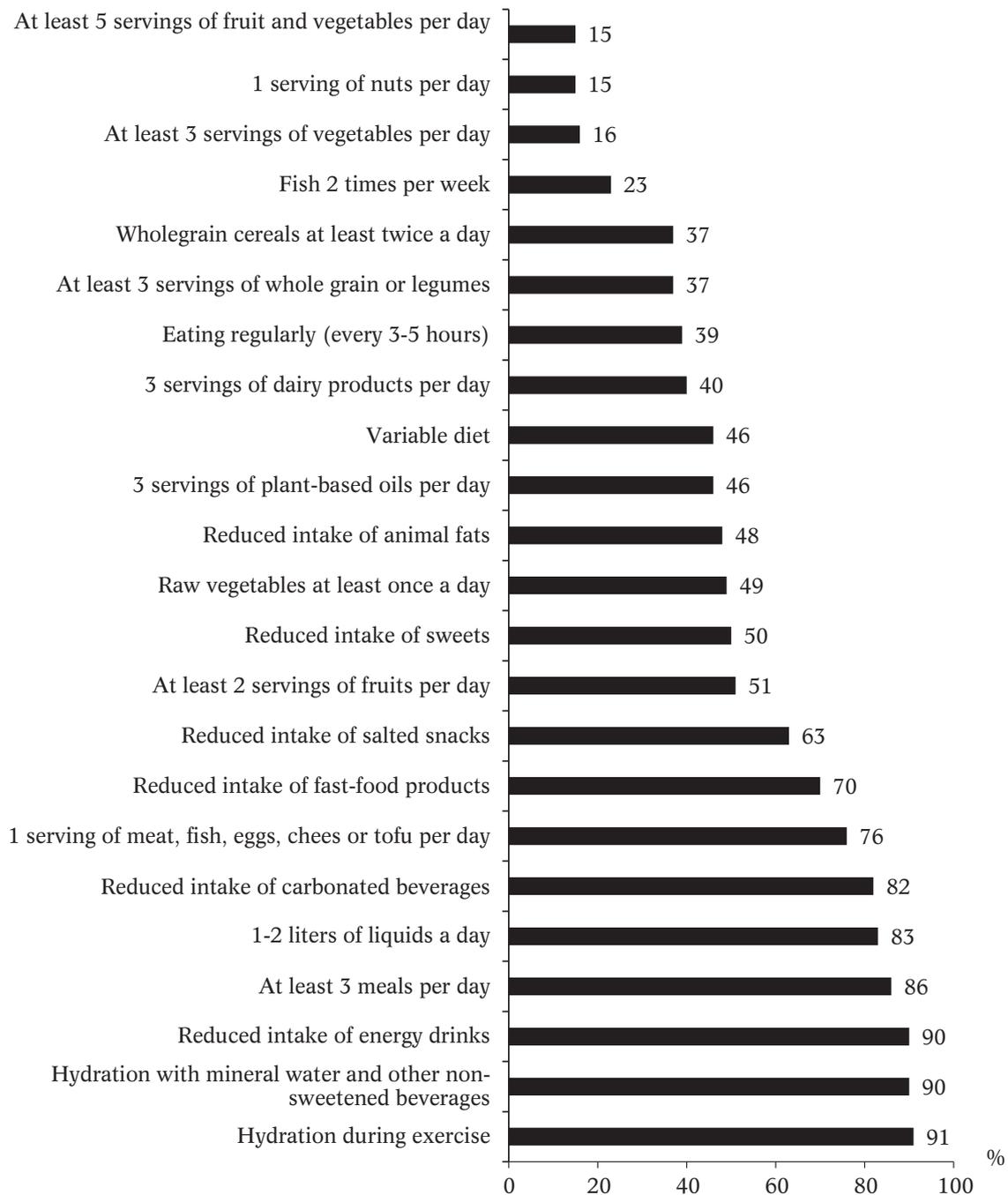


Figure. 1. Adherence of Border Guard officers to the recommendations of the Swiss Food Pyramid for Athletes (the basic pyramid)

Four out of 23 statements describing nutritional behaviours consistent with the food pyramid differentiated the FMI value depending on the subjects' compliance with these recommendations (Table 2). BG officers using a varied diet ($p=0.038$), eating meals regularly ($p=0.023$), consuming fruits at least twice a day ($p=0.037$) and consuming fish twice a week ($p=0.001$), as well as consuming nuts daily ($p=0.053$) were characterized by a smaller FMI value. A two-factor analysis of variance showed an interaction between the examined factors (sex and the recommendation fulfillment) only in one recommendation, i.e. two portions of fruit a day,

which depending on the sex of the subjects varied the Fat Mass Index of these people ($p=0.005$). Using the Post hoc Tukey test statistically significant differences between the FMI of men and women fulfilling this recommendation (FMI of women eating fruit twice a day = 6.61 kg/m^2 and FMI for men eating fruit twice a day = 4.99 kg/m^2 ; $p<0.001$) were shown, as well as in the group of men due to the fulfillment of the recommendation (FMI for men eating fruit twice a day = 4.99 kg/m^2 and FMI for men who do not comply with this recommendation = 6.07 kg/m^2 , $p<0.001$).

DISCUSSION

The carried out research revealed excessive amount of fat in every third officer of the Border Guard and numerous irregularities in the nutritional behaviours of these people. In recent years, as in general population, excessive body mass is more and more often observed among officers of other groups of uniformed services, e.g. soldiers [1, 19, 20, 27, 29], police officers [25, 31] and firefighters [2, 18].

A state of human health, in particular the nutritional status, depends to a large extent on a nutrition manner. That is why experts have been creating and publishing dietary recommendations in various forms - not only as nutrition standards but also as food pyramids that are present in various countries around the world. Their main task is to provide nutritional recommendations in an accessible way, as well as encouragement to physical activity [5]. Research carried out by other authors regarding evaluation of sportsperson nutrition in relation to the Swiss Food Pyramid showed differences in fulfillment of individual recommendations due to the sports level, indicating more rational dietary choices in competitive athletes than amateurs practicing volleyball [9] and long-distance runners [12], or tendency to fuller implementation of the recommendations of the Swiss Pyramid by women than by men [8, 11]. However, none of these studies considered the nutritional status of these people.

Due to the nature of the service of Border Guard officers and the requirements for general health, in particular high physical fitness, it seems justified to use the Swiss Pyramid also for this population group. General level of fulfillment of recommendations contained in the Swiss Food Pyramid by the Border Guard officers (49-59%) should be considered insufficient. The subjects implemented the recommendations regarding hydration of the body, eating at least 3 meals a day and eating one portion of meat, fish, eggs, cheese or tofu daily. However, more than half of the subjects declared not remaining on a variable diet. In addition, officers, regardless of the level of adipose tissue, fulfilled recommendations regarding consumption of 5 portions of fruit and vegetables (10-23% of subjects) to the smallest extent. Similar nutritional errors, i.e. insufficient consumption of cereal products, fish, fruit and vegetables and dairy products, as well as smaller than recommended number of meals were also observed in the total population [6] and among athletes [13, 30, 32, 33]. Research conducted with participation of another group of uniformed services also shown an insufficient frequency of eating fruit and vegetables and milk and its products among soldiers [14]. In addition, it has been shown that along with duration of the service, frequency of fruit and dairy products consumption by soldiers is reduced, and thus the Healthy Eating Index-2010 decreases [7]. According

to the principles of proper nutrition, it is recommended to eat 4-5 properly balanced meals during a day in order to ensure maintenance of a constant level of glucose in the blood and regular supply of essential nutrients [15]. Insufficient consumption of fruit and vegetables can lead to unbalanced supply of some antioxidant vitamins, which are especially important in the increased oxidative stress condition associated with, for example, intensive exercise [26]. Moreover, low frequency of cereal products consumption, in particular from full milling, may promote deficiency of B vitamins and influence reduction of exercise capacity, as well as increase risk of fiber deficiency. And inadequate consumption of dairy products can lead to calcium deficiency. Calcium is the basic building material of bones and teeth and is involved in regulation of neuromuscular excitability and acid-base balance of the system [15]. Moreover, a properly balanced daily food intake secures the body, among others against a decrease in concentration, which is especially important among people whose work requires maintaining high psychophysical fitness and protects against fatigue [22].

The smallest scale of rational dietary choices was characteristic of officers with excessive adipose tissue (excess fat: male $>6 \text{ kg/m}^2$, female $>9 \text{ kg/m}^2$), which may explain their nutritional status. In the examined group, a negative correlation between the sum of points obtained for correctness of nutritional behaviours (according to the food pyramid) and the FMI value was found. In addition, nutritional behaviours differentiating level of the adipose tissue index among the subjects, such as regularity of eating meals, the varied diet, consumption of two portions of fruit a day, consumption of fish twice a week and daily consumption of nuts were distinguished. Officers complying with these recommendations were characterized by lower FMI values compared to the subjects who declared failure to fulfillment of these recommendations. More rational food choices favored maintaining the right amount of adipose tissue in Border Guard officers. Thus, the existence of relationship between the nutritional status and the nutrition manner of BG officers was confirmed.

CONCLUSIONS

1. The carried out research has shown excessive amount of fat in every third officer of the Border Guard and numerous irregularities in eating behaviours, including lack of variety and regularity of eating, as well as insufficient frequency of eating fruit and vegetables, whole grain products, dairy products, fish and nuts.
2. Dependencies between the Fat Mass Index and correctness of nutrition manner in relation to recommendations included in the Swiss Food Pyramid were revealed.

3. There is a need for nutritional education and further monitoring of both the nutritional status and dietary behaviours of Border Guard officers.

Conflict of interest

The authors declare no conflict of interest.

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