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The amount of monounsaturated, polyunsaturated, and saturated fatty acids in the diet of fifteen-year-olds boys and girls in correlation with body mass index values

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ABSTRACT

Aim of the study: A change in dietary habits affects the biochemical composition of the diet, including the amount of fatty acids and their mutual proportions. The aim of this study was to assess the intake of fatty acids by 15-year-olds in correlation with body mass index (BMI) values.

Material and methods: The study covered a group of 76 boys and 57 girls who were third-year middle-school pupils in Poland. The included a 7-day dietary record for the assessment of the intake of nutrients, energy, and fatty acids using the DIETA FAO.

Results: The results show varied intake of energy and individual fatty acids by children relative to their division into groups depending on BMI values. Boys within the 5th to 85th BMI percentile bracket had the lowest intake of saturated fatty acids. The highest intake of monounsaturated and polyunsaturated fatty acids was observed among boys in group with the highest BMI percentile. In girls, the lowest intake of saturated fatty acids was in the group of girls below the 5th percentile.

Conclusions: The normal dietary intake of fatty acids n-3 and n-6 occurred amongst 15-year-old boys and girls with BMI below the 5th percentile. In order to achieve a properly balanced diet, it is necessary to increase the intake of monounsaturated fatty acids and reduce the intake of saturated fatty acids at the same time.

KEY WORDS:

adolescent, BMI, monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA), saturated fatty acids (SFA).

INTRODUCTION

A change in dietary habits affects the biochemical composition of the diet, including the amount of fatty acids and their mutual proportions. When the intake of fatty acids (FAs) does not match physiological needs, this leads to BMI deviations and various metabolic complications. The BMI values are influenced by a number of other variables, such as sedentary lifestyle and low physical activity [1–3], and daily meal schedule, in particular the consumption of high energy foods in the evening

and at night [4], as well as the amount of proteins, fats, and carbohydrates in the daily diet [5–8].

Fatty acids are essential substances. They participate in energy processes, the metabolism of proteins and sugars, and the control of gene expression; furthermore, they are precursors of prostacyclins, prostaglandins, thromboxanes, and leukotrienes [9, 10].

Long-chain polyunsaturated fatty acids (LCPUFA) are assigned a particular role [11–13]; they are believed to have protective properties for human health by influencing immunological reactions, protecting from allergies [14].

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The proportion of n-6 family FAs to n-3 family FAs in the diet can determine the stimulation or suppression of important bodily physiological processes (proliferation, infections, the activity of transcription factors, the tendency for mutagenesis, apoptosis, etc.) [15, 16].

As far as the physiological needs of the child are concerned, the second most important group of fatty acids present in the diet are MCFAs (medium-chain fatty acids), mainly 10 : 0, 12 : 0, and 14 : 0, which stabilise the bacterial flora in the child's digestive system, influence acylation and myristoylation of protein, are subject to quick oxidation [17–21]. Recent research indicates that fatty acids, especially long-chain polyunsaturated fatty acids, inhibit carcinogenesis [16].

An insufficient amount of fatty acid in the diet is caused principally by worldwide changes in dietary habits, the so-called western diet. This diet is characterised by high intakes of saturated fatty acids and sucrose as well as low intakes of dietary fibre, posing a risk for health by the increase of metabolic diseases incidence [22]. Insufficient supply of FAs leads to numerous metabolic changes and the occurrence of conditions such as diabetes and cardio-vascular illness – even in the distant future.

Excess weight and the related quality of nutrition are key public health problems around the world, which have grown particularly quickly in recent years. The aetiology is complex; however, one important factor is the change of dietary habits in western culture [15, 23, 24].

During adolescence the eating habits of youths may change. This change results from the impact of TV commercials, attempts to be liked by their peers, or an increased amount of time spent eating meals with friends in fast-food restaurants. It is of interest to know whether changes taking place in the life of a 15-year-old person can influence the fatty acid content in his/her diet [25].

The aim of the study was to assess the intake of fatty acids by 15-year-olds in correlation with BMI values.

MATERIAL AND METHODS

The research was conducted in February 2018 in a typical middle school in the village in the region Podbeskidzie in Poland. The study covered all third-year middle-school pupils. Participation in the study was voluntary. Permission for the research was obtained from the children and their parents. In total, the research included 133 pupils at the age of 15 years (57 girls and 76 boys), which accounted for around 22% of the pupils living in the village aged 7–18 years.

GATHERING AND ASSESSMENT OF DATA

With the assistance of the authors conducting the research, a validated questionnaire, employed al-

ready in other research on large groups of children [26], was filled in, addressing the consumption of food products consumed every day for a period of 7 days. All children were tested simultaneously. The parents and adolescents were trained in correctly assessing the size of portions of foodstuffs consumed. During the assessment of food consumption, units of measurement such as millilitres, grams, mugs, and spoonful were used. The size of portions consumed was additionally checked using 'The Album of Photographs of Food Products and Dishes' [27].

To ascertain the number/amount of kilocalories, fatty acids, fat, proteins, and carbohydrates consumed daily, the DIETA FAO programme was used. The programme contains data on 1067 typical food products. A precise description of similar research using this programme has been included in earlier publications [28].

The questionnaire also took into account the results of anthropometric measurements of the adolescents taken by the researcher. BMI values were calculated for all the children, with these values classified according to the recommendations of the WHO: a BMI below the 5th percentile – underweight; a BMI between the 5th and 85th percentile – appropriate body mass; and a BMI above the 85th percentile – excess body weight [29]. Energy requirements for the analysed population were determined individually for each child, taking into account the child's gender and body weight as well as the average physical activity specified for the Polish population [30].

The financial situation of the study participants was declared by their parents and was measured on a 5-degree scale:

- very good – the money is sufficient to cover all the costs without saving,
- good – living economically and being able to afford everything,
- mediocre – living economically but having some problems with larger purchases,
- bad – the money is sufficient to buy the cheapest food and clothing,
- very bad – there is not enough money for the cheapest food or for clothes [26].

Physical activity was defined as the average amount of time spent on curricular and extracurricular physical activities during the week when the participants completed the questionnaire. Participants' parents declared the time spent on physical activity, which was checked against the number of obligatory physical education lessons.

STATISTICAL ANALYSIS

All calculations were made using the PQStat program (version 1.6.6). A significance level of $p < 0.01$ was assumed in the analysis. The statistical analysis included

TABLE 1. Presentation of the study group

Parameter		Boys (n = 76)		Girls (n = 57)	
Age (years)	Mean (SD)	15.2	0.2	15.1	0.3
SES					
Very good	n (%)	22	28.9	16	28
Good	n (%)	50	65.8	38	66.7
Mediocre	n (%)	4	5.3	3	5.3
BMI					
Below 5 th percentile	n (%)	14	18.4	13	22.8
5 th –85 th percentile	n (%)	50	65.8	39	68.4
Above 85 th percentile	n (%)	12	15.8	5	8.8
Moderate activity (MET-min/week)	Mean (SD)	245	31.4	220	60.1
Number of meals during of the day					
4 meals	n (%)	63	82.9	50	87.7
5 meals	n (%)	13	17.1	7	12.3

SD – standard deviation; SES – socioeconomic status; BMI – body mass index

TABLE 2. Amount of energy intake by gender and assigned BMI group [kcal/day] and percentage of energy intake from fats, protein, and carbohydrates

	Boys/percentile			Girls/percentile		
	Below 5	5–85	Above 85	Below 5	5–85	Above 85
Energy intake (kcal/day)	2672	2573	3385	1660	2143	3076
% of energy intake from						
Fats	42.2%	35%	37.3%	35.9%	36.6%	33.1%
Protein	13.2%	12.1%	14.5%	14.3%	13.6%	13.9%
Carbohydrates	44.6%	52.9%	48.2%	49.8%	49.8%	53%

descriptive variable statistics, i.e. the average, the median (50th percentile), and the 25th and 75th percentiles.

ETHICAL CONSIDERATIONS

The study was approved by the Bioethics Review Board of Bielsko-Biala (No: 2017/06/1/4), which is in accordance with the Declaration of Helsinki. All the participants (the examined children and their parents) provided informed written consent to take part in the research, participation in the study was voluntary, and the anonymity of the participants was maintained.

RESULTS

The socioeconomic status of the studied adolescents in both boys and girls groups in the majority of cases was very good or good. Only 5.3% of boys' families and 5.3% girls' families defined their socioeconomic status as mediocre. No families were found to be in a very bad financial situation (Table 1).

The results show varied intake of energy and individual fatty acids by children relative to their division into groups depending on BMI values.

ENERGY – GIRLS AND BOYS

In girls, the daily calorie intake was proportional to their division into groups according to BMI. The greater the daily intake of energy in each group, the higher the BMI value; however, this was not a simple proportional increase. Boys in group with the highest BMI percentile values had the highest intake of calories, while boys in the group with the lowest BMI percentile (below the 5th percentile) had the same calorie intake as boys in group within the 5th to 85th BMI percentile bracket. A BMI value below the 5th percentile could be the consequence of a significant amount of time being spent on physical activity.

In the studied group, fats were used to produce large amount of energy. In the group of boys with the lowest BMI percentile it was as high as 42.2%. Only in girls from the group with BMI above 85th percentile did the percentage of energy intake from fats constitute less than 35%. Proteins provided 12.1–14.5% of the energy. The rest of the energy in the diet was provided by carbohydrates (Table 2).

TABLE 3. The interquartile range (IQR) and median of saturated fatty acids intake in the studied groups of boys (g/day)

Saturated fatty acids				
Fatty acid	Below 5 th percentile	5 th –85 th percentile	Above 85 th percentile	P-value ^a
C4:0	0.59–0.80 0.69	0.17–0.90 0.37	0.24–0.45 0.44	<i>p</i> < 0.01
C6:0	0.49–0.61 0.55*	0.24–0.59 0.34**	0.28–0.38 0.37***	
C8:0	0.39–0.43 0.41*	0.32–0.42 0.34	0.32–0.34 0.33***	
C10:0	1.04–1.14 1.09*	0.76–0.98 0.821	0.80–0.82 0.82***	
C12:0	1.46–1.52 1.49*	1.15–1.65 1.19	1.57–1.64 1.57***	
C14:0	6.21–6.62 6.41*	4.42–5.57 5.01**	5.55–5.69 5.67***	
C15:0	0.81–0.91 0.86	0.62–0.67 5.01	0.75–0.83 0.81	
C16:0	29.62–31.93 30.78*	20.72–27.30 22.08**	28.22–30.98 30.88	
C17:0	0.41–0.54 0.48	0.34–0.42 0.34	0.35–0.38 0.37	
C18:0	14.03–16.84 15.44*	6.63–11.71 9.68**	12.40–14.46 14.45***	
C20:0	0.05–0.07 0.06	0.02–0.20 0.04	0.19–0.20 0.19	
Total saturated fatty acids	55.25–61.50 58.38*	36.77–51.56 41.67**	50.96–56.20 56.18***	

* statistically significant difference relative to group below 5th percentile and group 5th–85th percentile** statistically significant difference relative to group 5th–85th percentile and group above 85th percentile*** statistically significant difference relative to group below 5th percentile and group above 85th percentile^a Pearson correlation**SATURATED FATTY ACIDS (SFA) – BOYS**

Boys within the 5th to 85th BMI percentile bracket had the lowest intake of saturated fatty acids (41.67). At the same time, boys in group with a BMI percentile of below 5 had the highest intake of saturated fatty acids (58.38). This is connected to the type of diet followed.

In groups within the 5th to 85th BMI percentile and with BMI above the 85th percentile, the intake of medium-chain fatty acids was comparable (58.38 and 56.18). There was a similar pattern for the intake of the long chain acids C16:0 and C18:0. The highest intake of medium-chain fatty acids (MCFA) (C6:0, C8:0, C10:0 and C14:0) was recorded in the boys' group with BMI of below 5th percentile. In the case of C12:0 acids, the highest intake was observed in the group with BMI above the 85th percentile (1.57), while the lowest amount of these acids was noticed in the diet of boys in the group within the 5th to 85th BMI percentile (1.19) (Table 3).

MONOUNSATURATED FATTY ACIDS (MUFA) – BOYS

The highest intake of monounsaturated fatty acids (MUFA) was among boys in the group with BMI above the 85th percentile (64.75). The lowest amount was found in the diet of boys with BMI in the 5th to 85th percentile bracket (34.67). The same pattern was found for the intake of C16:1 and C18:1 acids. For C15:1, C17:1, and C22:1 acids, however, the intake was proportionally opposite to the BMI value. The highest intake of these acids was among boys with the lowest BMI percentile, while the lowest intake of C15:1, C17:1, and C22:1 was recorded in boys from the group with the highest BMI percentile (Table 4).

POLYUNSATURATED FATTY ACIDS (PUFA) – BOYS

Boys with BMI values above the 85th percentile had the highest intake of polyunsaturated fatty acids (16.36), which was reflected in their intake of C18:2 acid (13.85). However, boys in this group had the lowest intake of C22:6 (0.03), and a higher intake of C20:4 than boys within the 5th to 85th BMI percentile (0.19). Boys with

TABLE 4. The interquartile range (IQR) and median of unsaturated fatty acids intake in the studied groups of boys (g/day)

Monounsaturated fatty acids				
Fatty acid	Below 5 th percentile	5 th –85 th percentile	Above 85 th percentile	P-value ^a
C14:1	0.48–0.74 0.61	0.33–0.53 0.44	0.34–0.36 0.35	<i>p</i> < 0.01
C15:1	0.10–0.20 0.15*	0.05–0.17 0.08**	0.06–0.07 0.07***	
C16:1	2.59–3.58 3.09*	2.21–2.99 2.44**	2.80–3.87 3.84**	
C17:1	0.21–0.41 0.31	0.09–0.32 0.19	0.11–0.16 0.14***	
C18:1	41.66–48.94 42.80*	25.10–48.69 31.17**	51.38–59.46 59.26***	
C20:1	0.21–0.45 0.33	0.18–0.48 0.33	0.53–0.68 0.67	
C22:1	0.23–0.23 0.23*	0.03–0.11 0.05	0.09–0.10 0.10***	
Total monounsaturated fatty acids	45.56–52.61 47.59*	28.31–51.22 34.67**	55.35–64.76 64.75***	
Polyunsaturated fatty acids				
Fatty acid	Below 5 th percentile	5 th –85 th percentile	Above 85 th percentile	P-value ^a
C18:2	8.27–8.33 8.30*	7.25–12.14 8.07**	12.57–13.86 13.85	<i>p</i> < 0.01
C18:3	1.60–2.41 2.0	0.90–1.71 1.17	1.79–2.05 2.05	
C18:4	0 0	0 0	0.006–0.01 0.01	
C20:4	0.26–0.4 0.33*	0.07–0.26 0.19**	0.26–0.41 0.40	
C20:5	0–0.01 0.007*	0–0.03 0**	0 0	
C22:5	0–0.014 0.007	0–0.005 0**	0 0***	
C22:6	0.03–0.08 0.06	0.01–0.09 0.09**	0.01–0.03 0.03***	
Total polyunsaturated fatty acids	10.41–11.03 10.72	8.04–14.07 10.40**	14.65–16.37 16.36***	

* statistically significant difference relative to group below 5th percentile and group 5th–85th percentile

** statistically significant difference relative to group 5th–85th percentile and group above 85th percentile

*** statistically significant difference relative to group below 5th percentile and group above 85th percentile

^a Pearson correlation

the lowest BMI had a higher intake of the acid C20:4 (0.33) than the boys in group within the 5th to 85th BMI percentile (0.40) (Table 4).

SATURATED FATTY ACIDS (SFA) – GIRLS

In girls, the intake of saturated fatty acids increased proportionally to the increase in BMI. The lowest intake was in the group of girls below the 5th percentile (29.55), while the highest intake was in group above the 85 BMI percentile (49.59). The same pattern appeared for the intake of saturated fatty acids with a chain length of 6 to

18 carbons. However, the highest intake of the fatty acid C20:0 was in girls assigned to the group with a BMI percentile of 5 to 85 (0.16), while the lowest intake was in girls from the group with the lowest BMI percentile of 5 (0.04) (Table 5).

MONOUNSATURATED FATTY ACIDS (MUFA) – GIRLS

Intake of monounsaturated fatty acids in the girls was in direct proportion to BMI values. The highest intake was in girls from group with the highest BMI values

TABLE 5. The interquartile range (IQR) and median of saturated fatty acids intake in the studied groups of girls (g/day)

Saturated fatty acids				
Fatty acid	Below 5 th percentile	5 th –85 th percentile	Above 85 th percentile	P-value ^a
C4:0	0.30–0.32 0.31	0.23–0.32 0.32	0.32–0.37 0.33	<i>p</i> < 0.01
C6:0	0.19–0.20 0.19	0.18–0.20 0.20**	0.20–0.31 0.31***	
C8:0	0.16–0.18 0.17*	0.18–0.20 0.20**	0.20–0.33 0.30***	
C10:0	0.39–0.48 0.39	0.39–0.48 0.48**	0.52–0.76 0.72***	
C12:0	0.53–0.65 0.58*	0.61–0.65 0.65**	0.71–1.64 1.32***	
C14:0	2.46–2.91 2.47	2.37–2.91 2.91**	3.08–5.34 4.60***	
C15:0	0.32–0.35 0.35	0.27–0.32 0.32**	0.34–0.74 0.64***	
C16:0	10.38–14.92 14.92*	10.38–20.60 20.50**	11.75–28.66 26.25***	
C17:0	0.21–0.251 0.21	0.183–0.25 0.24**	0.25–0.39 0.35***	
C18:0	3.39–10.07 10.03	3.39–9.84 9.82	4.06–13.37 11.81***	
C20:0	0.03–0.12 0.04*	0.12–0.18 0.16**	0.09–0.16 0.12***	
Total saturated fatty acids	19.40–29.65 29.55*	19.40–35.15 34.15**	21.81–52.11 49.59***	

* statistically significant difference relative to group below 5th percentile and group 5th–85th percentile

** statistically significant difference relative to group 5th–85th percentile and group above 85th percentile

*** statistically significant difference relative to group below 5th percentile and group above 85th percentile

^a Pearson correlation

(above the 85th percentile) (35.97). The lowest intake was in girls from the group with the lowest BMI values (below the 5th percentile) (25.71). These results were reflected in the intake of individual monounsaturated fatty acids. Intake of C14:1, C15:1, C16:1, and C18:1 acids increased in equal proportion to the assigned BMI group (Table 6).

POLYUNSATURATED FATTY ACIDS (PUFA) – GIRLS

The intake of polyunsaturated fatty acids in girls was lowest in group with the lowest BMI values (below the 5th percentile) (5.41). Between groups with a BMI percentile of 5 to 85 and with BMI above the 85th percentile, however, no statistical difference was noted in the intake of these fatty acids. This was reflected in the intake of C18:2 acids. Meanwhile, the intake of C22:6 acid was greatest amongst girls with BMI values below the 5th percentile (1.87) (Table 6).

DISCUSSION

The research has shown that the BMI coefficient in children is related to the daily intake of energy. The higher a child's BMI coefficient, the greater their daily intake

of energy. These results are consistent with data in the literature from studies regarding children's diets [1, 4, 5, 31, 32]. In the current study, we focused on detailed analysis of selected fatty acids in the diets of 15-year-olds with various BMI scores.

On the basis of the results obtained from the research, it was elucidated that the average daily intake of fatty acids in both the boys and girls was too high. The recommended fat intake for 13- to 15-year-old boys and girls is 93 g per day and 82 g per day, respectively [29]. In the study, intake of fatty acids was 87–137 g per day for boys and 61–102 g per day for girls. This is far too much because it can lead to excess weight and obesity in adult life as well as increased risk of cardiovascular diseases and cancer.

One limitation to our study was that the study group was small. However, the study covered 100% of the pupils of the same age living in the village where the study was conducted. The literature shows no studies that include analysis of the intake of fatty acids among children and adolescents.

Research conducted amongst Polish young people aged 16–18 years residing in rural areas near Żywiec has shown that boys as well as girls consumed fats within the limits of the recommended values.

TABLE 6. The interquartile range (IQR) and median of unsaturated fatty acids intake in the studied groups of girls (g/day)

Monounsaturated fatty acids				
Fatty acid	Below 5 th percentile	5 th –85 th percentile	Above 85 th percentile	P-value ^a
C14:1	0.25–0.33 0.27	0.25–0.33 0.33**	0.33–0.40 0.36***	p < 0.01
C15:1	0.064–0.065 0.064	0.05–0.07 0.065**	0.06–0.08 0.07	
C16:1	1.35–1.67 1.64*	1.35–2.67 2.66**	1.35–2.85 2.58***	
C17:1	0.08–0.30 0.09	0.14–0.30 0.16	0.13–0.28 0.16	
C18:1	19.66–23.39 23.31*	19.66–27.32 27.22**	20.44–57.38 31.96***	
C20:1	0.24–1.31 0.25	0.29–1.31 0.47	0.35–1.11 0.51	
C22:1	0.01–1.67 0.01	0.08–1.67 0.23	0.15–1.31 0.25	
Total monounsaturated fatty acids	24.72–25.73 25.71*	24.72–30.84 30.64**	24.72–61.64 35.97***	
Polyunsaturated fatty acids				
Fatty acid	Below 5 th percentile	5 th –85 th percentile	Above 85 th percentile	P-value ^a
C18:2	3.42–15.18 3.48*	8.98–15.18 12.28	9.38–14.87 13.93***	p < 0.01
C18:3	0.79–1.91 0.89*	0.98–1.91 1.81**	1.80–2.67 2.02***	
C18:4	0.30–0.30 0.30*	0.01–0.30 0.02**	0.30–0.30 0.30	
C20:4	0.19–0.21 0.19	0.14–0.21 0.21	0.11–0.25 0.23	
C20:5	1.10–1.10 1.10	1.100–1.10 1.10	0.07–0.10 1.10***	
C22:5	0.23–0.24 0.23	0.23–0.24 0.23	0.006–0.23 0.21***	
C22:6	1.87–1.88 1.87*	0.07–1.87 0.09	0.02–1.87 0.09***	
Total polyunsaturated fatty acids	4.41–18.82 5.41*	10.19–20.82 14.73	11.65–19.84 16.89***	

* statistically significant difference relative to group below 5th percentile and group 5th–85th percentile

** statistically significant difference relative to group 5th–85th percentile and group above 85th percentile

*** statistically significant difference relative to group below 5th percentile and group above 85th percentile

^a Pearson correlation

Stachura *et al.* did not give the size of the study group but only the number of dietary records received. However, this research did not include the analysis of the BMI values of youths. For girls, BMI values were proportionate to the intake of saturated and monounsaturated fatty acids. In boys, however, this was true for the groups of between the 5th and 85th BMI percentiles, and above the 85th BMI percentile [33].

These results are consistent with data from the literature indicating that people with a high BMI have a significantly higher intake of fats [5–8, 34–36].

The caloric value of food was not different for boys in the BMI group below the 5th percentile

from that of the group of boys in the 5–85th BMI percentile bracket. However, boys with a BMI below the 5th percentile had a statistically significant higher intake of saturated (58.38) fatty acids. The influence of the increased intake of fatty acids on low BMI value can be explained to some degree by the detailed composition of fatty acids in the diets of the boys in these 2 groups. In comparison to the 5–85th BMI percentile group, boys with a BMI below the 5th percentile had a significantly higher

intake of monounsaturated fatty acids, in particular C18:1 and C16:1. These acids stimulate thermogenesis; thus, their secondary effect can be to increase energy demand [37–39], which ultimately leads to a drop in body mass. Similar results were reported by Moussavi *et al.* [31] in their analysis of the diet of 15-year-old girls. However, they described only the relation between BMI and the total amount of monounsaturated fatty acids (MUFA) in the diet without analysing the influence of individual MUFAs on BMI. One interesting aspect is the direction of change in the intake of MCFAs in both boys and girls. Amongst the boys, a higher intake of MCFAs was observed in the group with the highest BMI values (64.75).

Similar tendencies were not observed in the groups of girls, in the case of which it was 25.71 for girls with the lowest BMI value and 35.71 for girls with the highest BMI value.

The causes of the increase in MCFA intake in the above-mentioned groups of boys undoubtedly vary. While the increase in MCFA in the group with the lowest BMI generally results from the higher intake of fat, in the group with the highest BMI values the percentage of fat in the diet increases due to proteins, which may be a compensatory reaction by the body.

Research of youths from the vicinity of Żywiec did not reveal such a high intake of monounsaturated fatty acids amongst boys, which amounted to 40.9. The intake of monounsaturated fatty acids amongst girls, according to Stachura *et al.* [33], totalled 34.2. In our own research it was lower (25.71) or similar (35.97) depending on the BMI value reached in studied girls. From the metabolic point of view, however, the differences in the amounts of main representatives of n-3 (C18:3) and n-6 (C18:2) are more significant, because they are not synthesized in the human body and they must be provided from the diet.

This is also true for the ratio of n-6 (C18:2) to n-3 (C18:3) in the diet, which for girls was 3.9:1 in the group with the lowest BMI percentile, 6.78:1 in the group within the 5th to 85th BMI percentile, and 6.89:1 in the group with the highest BMI percentile. For boys, the ratios were 5.18:1 in group with the lowest BMI percentile, 6.89:1 in group within the 5th to 85th BMI percentile, and 6.75:1 in group with the highest BMI percentile. The proportion of n-6 to n-3 should be 2:1 – 5:1. Consequently, only groups with the lowest BMI value reached the normal intake of these acids. Also, the n-6/n-3 ratio has been examined as a potential risk factor in cardiovascular diseases or as a factor that increases the risk of oxidative stress and the development of obesity.

The research showed that in the modern diet, fats account for as much as 40% of daily energy requirements, while the proportion of fatty acids n-6 and n-3 amounted to over 10:1. The optimal intake of EPA and DHA is 1 g per day. The current research has shown that in the group of girls with BMI below the 5th percentile the intake of EPA and DHA was very high. This may result from preparing

meals high in oil. Very high intake of EPA and DHA leads to increased cholesterol levels [40, 41].

The main dietary source of n-3 acids is fish, while in Poland also rapeseed oil. The source of n-6 acids is corn oil, sunflower oil, and rapeseed oil. Furthermore, rapeseed oil has a normal n-6/n-3 ratio of around 2 : 1. The source of EPA and DHA is fish and oils [30].

A low intake of unsaturated fatty acids is caused by too infrequent consumption of fish, and the preparation of dishes using margarine. Inappropriate dietary habits also include excessive consumption of saturated fatty acids found in yellow cheeses, eggs, and milk – products that young people are happy to consume [26].

Numerous studies have shown unhealthy habits in children's nutrition. The problem affects a large proportion of children worldwide and is showing a tendency for rapid progression. Unfortunately, numerous costly campaigns promoting a healthy diet have shown limited effect. While the medical and social consequences of this trend may be predicted for the current generation, they cannot be estimated for future generations.

CONCLUSIONS

The normal dietary intake of fatty acids n-3 and n-6 occurred amongst 15-year-old boys and girls with BMI below the 5th percentile.

In order to achieve a properly balanced diet, it is necessary to increase the intake of monounsaturated fatty acids and reduce the intake of saturated fatty acids at the same time. The diet should also be appropriate to the child's level of physical activity and to their energy requirements.

DISCLOSURE

The authors declare no conflict of interest.

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