Cytowanie: Strashok L, Khomenko M, Buznytska O: Nawyki żywieniowe wśród ukraińskiej młodzieży z otyłością.
Pediatr Med Rodz 2024; 20 (1): 77–82. DOI: 10.15557/PiMR.2024.0010

Otrzymano: 18.08.2023
Zaakceptowano: 15.12.2023
Opublikowano: 11.07.2024

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Nawyki żywieniowe wśród ukraińskiej młodzieży z otyłością

Food habits of Ukrainian adolescents with obesity

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https://doi.org/10.15557/PiMR.2024.0010

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Streszczenie

Wprowadzenie i cel: Na całym świecie obserwowany jest znaczący wzrost częstości występowania otyłości wśród dzieci. Celem pracy była analiza sposobu odżywiania i nawyków żywieniowych młodzieży w kontekście występowania otyłości oraz wykazanie wpływu nieprawidłowego żywienia na zaburzenia gospodarki lipidowej i mineralnej. **Materiały i metody:** Badanie przeprowadzono w grupie 133 nastolatków w wieku 12–17 lat: u 101 występowała otyłość, a 32 miało prawidłową masę ciała (grupa kontrolna). Plan badania zakładał zebranie wywiadu oraz kompleksową standardową ocenę stanu klinicznego, z uwzględnieniem analizy nawyków żywieniowych oraz wyników badań laboratoryjnych. **Wyniki:** U nastolatków z otyłością istotnie częściej niż w grupie kontrolnej stwierdzono nieregularne spożywanie posiłków ($p < 0{,}001$), nawyk podjadania słodyczy i wyrobów cukierniczych w ciągu dnia ($p < 0{,}01$), a także późne spożywanie kolacji ($p < 0{,}001$). Młodzież z otyłością znamiennie częściej niż rówieśnicy z grupy kontrolnej (codziennie lub kilka razy w tygodniu) spożywa słodycze, wyroby cukiernicze, żywność typu fast food, chipsy i krakersy, natomiast rzadziej częścią ich diety są warzywa ($p < 0{,}05$). U młodzieży z otyłością odnotowano istotnie obniżone stężenie cynku i magnezu w porównaniu z grupą kontrolną ($p < 0{,}05$). **Wnioski:** Przeprowadzone badanie potwierdziło nieprawidłowy (nieracjonalny) sposób odżywiania się w grupie młodzieży z otyłością. Zebrane dane mogą wesprzeć działania ukierunkowane na wczesne korygowanie niewłaściwej diety u otyłych nastolatków. To z kolei może przyczynić się do zapobiegania schorzeniom przewodu pokarmowego oraz progresji choroby podstawowej.

Słowa kluczowe: otyłość, pierwiastki śladowe, młodzież, nawyki żywieniowe

Abstract

Introduction and objective: There is currently a significant increase in the prevalence of obesity among children worldwide. The aim of the study was to analyse the diet and eating habits of adolescents depending on the presence of obesity and demonstrate the impact of incorrect eating habits on lipid and mineral metabolism disorders. **Materials and methods:** The study involved 133 adolescents aged 12–17 years: 101 adolescents with obesity and 32 healthy children in the control group. The study plan provided for a combination of standard clinical and anamnestic evaluations, including a study of eating habits, and laboratory-instrumental research. **Results:** In adolescents with obesity, violations of the regularity of eating ($p < 0.001$), as well as the habit of snacking on bakery products and sweets during the day ($p < 0.01$) and late dinner ($p < 0.001$) were significantly more common compared to the control group. Adolescents with obesity consumed sweets, bakery products, fast food products, chips, crackers significantly more often, and vegetables less frequently, compared to their peers in the control group, every day or several times a week ($p < 0.05$). Adolescents with obesity had significantly lower levels of zinc and magnesium compared to the control group ($p < 0.05$). **Conclusions:** The study revealed the problem of irrational and unbalanced nutrition in adolescents with obesity. The obtained data may become the basis for timely correction of the diet of obese adolescents, which will prevent the development of disorders of the gastrointestinal tract, and halt the progression of the underlying disease.

Keywords: obesity, trace elements, adolescents, food habits

INTRODUCTION

Today, obesity is widespread across the globe, affecting people of all ages, including children. Currently, according to the World Health Organization (WHO), the overall prevalence of overweight and obesity among children and adolescents aged 5 to 19 years has increased significantly, reaching about 18%, while in 1975 the indicator was at the level of about 4%. Obesity was present in 6% of girls and 8% of boys aged 5–19 years in 2016[1]. In a study among more than 18,000 Ukrainian schoolchildren aged 7–17 years, 13.0% to 19.7% of children suffered from obesity and overweight, depending on the international classifications used, with obesity found in 2.1–4.7% of examined individuals[2].

Obesity is recognised as a multifactorial disease caused by an interplay of genetic and epigenetic changes, and the environment, with the main factors that contribute to the development of obesity including a sedentary lifestyle, a high-calorie diet that is unbalanced in terms of qualitative and quantitative content, violations of the daily rhythm of food intake and eating behaviour, etc.[3–5].

The rapid increase in the prevalence of obesity among children and adolescents, which is the basis of the metabolic syndrome and many conditions sharing a common pathogenesis, such as type 2 diabetes, cardiovascular diseases, dyslipidaemia, hepatobiliary pathology, in particular, non-alcoholic fatty liver disease etc., underscores the relevance of studying the problem of obesity in this age group[6].

AIM OF THE PAPER

The aim of the study was to analyse the diet and eating habits of adolescents depending on the presence of obesity and demonstrate the impact of incorrect eating habits on lipid and mineral metabolism disorders.

MATERIALS AND METHODS

A total of 133 adolescents were enrolled. The examination plan provided for a combination of standard clinical and anamnestic research, including a study of eating habits, and laboratory-instrumental research. The clinical study group consisted of 101 adolescents aged 12–17 years (average age: 14.59 ± 1.61) with obesity, among whom 51 (50.5%) were boys and 50 (49.5%) were girls. Obesity is diagnosed with a body mass index (BMI) ≥95th percentile for a given age and sex according to the WHO recommendations and the clinical guideline "Obesity in children"[7–9]. The control group consisted of 32 healthy adolescents with BMI within the 5th to 85th percentile, among whom 18 (56.2%) were boys and 14 (43.8%) were girls aged 12–17 years (average age: 14.96 ± 1.83), $p > 0.05$.

When conducting anthropometry, the standing height (cm), body weight (kg), waist circumference (WC), and hip circumference (HC) (cm) were measured. BMI was calculated according to the Quetelet formula: BMI = body weight (kg)/height (m^2). To study the nature and regime of nutrition, we used a questionnaire developed on the basis of the Institute of Health Care of Children and Adolescents of the National Academy of Medical Sciences of Ukraine. The questionnaire is based on selected food products with the following answer options regarding the frequency of their consumption: "daily", "2–3 times a week", "once a week", "once a month", "never"[10].

As part of laboratory tests, biochemical indicators of lipid metabolism, aminotransferase activity (alanine aminotransferase – ALT and aspartate aminotransferase – AST), and ultrasound examination of the liver were performed in obese adolescents. Also, the levels of trace elements zinc and magnesium, which are indispensable for the vital processes of the body, in the blood were determined using standard sets manufactured by Cormay.

Ethical standards were observed at all stages of the study. Informed consent was obtained from all examined individuals. The study was performed in accordance with the principles of the Declaration of Helsinki. The study protocol was approved by the Local Ethics Committee for all participants.

Statistical analysis was carried out using the software STATISTICA 6.0 for Windows (StatSoft Inc.). Quantitative indicators are presented as the arithmetic mean (*M*) and its standard error (*m*), qualitative indicators as the frequency (%). The Student's *t*-test was used to compare quantitative indicators, and Pearson's Chi-square test and Fisher's exact test were used for frequency indicators. To assess the trend, strength, and significance of the relationship between the studied variables, correlation analysis was used with determination of the Spearman rank correlation coefficient. $p < 0.05$ was taken as the critical level of statistical significance when testing hypotheses.

RESULTS

In order to study the eating habits and diet, a survey was conducted among the examined adolescents. It was established that 78 (77.2%) and 11 (34.4%) ($p < 0.001$) of the examined adolescents in the study and control groups respectively had an irregular diet. There was no statistically significant difference in the number of adolescents with

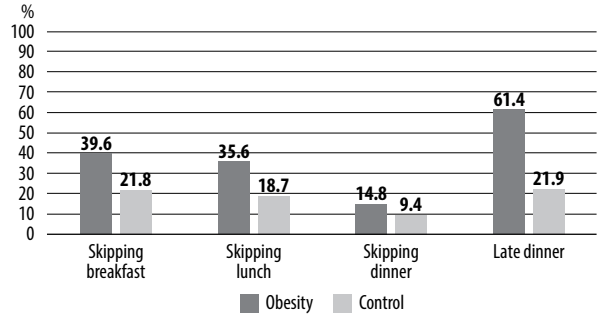

Fig. 1. Dietary habits of the examined adolescents

DOI: 10.15557/PiMR.2024.0010

Products		Daily	2–3 times a week	Once a week	Once a month	Never
Sweets	Study group	7 (6.9)	46 (45.5)	32 (31.7)	16 (15.8)	0 (0)
	Control group	0 (0)	9 (28.1)	19 (59.4)	4 (12.5)	0 (0)
Bakery goods	Study group	4 (4.0)	37 (36.6)	39 (38.6)	21 (20.8)	0 (0)
	Control group	0 (0)	6 (18.8)	17 (53.1)	9 (28.1)	0 (0)
Meat	Study group	56 (55.5)	38 (37.6)	7 (6.9)	0 (0)	0 (0)
	Control group	14 (43.8)	16 (50.0)	2 (6.2)	0 (0)	0 (0)
Sausages	Study group	11 (10.9)	38 (37.6)	31 (30.7)	13 (12.9)	8 (7.9)
	Control group	3 (9.4)	7 (21.9)	10 (31.2)	9 (28.1)	3 (9.4)
Fish	Study group	1 (1.0)	9 (8.9)	33 (32.7)	47 (46.5)	11 (10.9)
	Control group	1 (3.1)	4 (12.5)	11 (34.4)	14 (43.7)	2 (6.2)
Milk	Study group	14 (13.9)	40 (39.6)	23 (22.8)	18 (17.8)	6 (5.9)
	Control group	8 (25.0)	12 (37.5)	3 (9.4)	7 (21.9)	2 (6.2)
Cheese	Study group	16 (15.8)	37 (36.6)	29 (28.7)	16 (15.8)	3 (3.0)
	Control group	4 (12.5)	13 (40.6)	7 (21.9)	6 (18.8)	2 (6.2)
Dairy products	Study group	18 (17.8)	32 (31.7)	29 (28.7)	19 (18.8)	3 (3.0)
	Control group	5 (15.6)	11 (34.4)	8 (25.0)	5 (15.6)	3 (9.4)
Vegetables	Study group	53 (52.5)	37 (36.6)	11 (10.9)	0 (0)	0 (0)
	Control group	24 (75.0)	7 (21.9)	1 (3.1)	0 (0)	0 (0)
Fruit	Study group	52 (51.5)	43 (42.6)	6 (5.9)	0 (0)	0 (0)
	Control group	18 (56.3)	13 (40.6)	1 (3.1)	0 (0)	0 (0)
Sauces	Study group	5 (5.0)	19 (18.8)	29 (28.7)	27 (26.7)	21 (20.8)
	Control group	0 (0)	5 (15.6)	12 (37.5)	9 (28.1)	6 (18.8)
Fast food products, chips, croutons	Study group	5 (5.0)	24 (23.8)	39 (38.6)	33 (32.7)	0 (0)
	Control group	0 (0)	3 (9.4)	9 (28.1)	17 (53.1)	3 (9.4)
Sweet carbonated drinks	Study group	4 (4.0)	18 (17.8)	26 (25.7)	43 (42.6)	10 (9.9)
	Control group	0 (0)	5 (15.6)	8 (25.0)	15 (46.9)	4 (12.5)

Tab. 1. Consumption of certain groups of food products by the examined adolescents, n *(%)*

an irregular type of diet depending on gender, both among obese and healthy adolescents ($p > 0.05$).

A detailed analysis of the dietary patterns revealed a statistical difference between the groups in the habit of late dinner: 62 (61.4%) of adolescents with obesity and 7 (21.9%) of adolescents in the control group ($p < 0.001$) (Fig. 1). It was also established that girls with obesity more often than boys skipped breakfast [23 (46.0%) and 17 (33.3%), respectively, $p > 0.05$)] and/or lunch [22 (44.0%) and 14 (27.5%), respectively, $p > 0.05$].

An analysis of unique patterns in the consumption of certain groups of food products by the examined adolescents was also carried out (Tab. 1). It was established that vegetables were present in the daily diet of 53 (52.5%) of adolescents with obesity and in 24 (75.0%) of adolescents in the control group ($p < 0.05$). Bakery products were consumed every day or several times a week by 41 (40.6%) of study group subjects and 6 (18.8%) of adolescents in the control group ($p < 0.05$), sweets were consumed by 53 (52.5%) of study group and 9 (28.1%) of control group subjects ($p < 0.05$), while fast food products, chips, croutons were consumed by 29 (28.7%) and 3 (9.4%) ($p < 0.05$) of the adolescents in both groups, respectively.

A correlational analysis was conducted between the consumption of certain food groups and anthropometric, anamnestic, laboratory, instrumental parameters in both groups of adolescents (Tabs. 2, 3). All data presented in the tables are statistically significant ($p < 0.05$). In the course of the analysis, an interdependence was established between an increase in the frequency of consumption of sweets, meat, sausage products, sweet carbonated drinks, and fast foods and an increase in anthropometric indicators related to obesity (BMI, WC, HC); between an increase in the frequency of consumption of sweet carbonated drinks and sausage products and an increase of the craniocaudal length of the liver (CLL), and between a higher frequency of fruit consumption and lower levels of triglycerides and very low-density lipoprotein cholesterol ($p < 0.05$).

The next stage was the evaluation of magnesium and zinc levels in blood serum (Tab. 4). According to research results, adolescents with obesity had a significant deficiency of zinc and magnesium, in contrast to the examined control group ($p < 0.05$).

DISCUSSION

In 2016, the results of research of the eating habits of young people from 15 countries were published. It was found that 5–83% of the respondents exhibited deviations from a healthy diet[11]. Research by Lee and Yoon showed that

 DOI: 10.15557/PiMR.2024.0010

	Sweets	Bakery goods	Meat	Sausages	Fish	Milk	Cheese	Dairy products	Vegetables	Fruit	Sauces	Fast food products, chips, croutons	Sweet carbonated drinks
Sweets	1												
Bakery goods	0.241	1											
Meat			1										
Sausages		0.366[c]		1									
Fish					1								
Milk						1							
Cheese				0.271		0.355[c]	1						
Dairy products						0.613[c]		1					
Vegetables					0.367[c]				1				
Fruit									0.408	1			
Sauces				0.297							1		
Fast food products, chips, croutons		0.353, 0.367[c]		0.304							0.422[c]	1	
Sweet carbonated drinks		0.318, 0.424[c]		0.244							0.276	0.678, 0.570[c]	1

[c] In the control group.

Tab. 2. Correlational analysis between the consumption of certain groups of food products by the examined adolescents

	Sweets	Bakery goods	Meat	Sausages	Fish	Milk	Cheese	Dairy products	Vegetables	Fruit	Sauces	Fast food products, chips, croutons	Sweet carbonated drinks
Age												0.269	
BMI	0.212					0.245							
Height			0.261										
Weight			0.245	0.199		0.201							0.275
WC				0.198				−0.200				0.213	0.276
HC	0.198					0.281			−0.385[c]			0.212	0.265
CLL				0.213									0.273
TG										-0.248			
VLDL										-0.248			

BMI – body mass index; **WC** – waist circumference; **HC** – hip circumference; **CLL** – craniocaudal length of the liver; **TG** – triglycerides; **VLDL** – very low-density lipoprotein.
[c] In the control group.

Tab. 3. Correlational analysis between the consumption of certain groups of food products and anthropometric, laboratory, instrumental parameters of the examined adolescents

people under the age of 20 had irregular meals more frequently compared to older people[12], and according to an Australian study, 10% of children aged 8–11 eat breakfast less than 5 days a week[13]. The regularity of food intake and its distribution throughout the day are important factors in controlling body weight. A positive correlation between BMI and skipping meals was established[11].

In our study, a dietary survey revealed that significantly more obese adolescents had irregular eating habits ($p < 0.001$) and late dinner ($p < 0.001$) compared to the control group. It can be assumed that the habit of frequent snacking during the day leads to the omission of one or more main meals, and delays dinner until a late hour. This is the reason for the redistribution of daily caloric intake and disturbance of the energy balance with the predominance of energy accumulation over its expenditure.

A variety of sweets, bakery products, fast foods, chips, croutons, sauces, etc. are high-calorie, but low-nutrient foods. Such food items are characterised by a high content of fats and simple carbohydrates, which are quickly digested and provide a feeling of satiety only for a short period of time. The cooking of fast food products, as a rule, involves the addition of a significant amount of salt, spices stimulating the appetite, as well as the formation of trans fats, which is the

Groups	Zinc [μmol/L] (N – 10–15)	Magnesium [mmol/L] (N – 0.7–1.1)
Study group	7.48 ± 0.3*	0.45 ± 0.2*
Control group	12.7 ± 0.3	0.93 ± 0.03
* Statistically significant difference between the study and control groups ($p < 0.05$).		

*Tab. 4. Zinc and magnesium levels in the examined adolescents (*M ± m*)*

result of repeated heating of vegetable oils. A questionnaire study, which included more than 72,000 children from 17 countries, showed that the respondents who consumed "fast foods" more often had a significantly higher BMI[14].

In our work, a relationship was established between an increased consumption of sweets, meat, sausage products, sweet carbonated drinks, and fast foods and an increase in anthropometric indicators associated with obesity, as well as between an increase in the frequency of consumption of sweet carbonated drinks and sausage products with an increase in CLL, which is one of the signs of non-alcoholic fatty liver disease.

The imbalance of trace elements, which occurs naturally against the background of irrational nutrition, significantly affects the course of metabolic processes in the body and closes the vicious circle of the disease. In particular, magnesium deficiency, according to global research, negatively affects the secretion and activity of insulin, which is a risk factor for the development of insulin resistance (IR) against the background of obesity[15]. On the other hand, elevated levels of insulin tend to increase the removal of magnesium from cells, while compensatory hyperinsulinaemia, which occurs as a result of IR, leads to a decrease in the intracellular content of the element, which increases the progression of IR.

Zinc also plays a significant role in the processes of synthesis, deposition, and release of insulin from β-cells of the islets of Langerhans. Zinc deficiency disrupts the synthesis and secretion of the normal physiological insulin molecule. Circulation in the blood of an insufficiently converted low-active hormone contributes to the development of tissue IR (on the one hand) and disrupts the process of binding hepatocytes to insulin, which leads to the development of hepatic IR (on the other hand)[16]. Our experience also suggests that along with other risk factors underlying the formation of IR, the deficiency/imbalance of some trace elements also plays an important role in the development of IR in obese patients, thus contributing to the progression of the metabolic syndrome[17].

The presented results confirm the prevailing ideas about the important role of trace elements in the regulation of the activity of all body systems. The biological significance of trace elements is evident across all levels of life, and, accordingly, research on this topic is a promising direction in medicine that can become the basis for developing new methods for the prevention and treatment of obesity.

Thus, unbalanced nutrition, which is a characteristic component of the daily life of obese adolescents, leads to the progression of the disease and associated metabolic disorders, functional and organic disorders of the gastrointestinal tract. Therefore, an individualised approach to lifestyle and nutrition modification is advisable to improve the effectiveness of obesity treatment and prevent complications.

CONCLUSIONS

The study confirmed the problem of irrational and unbalanced nutrition in adolescents with obesity, which manifested itself in the form of a significant deficiency of zinc and magnesium in obese patients. The obtained data may become a basis for timely correction of the diet of obese adolescents, which will contribute to preventing the development of disorders of the gastrointestinal tract, and halt the progression of the underlying disease.

Conflict of interest

The authors do not declare any financial or personal links with other persons or organisations that might adversely affect the content of the publication or claim any right to the publication.

Author contribution

Original concept of study: LS. Collection, recording and/or compilation of data: MK, OB. Analysis and interpretation of data: MK, OB. Writing of manuscript: LS, MK, OB. Critical review of manuscript: LS. Final approval of manuscript: LS.

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DOI: 10.15557/PiMR.2024.0010