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ORIGINAL PAPER

Ewelina Polak [1(ABDFG)], Katarzyna Dereń [1(ADFG)], Edyta Łuszczki [1(ADFG)], Justyna Wyszyńska [2(ADFG)], Adriana Piątek [1(ABCDE)], Artur Mazur [1(ADFG)]

Risk factors for overweight and obesity in pre-school children

[1] Institute of Nursing and Health Sciences, Faculty of Medicine, University of Rzeszow, Poland
[2] Institute of Physiotherapy, Faculty of Medicine, University of Rzeszów, Rzeszów, Poland

ABSTRACT

Introduction. Obesity in children and adolescents is a growing problem in the 21st century. The epidemic of chronic non-communicable diseases resulting from obesity is currently one of the biggest problems of modern medicine. Excessive body weight is the result of a long-lasting imbalance between the amount of energy supplied and its expenditure. Energy regulation of the body is subject to both genetic and environmental factors. Among other things, due to this, the problem of excessive body weight is most severe in societies with a high degree of socio-economic development. The aim of this paper is to determine the influence of selected environmental and social factors on the occurrence of overweight and obesity in pre-school children.

Material and methods. The study included pre-school children from south-eastern Poland. After obtaining the consent from parents, 200 children (87 boys, 113 girls) aged 3 to 6 years were examined. A questionnaire used for the research was derived from the program: European Pilot Study Evaluating the Influence of Local Promotional Activities on Prevention of Obesity in Pre-school Children. In the subjects, body weight was measured on an electronic scale three times and the body height was measured three times using a stadiometer. Obesity was determined according to the criteria developed by the International Obesity Task Force (IOTF).

Results. The prevalence of overweight and obesity among children amounted to 6.4% in 3-year-olds, 11.3% in 4-year-olds, 17.7% in 5-year-olds, and 20.7% in 6-year-olds. A factor significantly increasing the risk of obesity among the examined girls and boys was the mother's BMI index.

Conclusion. Although knowledge about the factors that promote overweight and obesity is common, it is still a common health problem. Particular attention should be paid to the prevention of obesity in children of parents with a BMI above 30 kg m^2. Early maternal education can change the lifestyle of the whole family.

Keywords. child obesity, inheritance of obesity, causes of obesity

Introduction

Child obesity is a progressive global problem. In 1975, the average BMI of children aged 5 - 19 years was 17.2 kg/m^2. The increase in BMI by 2016 was, on average, 0.32 kg/m^2 per decade for girls and 0.40 kg/m^2 for boys. The smallest increase in BMI was found in south Asia and East Africa. The largest occurred in Polynesia and Micronesia.[1] There were 42 million children with ex-

Corresponding author: Ewelina Polak, e-mail: ewelina.polak@gmail.com

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cessive body mass worldwide in 2013, of which 31 million reside in highly developed countries.[2] In the US, the number of obese children has tripled in the last 30 years. Up to 9% of children are obese in pre-school age. In addition, it has been observed that nutrient deficiencies such as iron and zinc accompany increasing body weight.[3,4]

Obesity of children has serious health consequences. Adipose tissue induces inflammation resulting in hypertension, dyslipidemia, heart disease, asthma, sleep apnea, and inflammation of the joints. Other diseases associated with obesity include insulin resistance, type 2 diabetes, non-alcoholic fatty liver and orthopedic problems resulting from excessive joint load.[4,5] Shashaj et al. studied 219 pre-school children with excessive body mass in 2014. Twenty-four per cent were diagnosed with dyslipidemia, 31% with hepatic steatosis, and 35% with insulin resistance. Changes in health appear soon after weight gain.[6] Research by Freedman et al. showed that obese children are more likely to become obese adults. Excessive body weight in childhood affects the state of health in later years. Obese children are four times more likely to develop type 2 diabetes, as adults, even if they normalize body weight in adulthood. Inflammation induced in childhood by adipose tissue results in increased CRP in adulthood and greater chances of developing metabolic diseases.[8,9] In addition, children with excessive body mass are characterized by low self-esteem and low self-confidence, which may result in poor academic performance. Behaviors discriminating against obese children have already been diagnosed in two-year olds.[10,11]

The causes of obesity can be different: socio-economic, environmental, genetic or behavioral. The excess energy consumed with food, exceeding the energy expenditure of the body should be considered the direct cause of fat accumulation. Consuming highly processed, high-energy food such as sweets, salty snacks or fast-food as well as spending free time in front of a TV or computer screen are the causes of the accumulation of excess fat tissue.[13] Another cause of obesity is the genetic factor. Heredity of body mass and genetic susceptibility to the environmental impact is significant. Marques-Lopes et al. determined that the influence of genes on the mechanisms of energy accumulation in the form of adipose tissue amounts to 40%.[14] The researchers are focusing on variants of obesity-promoting genes, e.g. (FTOrs9939609), melanocortin-4 (MC4R) and FLJ35779 (rs2112347) receptors more and more frequently. Along with the development of genetics, obesity risk diagnostics may take place in the early years of life.[13]

Dysfunction of the body's energy homeostasis may also result from medical reasons such as:

– disorders within the central nervous system (CNS): hypothalamus diseases, tumors and CNS inflammatory conditions, intracranial hypertension, neurological disorders, Froehlich syndrome, Blount syndrome,
– endocrinopathies: hypothyroidism, Cushing's syndrome, growth hormone deficiency, hyperinsulinism, polycystic ovarian syndrome, alleged hypoparathyroidism, hypogonadotropin hypogonadism, status post ovarectomy,
– genetical syndromes: Turner, Klinefelter, Willi-Prader syndromes, Dercun's disease, Lawrence-Moon--Biedl disease,
– drug-induced obesity, such as: neuroleptics, antidepressants, phenothiazine derivatives, antiepileptic drugs, steroids and glucocorticoids.[15]

Children with excessive amounts of adipose tissue become adults susceptible to civilization diseases to a greater extent than those with normal body mass. Therefore, prophylactic measures such as nutritional education should be introduced both at parents during pre-conception and later as well as in pre-school children.

Aim of the study

The aim of this study was to determine the impact of selected environmental and social factors on the prevalence of overweight and obesity in pre-school children.

Material and methods

The study covered children from kindergarten, in which we obtained the consent of the director of the facility and parents who were also asked to complete the questionnaire. The survey was taken from the program: European Pilot Study Evaluating the Impact of Local Promotional Activities on Prevention of Obesity in Preschool Children. The consent to use the survey was received from the coordinator of the above-mentioned program. In total, the study covered 200 children, including 87 boys and 113 girls, aged from 3 to 6 years. In children, the body weight was measured on an electronic scale three times and the height was measured using a stadiometer. Preschoolers were weighed and measured without shoes, in underwear. The BMI was calculated from the obtained measurements. Obesity was determined based on criteria developed by the International Obesity Task Force (IOTF).[16] The parents' body mass index was determined on the basis of their body weight and height obtained from the measurement on the weight and using the stadiometer. The calculated BMI was classified according to the WHO criteria.[17]

In order to examine the influence of risk factors on the occurrence of obesity, odds ratio (OR) for each factor was calculated assuming the significance of differences at the level of $p < 0.05$. The statistical analysis was carried out using the R software (version 2.13.1) and an

Excel spreadsheet. The differences were tested using the chi-square test (for qualitative variables), the student's t-test for quantitative variables and the Wilcoxon test for non-parametric variables. Using the ×2 test, the differences in the risk of obesity were verified in the group of children subjected to the given factor in relation to the group of children without the obesity.

Results

Table 1 presents the general characteristics of the examined children. The boys had a slightly higher average body weight (19.40 kg) than girls (19.05 kg). The mean BMI values for boys were 15.99 kg/m^2 and for girls 15.32 kg/m^2.

When analyzing Cole's coefficient, no obesity was found in 3-year-old preschoolers (Table 2). Among boys at this age, overweight accounted for 6.5%, while for girls 6.2%. In the study group, 4-year-old girls did not experience obesity, while in boys it was 11.4%. Overweight at this age occurred in 2.5% of boys and 7.4% of girls. In the group of 5-year-old girls obesity most often occurred at the level of 12.5%, while in boys it was 3.3%. In 6-year-olds, obesity occurred only in boys and accounted for 10%. Overweight in 6-year-old boys was at 15%, and in girls - 11.1%. Analyzing the average body weight values in children, it was found that overweight and obesity was more common in boys than in girls. Among the male subjects, overweight constituted 9.5%, while in the female subjects it was 6%. Obesity in boys was found in 6% and in girls in 4.7%. The body mass deficit in girls was found in 22.6%, and in boys slightly less, 22.4%.

Analyzing the body mass (p = 0.037) and the mothers' BMI (p = 0.012) and the child's BMI (p = 0.001) and body mass (p = 0.001), significant relationships were found (Table 3). The mean body mass of mothers with normal BMI index was on average 61.54 kg, and in children with overweight and obesity 65.81 kg. The mean BMI values in mothers of children who had normal body mass amounted to 22.31 kg/m^2, while in mothers of children with overweight and obesity 24.09 kg/m^2.

According to the data from table 4, the following factors were statistically significant among boys: birth weight of a child p = 0.0026, maternal BMI p = 0.0489, birth body length p = 0.016. Mean maternal BMI values of boys with normal body mass amounted to 22.39 kg/

Table 1. General characterictics of the studied children

Parameter	Total		Boys		Girls		P
	N	X± SD	n	X± SD	N	X± SD	
Age (years)	200	4.37 ± 1.00	116	4.34 ± 1.05	84	4.40 ± 0.92	0.6329
Child's body mass [kg]	200	19.25 ± 3.59	116	19.40 ± 3.59	84	19.05 ± 3.59	0.4987
Child's body height [m]	200	1.11 ± 0.09	116	1.10 ± 0.09	84	1.11 ± 0.08	0.3474
Child's BMI [kg/m^2]	200	15.71 ± 2.09	116	15.99 ± 2.20	84	15.32 ± 1.87	0.0247
Centile according to Cole*	200	3.84 ± 0.99	116	3.84 ± 1.04	84	3.82 ± 0.91	0.8000

N – number of subject studies; (X ± SD) – arithmetic mean ± standard deviation, p < 0.05 differences statistically significant.
* 1,2,3 underweight, 4 normal, 5 overweight, 6 obesity.

Table 2. The incidence of body mass disorders in the studied children according to Cole

	Boys				p	Girls				p	Total		p
											B*	G*	
Age (years)	3	4	5	6		3	4	5	6		4.34 ± 1.05	4.40 ± 0.92	
Underweight (%)	25.8	17.1	30	15	0.392	12.5	22.2	21.9	44.4	0.542	22.4	22.6	0.17
Normal (%)	67.7	68.6	50	60		81.2	70.4	62.5	44.4		62.1	66.7	
Overweight (%)	6.5	2.5	16.7	15		6.2	7.4	3.1	11.1		9.5	6	
Obesity (%)	0	11.4	3.3	10		0	0	12.5	0		6	4.7	

*B – Boys, G – Girls, p < 0.05 differences statistically significant.

Table 3. Selected parameters affecting the prevalence of overweight and obesity in preschoolers

Parameter	Children with normal body mass		Children with overweight and obesity		p
	N	X±SD	N	X±SD	
Child's sex: 1-boy, 2-girl	128	1.44 ± 0.50	27	1.33 ± 0.48	0.324
Mother's age [yrs]	128	32.96 ± 4.19	27	35.19 ± 5.68	0.128
Father's age [yrs]	128	35.13 ± 4.93	27	36.74 ± 5.35	0.136
Mother's height [cm]	128	166.02 ± 4.94	27	165.30 ± 6.36	0.566
Mother's body mass [kg]	128	61.54 ± 8.15	27	65.81 ± 9.51	0.037
Mother's BMI [kg/m²]	128	22.31 ± 2.70	27	24.09 ± 3.31	0.012
Father's height [cm]	128	179.04 ± 6.31	27	178.22 ± 5.73	0.312
Father's body mass [kg]	128	86.09 ± 12.30	27	85.59 ± 9.01	0.895
Father's BMI [kg/m²]	128	26.82 ± 3.26	27	26.95 ± 2.68	0.977
Mother's gestational weight gain	123	14.06 ± 4.40	23	15.83 ± 5.81	0.208
When was the child born: 1-preterm, 2-on time, 3-postterm	128	2.02 ± 0.51	27	2.19 ± 0.40	0.120
Child's body mass at birth [g]	126	3401.83 ± 499.51	25	3592.40 ± 428.40	0.087
Child's body length at birth [cm]	126	54.79 ± 3.02	25	56.32 ± 2.73	0.010
Was the child breast fed: 1-no, 2-don't know, 3-yes	128	2.88 ± 0.49	27	2.93 ± 0.38	0.603
How long was the child breast fed: 1-less than 1 month, 2-up to 3 months, 3- up to 6 months, 4-up to 9 months, 5-more than 1 year	119	3.08 ± 1.20	26	3.04 ± 1.08	0.753
Child's body mass [kg]	128	18.97 ± 2.70	27	23.74 ± 4.87	<0.001
Child's body height [cm]	128	1.10 ± 0.08	27	1.10 ± 0.10	0.782
Child's BMI [kg/m²]	128	15.71 ± 0.98	27	19.50 ± 1.97	<0.001
Mother's BMI: 1-underweight,2-normal, 3-overweight, 4-obesity	128	2.13 ± 0.40	27	2.30 ± 0.54	0.106
Father's BMI: 1-underweight,2-normal, 3-overweight, 4-obesity	128	2.82 ± 0.67	27	2.81 ± 0.68	0.967
Child's body mass: 1- below 2500g,2-2500g to 3500g, 3-3500g to 4000g 4- over 4000g	128	2.50 ± 0.80	25	2.84 ± 0.75	0.042
Centile according to Cole: 1,2,3 underweight, 4 normal, 5 overweight, 6 obesity.	128	4.00 ± 0.00	27	5.41 ± 0.50	<0.001

N – number of subjects; X ± SD – arithmetic mean ± standard deviation; p < 0.05 differences statistically significant

m², and mothers of boys with overweight and obesity 23.74 kg/m². Body weight of boys with normal BMI was 19.33 kg, while boys with overweight and obesity 23.17 kg. Birth length was statistically significant in boys. Boys with normal body mass at birth were 54.73 cm and with an excess of 56.69 cm. Among girls, the maternal body weight p = 0.0237 and mother's BMI p = 0.0171 turned out to be a statistically significant parameter. Mothers of overweight and obese girls increased their body weight during pregnancy to an average of 18.00 kg, while mothers of girls with normal body mass, took on average 13.54 kg. The mean BMI values of girls' mothers with excessive body weight were 24.81 kg/m², while those with normal body weights - 22.21 kg.

The quotient of obesity risk in children for overweight and obese mothers, and normal weight mothers is OR = 21.64 (Table 5).

The relationship between environmental and nutritional factors influencing the incidence of overweight and obesity in preschoolers was also checked (Table 6). Not all of the analyzed parameters were statistically significant. A whole group of children ate meals prepared in kindergarten at the same frequency, regardless of whether they were breakfasts, dinners or afternoon teas. Both parents of overweight or obese children and parents of children with normal body mass allow their offspring to consume fast-food dishes less than once a month. The question concerned both replacing main

Table 4. Selected anthropometric parameters affecting the occurrence of overweight and obesity in boys and girls

Parameter	Boys with normal body weight		Boys with overweight and obesity		p	Girls with normal body weight		Girls with overweight and obesity		p
	N	X ± SD	N	X ± SD		N	X ± SD	N	X ± SD	
Mother's body mass [kg]	72	61.44 ± 8.28	18	64.28 ± 7.86	**0.187**	56	61.66 ± 8.06	9	68.89 ± 12.12	**0.0237**
Mother's BMI [kg/m²]	72	22.39 ± 2.80	18	23.74 ± 2.39	**0.0489**	56	22.21 ± 2.59	9	24.81 ± 4.74	**0.0171**
Father's body mass [kg]	72	86.01 ± 12.45	18	86.56 ± 8.12	**0.8234**	56	86.18 ± 12.20	9	83.67 ± 10.84	**0.5633**
Father's BMI [kg/m²]	72	26.73 ± 3.19	18	27.10 ± 2.74	**0.6274**	56	26.93 ± 3.37	9	26.66 ± 2.70	**0.8194**
Estimated gestational weight gain [kg]	71	14.44 ± 4.40	15	14.67 ± 5.69	**0.8844**	52	13.54 ± 4.39	8	18.00 ± 5.76	**0.0129**
Body mass at birth [g]	71	3452.54 ± 537.94	16	3662.50 ± 439.48	**0.1104**	55	3336.36 ± 441.25	9	3467.78 ± 401.43	**0.4055**
Body length at birth [cm]	71	54.73 ± 3.08	16	56.69 ± 2.65	**0.016**	55	54.87 ± 2.96	9	55.67 ± 2.92	**0.4572**
Do you think your child is*	72	3.47 ± 0.95	18	3.78 ± 0.88	**0.2047**	56	3.54 ± 0.87	9	4.44 ± 0.73	**0.0044**
Which figure does your child have	72	2.19 ± 0.99	18	2.67 ± 1.37	**0.1835**	56	1.96 ± 0.97	9	2.89 ± 1.45	**0.0165**
Child's age [yrs]	72	4.25 ± 1.06	18	4.78 ± 1.00	**0.0586**	56	4.27 ± 0.90	9	4.67 ± 0.87	**0.2216**
Child's body mass [kg]	72	19.33 ± 2.78	18	23.17 ± 4.54	**0.0026**	56	18.51 ± 2.53	9	24.89 ± 5.58	**<0.0001**
Child's height [m]	72	1.10 ± 0.08	18	1.09 ± 0.11	**0.7457**	56	1.10 ± 0.07	9	1.12 ± 0.07	**0.3344**
Child's BMI [kg/m²]	72	16.04 ± 0.95	18	19.54 ± 2.05	**<0.0001**	56	15.28 ± 0.84	9	19.44 ± 1.91	**<0.0001**
Mother's BMI **	72	2.17 ± 0.41	18	2.22 ± 0.43	**0.6211**	56	2.07 ± 0.37	9	2.44 ± 0.73	**0.0544**
Father's BMI **	72	2.75 ± 0.67	18	2.83 ± 0.71	**0.6526**	56	2.91 ± 0.67	9	2.78 ± 0.67	**0.5819**

N – number of subjects; (X± SD) – arithmetic mean ± standard deviation; p < 0.05 differences statistically significant
* 1 very slim, 2 slim, 3 slightly slim, 4 normal body weight, 5 slight overweight, 6 overweight, 7 obese, **1 underweight, 2 normal, 3 overweight, 4 obese

Table 5. Odds ratio for selected biological risk factors for obesity in girls

Parameter	OR	95% CI	p
A mother with overweight and obesity / mother with normal weight	21.64	1.49 – 1271.77	0.0100
Body mass at birth > 4000 g ≥ 2500 g i < 3500 g	6.82	0.076- 603.87	0.2619

OR – odds ratio; CL – confidence interval; p – statistical significance level; p < 0.05-differences statistically significant

meals with fast food and eating them as an additional meal. As the least liked product, both groups of children enumerated legumes, while their favorite food products included sweets in the first place. Parents of both groups of children determined that children eat meals watching TV on average twice a week. The time of watching television is about 1 hour a day, while on Saturdays and Sundays it is extended to 2 hours a day. The amount of time devoted to watching TV did not affect the weight of children. Similarly, the amount of body fat was not affected by the time spent on computer games. On weekends children spent a little more time on computer games than on weekdays. While on working days, parents often declared that the child plays less than an hour or not at all, during the weekend this time extended to 1 hour. Obese children were more likely to eat fish than normal body mass children, but less often legumes, milk, cheese and fruit. Children with normal

Table 6. Environmental and nutritional parameters influencing the incidence of overweight and obesity in preschoolers

Parametrs	Children with normal body mass		Children with overweight and obesity		p
	N	X±SD	N	X±SD	
How often does a child eat breakfast in the kindergarten: 1 – never,2 – 1 once a week, 3 – several times a week, 4 – every day	127	3.89 ± 0.44	27	3.85 ± 0.60	0.9592
How often does a child eat dinner in the kindergarten: 1 – never,2 – 1 once a week, 3 – several times a week, 4 – every day	128	3.89 ± 0.49	27	3.89 ± 0.42	0.8289
How often does a child eat evening tea in the kindergarten: 11 – never,2 – 1 once a week, 3 – several times a week, 4 – every day	127	2.76 ± 1.42	27	2.93 ± 1.41	0.5696
How often do you take your child to have fast-food for dinner or supper: 1 – never, 2 – once a month, 3 – several times a month, 4 – 1 to 2 times a week, 5 – 3 or more times a week	128	1.25 ± 0.47	27	1.52 ± 0.80	0.0932
How often do you take your child to have fast-food for a snack between meals: 1 – never, 2 – once a month, 3 – several times a month, 4 – 1 to 2 times a week, 5 – 3 or more times a week	128	1.64 ± 0.51	27	1.85 ± 0.72	0.1887
Child likes eating the best: sweets	128	0.37 ± 0.48	27	0.30 ± 0.47	0.4856
Child dislikes: legumes	128	1.00 ± 0.00	27	1.04 ± 0.19	0.0295
How often does your child eat watching TV/playing games: 1 – never/rarely, 2 – a few times a week, 3– once a week, 4 – a few times a day	128	1.95 ± 0.98	27	2.00 ± 1.11	0.9581
How often does your child watch TV a day on week days: 1– never, 2 – less than 1h a day, 3 – 1h to 2 h a day, 4 – 2 to 3h a day, 5 – more than 3h	128	2.76 ± 0.71	27	2.59 ± 0.75	0.2863
How often does your child watch TV a day at the weekend: 1– never, 2 – less than 1h a day, 3 – 1h to 2 h a day, 4 – 2 to 3h a day, 5 – more than 3h	128	3.48 ± 0.83	27	3.41 ± 0.84	0.6373
How often does your child play computer games a day: 1– never, 2 – less than 1h a day, 3 – 1h to 2 h a day, 4 – 2 to 3h a day, 5 – more than 3h	128	1.43 ± 0.62	27	1.59 ± 0.64	0.1560
How often does your child play computer games a day at the weekend: 1– never, 2 – less than 1h a day, 3 – 1h to 2 h a day, 4 – 2 to 3h a day, 5 – more than 3h	128	1.77 ± 0.85	27	2.15 ± 0.95	0.0373
Child likes eating the best: sweets	128	1.03 ± 0.17	11	1.18 ± 0.40	0.0188
Child dislikes: legumes	128	1.00 ± 0.00	11	1.09 ± 0.30	0.0006
Child likes eating the best: milk and cheese	128	1.29 ± 0.46	11	1.00 ± 0.00	0.0381
Child dislikes: fruit	128	1.04 ± 0.19	11	1.18 ± 0.40	0.0384
Child attends sport classes: No. of days a week	35	1.66 ± 0.97	4	1.00 ± 0.00	0.0003

N – number of subjects; (X ± SD) – arithmetic mean ± standard deviation; $p < 0.05$ differences statistically significant

body mass more often participated in sports activities than children with obesity. In children with excessive adipose tissue in the week, it was only one day and in children with normal amount of adipose tissue on average 1.6 days.

Discussion

With age, the likelihood of overweight or obesity increases.[6] In studies by Shashaj et al., overweight in children aged 2 years was 7% and in children aged 5 it was 16.9%. Obesity at the age of 2 years is 1.1% and by the age of 5 was already 2.9%. A similar tendency was observed by Majcher A. et al.[18] examining adolescents with obesity and their previous developmental history. At the age of 2, 53% of them were overweight or obese, at the age of 4 this rose to 71.6%, while at the age of 6, to as much as 85.4%. A similar tendency is presented by a study of population in kindergartens in south-eastern Poland. Overweight children at the age of 3 accounted for 6.35% of the total, and at the age of 6, 13.05%. Obe-

sity in the group of 3 year-olds did not occur, and in 6-year-old children it was 5%.[6] This dependence can be explained by a longer time of exposure to environmental factors such as excessive energy consumption from food and too little physical activity.[15] For this reason, it is necessary to monitor the child's body weight at various stages of development and to introduce nutritional education from the earliest years. Prevention of obesity in children cannot focus only on children, but should cover the whole family. Children usually eat the foods offered them by caregivers, which means that exclusive education of children is less effective.[19]

It can be suggested that parents are responsible for the weight of their children also before they are born. Animal studies showed that the BMI of their descendants was much higher when mothers were fed unhealthy, high-calorie foods during pregnancy.[20] For this reason, mothers from south-eastern Poland, who had gestational weight gain on average 18 kg gave birth to children who later developed excessive body mass, while those who increased body weight by 13.54 kg gave birth to children with normal body mass at a later stage of development. Improper nutrition of women during pregnancy resulted in excessive weight gain during this period, which influenced the development of obesity in their offspring. It has also been proven that the choice of food for pregnant women influences the nutritional preferences of their children after birth. Mennella A. et al.[21] observed in pregnant women the following relationship: children of women who during the pregnancy drank large amounts of carrot juice, at the first administration of carrots were less grimacing compared to children whose mothers did not drink carrot juice. The breastmilk is another factor responsible for the predispositions of a baby to become overweight at an early stage of their lives. Numerous studies show that naturally-fed children are less likely to be obese.[22] However, this correlation was not found in this study. Equally often children fed with natural milk and artificial milk had excessive or normal BMI. Statistically significant was the relationship between the body mass of mothers and their children. In the study group from the south-east of Poland it was found that mothers of children with excessive body mass have a higher BMI than mothers of children with normal body mass. The question whether the dependence of the excessive weight of the parents and their descendants results from the inheritance of the tendency to gain weight or eating habits remains an issue. We can look for genetic predispositions to obesity, however, Lobstein et al. claims that there is no consensus on the extent of genes and the environment in the formation of obesity. Genetic factors indicate population studies, which show that obese parents more often than slim parents have obese children. If both parents are obese, 2/3 of their children will be obese, if one of the parents is obese, nearly half of their children will be fat. Genetic predisposition leads to excessive accumulation of adipose tissue when specific environmental conditions occur.[23] On the other hand, Mazur et al. suggests that the increasing prevalence of obesity in children and adults in recent years should be explained not by genetic changes but by environmental factors. In his research, the author states that obesity in fathers significantly increases the risk of obesity in offspring, but to a lesser extent than maternal obesity.[24] It can be assumed that the unhealthy eating habits of mothers resulted in improper feeding of the children, which is reflected in the weight of the body. Myles et al. in their review showed that in 19 out of 22 studies, heredity of eating behaviors has been proven[25] Studies reveal that it is mainly mothers who are responsible for the selection of foods in the home diet. Obese mothers are mainly focused on the family, have excessive control over the children and are overprotective towards them, overfeeding them.[26]

This paper confirms the greater impact of maternal obesity than father's obesity on the increased amount of adipose tissue in a child. This trend is also confirmed by the study of Portela et al., who claims that maternal obesity is the most frequent risk factor for the formation of excessive body mass in children aged 6 years.[27] The risk of obesity in a child in correlation with obesity and overweight of the mother was higher in girls than in boys. A statistically significant relationship was found between maternal obesity and daughter obesity. The odds ratio for this factor was OR = 21.64. Perez-Pastor et al.,[28] estimate that the obese mother is ten times more likely to have an obese daughter than a mother with a normal body weight. It is noted that the overweight of the mother affects the weight of the daughter, not the son. However, the an overweight father affects the weight of the son, not the daughter. Studies[28] conducted on 226 families show that in women with obesity up to 41% of daughters aged 8 years showed body mass that was too high. However, in women with normal body mass, only 4% of obese daughters were present. Among boys, these proportions are smaller; obese fathers have about 18% of sons with excessive body mass, while in fathers with normal BMI, sons with overweight and obesity are only 3%. In both cases, the researchers did not detect the relationship between mother-son and father-daughter. They argue that the inheritance of obesity from mother to daughter and from father to son has nothing to do with genes. The reason is watching the behaviors that later cause one to become overweight. The sons imitate the behavior pattern of the father and the daughter copy their mother.[28] Parents' perceived feeding habits are transferred to the way children are fed. However, not all dietary choices in this study have been reflected in excessive body weight in children. In the study, obese children were eating fish more often than

children of normal weight. Fish, although considered healthy, are often eaten by children in the form of fried fillets or fish fingers, which reduces their nutritional value and exceeds the number of calories accepted. Children with excess body weight were less likely to eat legumes. It is believed that legumes are beneficial in the prevention of obesity due to the high content of prebiotic compounds that is regulating the intestinal microflora, which disorders are an important risk factor for the development of excessive body mass.[29] Legumes are a valuable source of vitamins and minerals responsible for the expression of genes that regulate the lipogenesis process. They reduce insulin resistance and normalize lipid metabolism.[30] Another important relationship is the fact that children with excessive body weight consumed fruit less often. According to Harton et al.[31], pre-school children eat fruit or sweets most often in the form of snacks. Fruits are a better choice because they contain fewer calories and have a higher nutritional value. Other studies also confirm that sweets are a frequent choice of preschool children as snacks.[32] Replacing sweet snacks with fruits can significantly affect the child's body weight. Another important aspect is the reluctant consumption of dairy products by overweight and obese children. Numerous studies confirm the beneficial properties of dairy products in the prevention of overweight. Weijing et al.[33] assessed that the risk of obesity decreased by 16% when consuming 200g of milk per day. There are several potential mechanisms underlying the impact of dairy products on the risk of obesity. A high-energy diet reduces energy storage through mechanisms associated with calcium levels in adipocytes, increases thermogenesis and reduces appetite.[33]

Proper nutrition of children is important due to their rapid developmental pace, which carries a high demand for nutrients. In addition to providing essential nutrients in the development of a child, physical activity is also important. It is an important factor affecting the body weight in children. Children from the south-east of Poland, with a correct body weight, were much more likely to participate in sports activities than children with overweight or obesity. It is recommended for children to devote about 60 minutes a day to physical activity. Only 1/3 of school children spend their free time actively. However, every seventh child does not take part in any physical activity other than that provided at school.[34] According to Kwiecień et al.[35], in Europe it was observed that with age, children spend less and less time on extracurricular physical activity and show less willingness to participate in physical education classes. Time spent passively is often devoted to watching TV and simultaneously advertising of food products. Brzozowski et al.[36] determined that pre-school children who often watch television and advertisements of food products later reach for it much more willingly. Limiting the amount of advertising for unhealthy food should be implemented to a significant extent. As many as 47.4% of children reach for "junk" food. According to Lioutades et al.[37], advertisements operate on four levels. First, they motivate children to buy unhealthy products, changing their expectations in relation to the type of food. Secondly, they present the product in a good light by tuning the child to it positively emotionally. In the third aspect, the funny dimension of advertising creates a pleasant mood related to the advertised food. The last dimension is the lack of objective assessment of the child in relation to the advertisement and the product itself.

Conclusion

Overweight and obesity occurred in 13.5% of all preschoolers surveyed. With age, the number of children with overweight and obesity increases. The prevalence of excessive body weight among preschoolers was 6.4% in 3-year-olds, 11.3% in 4-year-olds, 17.7% in 5-year-olds, and 20.7% in 6-year-olds. Among boys, obesity and overweight occurred more often than among girls. In the female children, excessive body mass was at the level of: 6.2% in 3-year-olds, 7.4% in 4-year-olds, 15.6% in 5-year-olds, 11.1% in 6-year-olds. In male children, excessive body weight occurred successively: 6.5% in 3-year-olds, 13.9% in 4-year-olds, 20% in 5-year-olds, and 25% in 6-year-olds. A factor significantly increasing the risk of obesity among the examined children was the maternal BMI index. This is closely related to the heredity of eating habits passed on to the young generation by mothers. Nutrition education should concern entire families, in particular mothers and children from the earliest years.

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