Nutritional education as an element improving nutritional behavior and selected anthropometric parameters in the group of children aged 12 years

Edukacja żywieniowa jako element poprawiający zachowania żywieniowe oraz wybrane parametry antropometryczne w grupie dzieci w wieku 12 lat

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Abstract

Background. Improperly shaped eating behavior in childhood may contribute to disturbances of nutritional status and many diseases, including type 2 diabetes, obesity, hypertension, and even cancers. In order to improve children's eating behavior, nutritional education addressed to children as well as their legal guardians should be conducted.

Objectives. The aim of the study was to assess nutritional behaviors and selected anthropometric parameters in a group of 12-year-old children before and after the program of nutritional education was implemented.

Material and methods. The study was conducted among 160 children aged 12 years from Koszalin. Children were divided into 2 groups: a group subjected to nutritional education and a group not subjected to such a program. The research was carried out twice: before the educational program was started and 6 months after its completion. The tool was the author's questionnaire, which asked about the frequency of consumption of food products, the frequency of meals consumed during the day, the frequency of consumption of selected beverages, and the habit of snacking. In addition, the height and weight of children were measured and the Cole index was calculated, and then on this basis the nutritional status of the children was determined.

Results. In the educated group in the 2nd measurement, an increase in the frequency of consumption of 1st and 2nd breakfast was recorded ($p < 0.001$). In addition, in this group after the education process the frequency of consumption of milk and milk products increased in girls ($p = 0.049$), and boys ($p = 0.047$), of fish and fish products in girls ($p = 0.070$) and in boys ($p = 0.008$), as well as of vegetables in girls ($p = 0.034$) and in boys ($p = 0.030$). In the educated group, there was also a decrease in the percentage of children consuming sweetened soda in girls by 28% ($p < 0.010$) and in boys by 34% ($p < 0.05$). In the final assessment, an increase in the percentage of children with normal nutritional status was noted: in girls by 35% and in boys by 13%.

Conclusions. Nutritional education can positively influence children's nutritional behavior and improve their selected anthropometric parameters.

Key words: children, anthropometric parameters, nutrition education, nutritional habits

Streszczenie

Wprowadzenie. Niewłaściwie ukształtowane w dzieciństwie zachowania żywieniowe mogą przyczynić się do zaburzeń stanu odżywienia oraz wielu chorób, m.in.: cukrzycy typu 2, otyłości, nadciśnienia tętniczego, a nawet nowotworów. Aby poprawić zachowania żywieniowe dzieci, należy prowadzić edukację żywieniową, która powinna być skierowana zarówno do dzieci, jak i do rodziców/opiekunów.

Cel pracy. Ocena zachowań żywieniowych oraz wybranych parametrów antropometrycznych w grupie dzieci 12-letnich przed wdrożeniem programu edukacji żywieniowej i po nim.

Materiał i metody. Badania przeprowadzono wśród 160 dzieci 12-letnich z Koszalina. Dzieci podzielono na 2 grupy: w pierwszej z nich wdrożono program edukacji żywieniowej, a w drugiej nie. Badania wykonano dwukrotnie: przed edukacją i po upływie 6 miesięcy po zakończeniu edukacji w grupie edukowanej. Narzędziem badawczym był autorski kwestionariusz ankiety, w którym pytano o: częstotliwość spożycia różnych grup produktów spożywczych, liczbę i częstotliwość posiłków w ciągu dnia, częstotliwość spożycia wybranych napojów oraz najczęściej pojadane produkty spożywcze. Dokonano także pomiarów wzrostu i masy ciała u dzieci i obliczono wskaźnik Cole'a, określając na tej podstawie stan odżywienia dzieci.

Wyniki. W grupie edukowanej w drugim pomiarze odnotowano zwiększenie częstotliwości spożycia I i II śniadania ($p < 0{,}001$). Dodatkowo w tej grupie dzieci po zakończonym procesie edukacji zwiększyła się częstotliwość spożycia mleka i przetworów mlecznych zarówno wśród dziewczynek ($p = 0{,}049$), jak i chłopców ($p = 0{,}047$), ryb i przetworów z ryb w grupie dziewczynek ($p = 0{,}070$) i w grupie chłopców ($p = 0{,}008$) oraz warzyw wśród dziewczynek ($p = 0{,}034$) i wśród chłopców ($p = 0{,}030$). W grupie edukowanej po zakończeniu programu odnotowano ponadto spadek odsetka dzieci spożywających słodzone napoje gazowane – w grupie dziewczynek o 28% ($p < 0{,}010$), a w grupie chłopców o 34% ($p < 0{,}05$). W końcowej ocenie w grupie edukowanej odnotowano wzrost odsetka osób, których stan odżywienia był w normie – w grupie dziewczynek o 35%, a w grupie chłopców o 13%.

Wnioski. Edukacja żywieniowa może korzystnie wpływać na zachowania żywieniowe dzieci oraz na poprawę wybranych parametrów antropometrycznych.

Słowa kluczowe: dzieci, wskaźniki antropometryczne, edukacja żywieniowa, zwyczaje żywieniowe

Background

Human nutritional behaviors are formed from the first years of life during the repeated performance of the same activities according to a learned pattern, and such behaviors shaped in childhood have a significant impact on health condition in adult life.[1] Over the last 3 decades, there has been a significant increase in the incidence of overweight and obesity among children and adolescents in many countries around the world.[2] The main cause of this situation is dietary errors committed by children and adolescents: too little fruit and vegetables, as well as milk products, and too many highly processed products containing large amounts of fat and sugar are consumed.[3,4] Sedentary lifestyle is not without significance for the nutritional status of children and adolescents. Wrong eating habits and lack of physical activity result in the development of non-infectious diet-related diseases such as obesity, type 2 diabetes, cardiovascular diseases, musculoskeletal diseases, caries, or cancer.[5] These diseases can develop both at an early age and in adulthood. In order to prevent the negative health effects of an improper lifestyle in a group of children and young people, nutrition education should be provided. It should be addressed both to the young generation and parents or guardians.[6] In Poland, nutrition education programs are implemented, e.g., *Wiem, co jem* (I Know What I Eat) – a campaign of the Warsaw local government, and the governmental *Program dla szkół* (Program for Schools), but there are no studies confirming the effectiveness of nutrition education in selected groups of children.

The aim of this study was to evaluate nutritional behaviors and selected anthropometric parameters in a group of 12-year-old children before and after the implementation of the nutritional education program.

Material and methods

The study was conducted in the years 2015–2016 among students of selected primary schools in the city of Koszalin (100,000 residents) in West Pomeranian voivodeship (province). Classes for the study were selected randomly. The study was conducted with the consent of the Bioethics Committee at the Institute of Food and Nutrition in Warsaw, Poland (consent of January 7, 2015) in children whose parents/legal guardians gave their written consent to the study. In total, 160 children (80 boys and 80 girls) aged 12 years were included in the study.

The students were divided into 2 groups: one group of 120 students (60 boys, 60 girls), included in the nutrition education program, and the other group of 40 students (20 boys, 20 girls), in which no nutrition education program was implemented (children uneducated on nutrition were in the same classes as children included in the nutrition education program).

In the educated group, qualified persons, i.e., certified nutritionists and dieticians, conducted didactic classes on the benefits of eating fruit and vegetables, dairy products, and fish. Moreover, the issue of choosing the so-called "healthy" snacks and drinks was raised and the health benefits of eating breakfast by children

were highlighted. In total, nutrition education lasted 8 h in each educated class and was conducted by way of lectures and workshops with the use of raw food materials. During the experiment, the parents/legal guardians of the pupils from the educated group had the possibility of consulting on the principles of proper meal planning for schoolchildren. The evaluation of nutritional habits and selected anthropometric parameters was carried out twice: at the beginning of the experiment in educated and uneducated groups (1st stage of the experiment) and after 6 months – also in both groups (2nd stage of the experiment). An original questionnaire was used to collect data on the number and frequency of meals consumed during the day, frequency of consumption of selected groups of products by children, consumption of selected beverages, and food products that people most frequently snack on during the day. The evaluation of the correctness of the number of consumed meals and frequency of consumption of selected groups of food products was made with reference to the recommendations of the Institute of Food and Nutrition in Warsaw (Instytut Żywności i Żywienia – IŻŻ).[7] In addition, measurements of body weight and height in children were carried out according to the methodology used by researchers from the OLA and OLAF projects.[8,9] Body weight measurements were made with the accuracy of 100 g, using SECA 875 electronic scale (SECA GmbH & Co. KG, Hamburg, Germany), and body height measurements with the SECA 213 height meter (SECA) with the accuracy of 0.1 cm. On the basis of the collected measurements, the values of the body mass index (BMI), necessary for the calculation of the Cole index, were determined, which enabled the assessment of the degree of overweight, obesity or underweight in children according to the classification in McLaren's and Red's scale.[10] The criteria for inclusion in the study were as follows: students had to be 12 years old (at the time the study was launched), the group had to consist of children of both sexes, and parents' (legal guardians') consent and students' consent to participate in the study were required. The exclusion criteria were: occurrence of chronic disease, e.g., diabetes, in a student, use of alternative diets, lack of participation in physical education classes due to health reasons, lack of consent of a parent (legal guardian) for participation of a child in the study, and lack of consent of a student for participation in the study. The statistical analysis was performed using IBM SPSS Statistics, v. 24 software (IBM Corp., Armonk, USA). For qualitative characteristics, McNemar's test was used to statistically evaluate the results. In the case of quantitative data, the normality of distribution was examined using the Shapiro–Wilk test and the Wilcoxon test was used to statistically assess the results. In all calculations, the level of statistical significance was $\alpha = 0.05$.

Results

In the 1st stage of the study, approx. 55–65% of children consumed 4–5 meals a day. In the 2nd stage, in the educated group (after nutrition education), an improvement in results was noted – the number of meals consumed during the day increased (Table 1). It was observed that after education, as many as 88% of girls and 83% of boys declared that they consumed 4–5 meals a day. The percentage of children in the educated group consuming too few meals, i.e., 1–3 per day, decreased by 22% for girls ($p = 0.001$) and by 24% for boys ($p = 0.003$). In the group not included in the education program, there were no significant changes in the number of meals consumed during the day in the 2nd measurement in relation to the 1st stage of the study.

For schoolchildren it is important to eat 1st and 2nd breakfast. Thanks to the implemented nutritional education program, the frequency of consumption among girls

Table 1. Number of meals consumed in the group of 12-year-old children ($N = 160$)

Tabela 1. Liczba spożywanych posiłków w grupie dzieci 12-letnich ($N = 160$)

Group of children	Number of meals	Girls ($N = 80$)			Boys ($N = 80$)		
		before the experiment [%]	after the experiment [%]	*p*-value[a]	before the experiment [%]	after the experiment [%]	*p*-value[a]
Educated group ($n = 60$)	1–2	3	0	0.001	3	0	0.003
	3	27	8		35	14	
	4–5	63	88		57	83	
	≥6	7	4		5	3	
Uneducated group ($n = 20$)	1–2	5	5	NS	5	5	NS
	3	30	25		35	35	
	4–5	65	70		55	60	
	≥6	0	0		5	0	

[a] McNemar's test: $p \leq 0.05$ – statistically significant differences, NS – statistically insignificant differences.

N – sample size.

Table 2. Number of meals consumed in the group of 12-year-old children ($N = 160$)

Tabela 2. Liczba spożywanych posiłków w grupie dzieci 12-letnich ($N = 160$)

Group of children	Meals[a]	Girls ($N = 80$)			Boys ($N = 80$)		
		before the experiment [%]	after the experiment [%]	p-value[b]	before the experiment [%]	after the experiment [%]	p-value[b]
Educated group ($n = 60$)	1st breakfast	4.28 ±1.16	4.83 ±0.42	0.001	4.28 ±1.23	4.85 ±0.39	<0.001
	2nd breakfast	3.43 ±1.43	4.05 ±0.79	<0.001	3.07 ±1.50	4.01 ±0.79	<0.001
	dinner	4.84 ±0.45	5.00 ±0.00	0.023	4.88 ±0.47	4.98 ±0.12	NS
	afternoon snack	2.45 ±1.29	3.50 ±0.89	<0.001	2.26 ±1.43	3.46 ±0.94	<0.001
	supper	4.51 ±0.92	4.83 ±0.46	0.024	4.68 ±0.85	4.95 ±0.21	0.007
Uneducated group ($n = 20$)	1st breakfast	4.53 ±0.73	4.53 ±0.73	NS	4.35 ±0.75	4.40 ±0.69	NS
	2nd breakfast	3.40 ±0.89	3.48 ±0.65		3.33 ±0.90	3.30 ±0.98	
	dinner	5.00 ±0.00	4.96 ±0.05		5.00 ±0.00	5.00 ±0.00	
	afternoon snack	2.80 ±1.23	2.80 ±1.23		2.88 ±1.31	2.80 ±1.23	
	supper	4.40 ±0.69	4.48 ±0.60		4.35 ±0.56	4.40 ±0.49	

[a] Scale: 1 – I do not eat it, 2 – I eat it 1–2 times a week, 3 – I eat it 3–4 times a week, 4 – I eat it 5–6 times a week, 5 – I eat it every day.

[b] McNemar's test: $p \leq 0.05$ – statistically significant differences, NS – statistically insignificant differences.

from the educated group increased significantly: from 5–6 times a week to almost daily in relation to 1st breakfast ($p = 0.001$) and dinner ($p = 0.024$); from 3–4 times a week to 5–6 times a week in relation to 2nd breakfast ($p < 0.001$); and from 1–2 times a week to 3–4 times a week in relation to afternoon snack ($p < 0.001$) – Table 2. In the group of educated boys, the frequency of consumption increased from 5–6 times a week to almost daily in relation to 1st breakfast ($p < 0.001$) and dinner ($p = 0.007$). The frequency of eating 2nd breakfast in this group of boys increased from 3–4 times a week to 5–6 times a week ($p < 0.001$), and from 1–2 times a week to 3–4 times a week in relation to afternoon snack ($p < 0.001$). In groups not included in the nutrition education program, no significant changes in the frequency of consumption of individual meals in the 2nd stage of the study compared to the 1st stage were observed in boys or girls.

As a result of the conducted education, changes in the frequency of consumption of selected groups of food products were observed in the educated group. The frequency of consumption of milk and dairy products ($p = 0.049$) and vegetables and vegetable products ($p = 0.034$) increased to over 5–6 times per week in the group of educated girls – Table 3. The frequency of consumption of fish and fish products also increased to approx. 1–2 times a week ($p = 0.070$) and the frequency of consumption of fruit and fruit products increased to more than 5–6 times a week ($p = 0.071$). In the case of the group of educated boys, the frequency of consumption of milk and milk products increased to approx. 5–6 times per week ($p = 0.047$), similarly to the consumption of vegetables and vegetable products ($p = 0.030$). In addition, it was observed that the consumption of fish and fish products increased to approx. 1–2 times a week ($p = 0.008$) and the frequency of candy consumption decreased ($p = 0.002$) in the period after education in the group of educated boys. There were no significant changes in the frequency of consumption of selected groups of products in the 2nd stage of the study compared to the 1st stage.

Subsequently, the consumption of particular types of beverages in the studied groups of 12-year-olds was analyzed (Table 4). The most commonly consumed beverage among young respondents was tea, which at the beginning of the experiment was drunk by 88% of girls in the educated group and 90% in the uneducated group, and 75% of boys in the educated group and 85% in the uneducated group. At the beginning of the study, only 63% of girls in the educated group and 60% in the uneducated group, and 58% of boys in the educated group and 70% in the uneducated group were drinking still water, which should be the basic drink in each age group. The consumption of sweetened drinks is alarming. Almost half of the boys from the educated group, approx. 60% of boys in the uneducated group, more than 1/3 of girls in the educated group, approx. 1/2 of the girls in the uneducated group reported consumption of carbonated and non-carbonated sweet drinks in the period prior to the beginning of the educational program. Moreover, in the group of 12-year-olds, the consumption of energy drinks in this period was recorded (10% of girls and 15% of boys from the educated group, and 30% of boys from the uneducated group). Thanks to the educational program, the proportion of girls in educated groups drinking still water increased by 20% ($p = 0.021$), milk drinks by 16% ($p = 0.049$) and fruit juices by 13% ($p = 0.065$), and the percentage of girls choosing carbonated sweet drinks decreased by 14% ($p = 0.039$) and non-carbonated sweet drinks also by 14% ($p = 0.079$), and energy drinks by 8% ($p = 0.090$). In the

Table 3. Frequency of consumption of selected product groups in the group of 12-year-old children ($N = 160$)

Tabela 3. Częstotliwość spożycia wybranych grup produktów w grupie dzieci 12-letnich ($N = 160$)

Group of children	Group of products[a]	Girls ($N = 80$)			Boys ($N = 80$)		
		before the experiment [%]	after the experiment [%]	*p*-value[b]	before the experiment [%]	after the experiment [%]	*p*-value[b]
Educated group ($n = 60$)	milk/milk products	3.84 ±1.04	4.32 ±0.86	0.049	3.52 ±0.82	3.84 ±0.7	0.047
	eggs	2.26 ±0.88	2.15 ±0.45	NS	2.03 ±0.5	2.09 ±0.42	NS
	meat/meat preparations	3.26 ±1.17	3.20 ±0.86	NS	3.87 ±0.95	3.58 ±0.75	0.015
	fish/fish products	1.77 ±0.77	1.91 ±0.59	0.070	1.53 ±0.5	1.74 ±0.47	0.008
	grain products	4.47 ±0.54	4.79 ±0.40	0.058	4.84 ±0.4	4.96 ±0.17	NS
	vegetables/vegetable products	3.35 ±1.12	4.16 ±0.67	0.034	3.11 ±0.96	3.88 ±0.8	0.030
	fruit/fruit products	4.05 ±1.09	4.30 ±0.63	0.071	3.44 ±0.98	3.82 ±0.79	NS
	sweets	2.98 ±1.39	2.83 ±0.99	NS	2.83 ±1.32	2.50 ±1.01	0.002
Uneducated group ($n = 20$)	milk/milk products	3.68 ±0.74	3.68 ±0.74	NS	3.66 ±0.98	3.70 ±0.90	NS
	eggs	2.00 ±0.37	2.10 ±0.58		1.77 ±0.44	1.82 ±0.52	
	meat/meat preparations	3.66 ±0.89	3.60 ±0.92		4.11 ±0.78	4.26 ±0.33	
	fish/fish products	1.60 ±0.50	1.60 ±0.50		1.44 ±0.52	1.50 ±0.46	
	grain products	4.80 ±0.25	4.75 ±0.35		4.88 ±0.33	4.80 ±0.25	
	vegetables/vegetable products	3.06 ±0.96	3.15 ±0.80		2.89 ±1.13	2.95 ±1.05	
	fruit/fruit products	3.66 ±0.97	3.58 ±1.08		3.22 ±0.97	3.30 ±0.95	
	sweets	3.25 ±1.03	3.32 ±0.99		3.11 ±1.16	3.21 ±1.12	

[a] Scale: 1 – I do not eat it, 2 – I eat it 1–2 times a week, 3 – I eat it 3–4 times a week, 4 – I eat it 5–6 times a week, 5 – I eat it every day.

[b] Wilcoxon test: $p \leq 0.05$ – statistically significant differences, $0.05 \leq p \leq 0.1$ – statistical trends, NS – statistically insignificant differences.

Table 4. Evaluation of consumption of selected beverages in the group of 12-year-old children ($N = 160$)

Tabela 4. Ocena spożycia wybranych napojów w grupie dzieci 12-letnich ($N = 160$)

Group of children	Beverages consumed	Girls ($N = 80$)			Boys ($N = 80$)		
		before the experiment [%]	after the experiment [%]	*p*-value[a]	before the experiment [%]	after the experiment [%]	*p*-value[a]
Educated group ($n = 60$)	still water	63	83	0.021	58	88	<0.001
	fruit juices	77	90	0.065	63	68	NS
	vegetable juices	28	37	NS	13	18	NS
	milk drinks	27	43	0.049	27	37	NS
	non-carbonated sweet drinks	37	23	0.079	48	30	0.049
	carbonated sweet drinks	37	23	0.039	43	27	0.041
	energy drinks	10	2	0.090	15	4	0.048
	tea	88	93	NS	75	73	NS
	chicory coffee	18	23	NS	18	30	0.057
Uneducated group ($n = 20$)	still water	60	60	NS	70	65	NS
	fruit juices	70	75	NS	65	65	
	vegetable juices	20	20	NS	0	5	
	milk drinks	25	25	NS	5	5	
	non-carbonated sweet drinks	60	65	NS	65	70	
	carbonated sweet drinks	40	45	NS	55	60	
	energy drinks	0	0	–	30	35	
	tea	90	85	NS	85	85	
	chicory coffee	0	5	NS	5	5	

[a] McNemar's test: $p \leq 0.05$ – statistically significant differences, $0.05 \leq p \leq 0.1$ – statistical trends, NS – statistically insignificant differences.

Table 5. Assessment of the habit of snacking in a group of 12-year-old children ($N = 160$)

Tabela 5. Ocena zwyczaju pojadania w grupie dzieci 12-letnich ($N = 160$)

Group of children	Group of products[a]	Girls ($N = 80$)			Boys ($N = 80$)		
		before the experiment [%]	after the experiment [%]	p-value[b]	before the experiment [%]	after the experiment [%]	p-value[b]
Educated group ($n = 60$)	I do not snack	10	7	NS	14	10	NS
	I snack	90	93	NS	86	90	NS
	sweets[a]	40	33	NS	50	25	0.001
	crisps/chips[a]	30	10	0.013	47	27	0.002
	pizza/hot-dogs/ French bread pizzas[a]	7	2	NS	10	4	NS
	stuffed buns[a]	23	15	NS	30	37	NS
	sandwiches[a]	30	23	NS	27	32	NS
	fruit/vegetable[a]	43	67	0.008	37	60	0.001
	fruit/vegetable juices[a]	40	58	0.078	33	53	0.023
	carbonated and non-carbonated sweet drinks[a]	43	32	NS	50	43	NS
Uneducated group ($n = 20$)	I do not snack	15	10	NS	5	10	NS
	I snack	85	90		95	90	
	sweets[a]	55	60		60	65	
	crisps/chips[a]	40	35		50	55	
	pizza/hot-dogs/French bread pizzas[a]	10	15		15	20	
	stuffed buns[a]	30	30		35	30	
	sandwiches[a]	40	45		35	30	
	fruit/vegetable[a]	40	40		35	35	
	fruit/vegetable juices[a]	30	30		45	50	
	carbonated and non-carbonated sweet drinks[a]	40	45		55	60	

[a] Percentage of children in the group of people who snack.

[b] McNemar's test: $p \leq 0.05$ – statistically significant differences, $0.05 \leq p \leq 0.1$ – statistical trends, NS – statistically insignificant differences.

group of educated boys, the percentage of children drinking still water increased by 30% ($p < 0.001$) and chicory coffee by 12% ($p = 0.057$) in the 2nd stage of the study. In addition, in the group of educated boys, the percentage of children consuming carbonated sweet drinks decreased by 16% ($p = 0.041$), non-carbonated sweet drinks by 18% ($p = 0.049$) and energy drinks by 11% ($p = 0.048$). In the non-educated groups, there were no significant changes in the number of children that would change their habits regarding the choice of drinks consumed during the day.

On average, approx. 90% of 12-year-old schoolchildren ate snacks both before and after the conducted nutrition education. In the 1st stage of the study, girls in the educated group most often drank carbonated and non-carbonated sweet drinks (43%) and snacked on fruit and vegetables (43%), and in the uneducated group, they snacked on sweets (55%) – Table 5. On the other hand, before the implementation of the nutrition education program, boys in the educated group most willingly snacked on sweets (50%) and drank carbonated and non-carbonated sweet drinks (50%), and in the uneducated group, they snacked on sweets (60%). Thanks to education, the profile of eaten products in the educated groups changed. In the group of girls, the percentage of children eating fruit and vegetables increased by 24% ($p = 0.008$), fruit and vegetable juices by 18% ($p = 0.078$) and the percentage of children eating crisps decreased by 20% ($p = 0.013$). In the group of educated boys, on the other hand, the percentage of children snacking on fruit and vegetables increased by 23% ($p = 0.001$), fruit and vegetable juices by 20% ($p = 0.023$), while the percentage of children eating sweets decreased by 25% ($p = 0.001$) and crisps by 20% ($p = 0.002$). In the groups not included in the nutrition educational program, no significant changes in the products consumed were observed in the 2nd stage of the study compared to the 1st stage.

Changes in nutritional behavior in 12-year-old children resulted in changes in selected anthropometric parameters. In the 1st stage of the study, approx. 1/3 of girls and

Table 6. Evaluation of nutritional status in the group of 12-year-old children based on the Cole index (*N* = 160)

Tabela 6. Ocena stanu odżywienia w grupie dzieci 12-letnich na podstawie wskaźnika Cole'a (*N* = 160)

Group of children	Cole index	Girls (*N* = 80)			Boys (*N* = 80)		
		before the experiment [%]	after the experiment [%]	*p*-value[b]	before the experiment [%]	after the experiment [%]	*p*-value[b]
Educated group (*n* = 60)	undernutrition	18	8	0.040	17	8	0.001
	standard	28	63		40	53	
	overweight	13	15		12	13	
	obesity	41	14		31	26	
Uneducated group (*n* = 20)	undernutrition	15	15	NS	10	10	NS
	standard	40	35		45	30	
	overweight	15	20		20	35	
	obesity	30	30		25	25	

[a] McNemar's test: $p \leq 0.05$ – statistically significant differences, NS – statistically insignificant differences.

almost 40% of boys had normal nutritional status based on Cole's index, and approx. 1/2 of the girls and over 40% of the boys were overweight (Table 6). In the 2nd stage of the study, in the group of educated girls, the percentage of children with normal body weight increased by 35% and the percentage of children with excessive body weight decreased by 29%, while the number of children with too low body weight decreased by 10% ($p = 0.040$). In the 2nd stage of the study, in the group of educated boys, the percentage of children with normal body weight increased by 13% and the percentage of children with excessive body weight decreased by 4%, while the number of children with too low body weight decreased by 9% ($p = 0.001$). In the group of respondents not included in the nutrition educational program, in the 2nd stage of the study, changes in the nutritional status were also noted, although they were not statistically significant.

Discussion

The study on children from Koszalin revealed abnormalities in nutritional habits regarding the number of meals consumed, as only 55–65% of 12-year-olds consumed 4–5 meals, as recommended by the Institute of Food and Nutrition, during the day.[7] Similar results were obtained by researchers in a group of children aged 11–12-years from Kalisz poviat (county), among whom the recommended number of meals was consumed by approx. 53% of children.[11] However, in a group of children from Białystok, only 65% of pupils aged 13–15 years and 70% of pupils aged 10–12 years ate 4–5 meals a day.[12]

Eating too few meals may reduce concentration and cause learning difficulties and sleepiness during the children's stay at school.[13] In own research, only approx. 60% of 12-year-olds ate 1st breakfast every day. Similar results were obtained in the Health Behaviour in School-aged Children (HBSC) study of 2014, which found that 71% of 11-year-olds, approx. 62% of 13-year-olds and 59% of 15-year-olds ate 1st breakfast regularly every day.[14] In a study on children and adolescents from Warsaw, breakfast was eaten by 86% of students,[15] and in the study of Wawrzyniak et al.,[16] 1st breakfast was eaten by 70% of children aged 11–13 from a town with <5,000 residents and 48% of children from a city with >100,000 residents from the Masovian voivodeship. In our own study, the 2nd breakfast was usually eaten by approx. 50% of 12-year-olds. Worse results were obtained among children aged 13–16 from Bytów, where 2nd breakfast was eaten by 37% of respondents, and slightly better among Warsaw children aged 10–13, where 66% of respondents declared eating 2nd breakfast on a daily basis.[17,18] In studies from Białystok, 2nd breakfast was consumed by 81% of children with normal body weight and 64% of overweight children.[19] It should be noted that 1st and 2nd breakfast are extremely important meals that affect children's academic performance, as has been confirmed in children from Wales, where the consumption of breakfast was positively associated with higher test scores of children.[20] Nutrition education can improve the frequency of breakfast consumption, as evidenced by studies conducted among 9–11-year-old children in the UK, among whom, as a result of educational activities, a 4-fold increase in the consumption of properly balanced breakfasts ($p < 0.01$) was recorded. In addition, there was a 5-fold increase ($p < 0.01$) in the number of children eating a meal at school (2nd breakfast) at least 2 days a week.[21]

According to the recommendations of the Institute of Food and Nutrition, milk and milk products should be consumed daily.[7] In own studies, milk and milk products were consumed by children 5–6 times a week. In studies by Ambrose et al.,[22] on the other hand, 49% of children from a city in the Silesian voivodeship aged 11–13 consumed milk at least once a day, and in studies by Wojtyła-Buciora,[11] 48% of children from Kalisz consumed milk at least once a day. Significantly worse results concerning the

frequency of consumption of milk and milk products are presented by Stefańska et al.[12] – 29% of children aged 10–12 years and 32% of children aged 13–15 years consumed milk every day. Studies show that nutrition programs can be effective in improving the frequency of consumption of milk and milk products. The *Smart Lunchbox* program carried out on 8–9-year-old children in the UK resulted in an 18% increase in milk product intake compared to the control group ($p < 0.05$) after teaching children and parents to compose their school meals correctly.[23] Studies carried out on children and adolescents show the health benefits of milk and milk products. Researchers show a positive correlation between milk and calcium intake and body weight and body composition in children and teenagers. Moreover, milk and milk products are a source of calcium, vitamin D, phosphorus, and potassium in the diet.[24]

The Institute of Food and Nutrition recommends eating 5 portions of fruit and vegetables every day.[7] The frequency of consumption of fruit and vegetables in own studies was on average 3–4 times a week and after the end of the educational program, it amounted to 5–6 times a week in the educated groups. The HBSC studies conducted among 4,516 participants showed that 41% of 11-year-olds and 33% of 13-year-olds consumed fruit at least once a day. In the case of vegetables, 34% of 11-year-olds and 28% of 13-year-olds declared their consumption at least once a day.[14] In the years 2009–2017, a program entitled *Fruit and Vegetables at School*, co-financed by the EU, was implemented in Poland. Within its framework, children from grades 1–3 of primary school received portions of fruit and vegetables at school. In 2017, the Institute of Food and Nutrition presented the results of this program (the evaluation covers the years 2011–2016). The report shows that fruit consumption among children participating in the program increased only by 18% compared to children not participating in the program, while there were no significant differences in the consumption of vegetables by children.[25] A meta-analysis carried out by Evans et al.[26] shows the effectiveness of intervention programs in the USA and Europe among children aged 5–12 years in terms of fruit and vegetables consumption. Children participating in the programs showed a higher consumption of fruit and vegetables by 20–30 g per day compared to the control group ($p < 0.01$). In connection with vitamins, minerals, antioxidants, and fiber contained in them, the consumption of fruit and vegetables has a beneficial effect on the prevention of many diseases, such as hypertension, obesity and cancer.[27]

As our own studies show, the consumption of fish by pupils from Koszalin in the 1st stage of the study was on average less than once a week. This is a lower intake than 1–3 times a week recommended by the Institute of Food and Nutrition.[7] In another study conducted among children from Koszalin, the percentage of respondents who did not eat fish was 26%.[28] A study conducted among 12-year-olds from Piekary Śląskie indicates that fish was consumed once a week by approx. 55% of respondents,[29] and 35% of children from Kalisz ate them once a week.[11] After the nutrition education program, the frequency of eating fish increased by 4% ($p = 0.070$) in the group of educated girls and by 5% ($p = 0.008$) in the group of boys. Similar results were reported after the completion of the *AVall Study* nutrition education project in children from Spain, during which culinary workshops and lectures took place – in the educated group, the consumption of fish remained at a similar level, while in the control group, the consumption of fish decreased by 13% compared to the initial measurement ($p = 0.024$).[30]

In own studies, children consumed sweets on average 3–4 times a week. In the 2014 HBSC study, 24% of 11-year-olds and 31% of 13-year-olds ate sweets at least once a day. It was also found that girls were more likely to reach for sweets than boys ($p = 0.001$).[14] In studies by Ponczek and Olszowa,[31] sweets were consumed daily by 35% of adolescents from Chełm, while as many as 75% of junior high school students from Warsaw declared that they consumed sweets daily.[32] In a study by Koryba and Wróblewska,[33] 23% of students in classes 3–5 ate sweets daily, and in a study conducted among children from Lublin, 23% of students in the 1st grade and 35% of students in the 3rd grade of primary school declared daily consumption of sweets ($p = 0.013$). Nutrition education for children can be effective in reducing the frequency of consumption of sweets and sugar. An example of this is a study on teenagers in Finland – teachers conducted nutritional education, during which topics related to sugar, fiber, fruit, and vegetables consumption were discussed. As a result of these activities, the frequency of candy consumption in the educated group decreased by 12% and the frequency of candy consumption in the control group increased by 10% ($p = 0.006$).[34]

The consumption of sweetened drinks (both carbonated and non-carbonated) in the group of children and adolescents is common. They are chosen for their taste, color and interesting label. In own studies, 41% of children habitually consumed sweetened drinks; in addition, approx. 10% drank energy drinks. Similar results were obtained in a group of junior high school students from Bydgoszcz, where 36% of students consumed sweetened drinks,[35] and in a study on adolescents from the Silesian voivodeship, where 44% of students declared regular consumption of sweetened drinks, with more boys choosing them than girls ($p < 0.001$). In addition, 58% of respondents consumed energy drinks regularly.[36] According to the authors, the consumption of sweetened drinks is a significant source of calories in their diet, leading to weight gain and related diseases.[37] The consequence of consumption of sweetened drinks may be the development of obesity, cardiovascular diseases, type 2 diabetes, and metabolic syndrome.[38] Nutrition education may be effective in the reduction of consumption of sweetened drinks in the group of children, as evidenced by stud-

ies conducted in a group of 12–13-year-olds from Rio de Janeiro. After 7 months of nutrition education, the consumption of sweetened drinks decreased 4 times in the educated group compared to the control group ($p = 0.03$), while the consumption of fruit juices in both groups increased ($p = 0.08$). The intervention had no significant impact on the reduction of BMI.[39]

The nutrition education program conducted by qualified persons in Koszalin influenced the anthropometric parameters of the examined children. In the educated group, after 6 months, the percentage of people with normal nutritional status increased by 35% in the group of girls and 13% in the group of boys. The benefits of nutrition education in terms of improving anthropometric parameters are also presented by researchers from Germany, who tested the effectiveness of nutrition education in a group of children. After 18 months of education, the percentage of overweight children in the educated group was 4% lower than in the control group ($p = 0.053$). On the other hand, the percentage of obese children in the educated group was 2% lower than in the control group ($p = 0.058$), while the percentage of children with eating disorders at the beginning of education was similar.[40] Silveira et al.[41] compared the results of 8 studies on changes in anthropometric parameters due to nutritional education and physical activity. The mean effect of BMI reduction in children was 0.33 kg/m^2 ($p = 0.003$) for programs lasting from 4 months to 3 years and 0.48 kg/m^2 ($p < 0.01$) for programs that lasted less than a year.

Conclusions

Nutritional habits of children in Koszalin were not proper; however, as a result of educational activities, the frequency of consumption of selected groups of food products (milk and products, fish, fruit, and vegetables) in the nutrition-educated group improved. Moreover, in the 2nd stage of the study, a decrease in the frequency of consumption of products undesirable in children's diets (sweets, sweetened drinks) was observed in the educated group. The change in eating habits also improved anthropometric parameters in the group of educated children. Therefore, educational activities should be carried out among children and their parents/guardians in relation to appropriate dietary choices.

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