

DO CHILDREN AND ADOLESCENTS WITH EXCESS BODY WEIGHT AND DYSLIPIDEMIA CONSUME ENOUGH VEGETABLES AND FRUITS BEFORE PARTICIPATING IN THE NUTRITIONAL INTERVENTION PROGRAM?

Beata Bondyra-Wisniewska^{ID}, Anna Harton^{ID}

Department of Dietetics, Institute of Human Nutrition Sciences, Warsaw University of Life Sciences (WULS), Poland

ABSTRACT

Background. The recommended intake of vegetables and fruits is an important element of dietotherapy in the treatment of excess body weight and dyslipidemia in children and adolescents.

Objective. Assessment of vegetables and fruits consumption by children and adolescents with excess body weight and diagnosed dyslipidemia before participating in the nutritional intervention program.

Material and Methods. The study included 64 children and adolescents (44 boys and 20 girls) aged 8-16 with overweight or obesity and dyslipidemia. These were patients of the Children's Memorial Health Institute in Warsaw referred by a pediatrician to participate in the nutritional intervention program. Vegetables and fruits consumption was estimated based on a 3-day current food record and the validated Food Frequency Questionnaire (FFQ-6).

Results. The average consumption of total vegetables and fruits was 593±311 g, including 286±163 g of vegetables and 306±199 g of fruits (no differences in the groups with overweight and obesity, $p \geq 0.05$). Compared to participants with overweight, patients with obesity consumed more vegetables per 1000 kcal of diet ($p=0.034$). In total, 41% of children and adolescents had a greater share of vegetables than fruits in meeting the recommendations (no differences between groups of participants with overweight or obesity, $p \geq 0.05$). About half of the participants ate vegetables and fruits less than once a day. Raw vegetables and fruits were chosen more often than processed ones or juices.

Conclusions. Only 16% of children and adolescents with excess body weight and dyslipidemia before participating in the nutritional intervention program did not consume the recommended amounts of vegetables and fruits set at a minimum of 400 g. In nutritional education, special attention should be paid to promoting the consumption of several portions of vegetables and fruits every day, as well as their appropriate proportions.

Keywords: *vegetables, fruits, childhood obesity, adolescents, dyslipidemia, diet*

INTRODUCTION

Proper consumption of vegetables and fruits is one of the basic elements of a healthy, balanced diet, both in dietary prevention and dietary therapy of diet-related diseases [1]. Experts from the World Health Organization (WHO) recommend eating at least 400 g of vegetables and fruits a day (excluding potatoes, sweet potatoes, cassava and other starchy roots) [2]. Healthy Eating Recommendations for the Polish population also specify that there should be more vegetables than fruits [3]. Vegetables and fruits are a source of dietary fiber, antioxidant vitamins, minerals and many bioactive compounds [4]. Additionally, they provide a greater feeling of satiety with lower calorie content compared to other products,

which helps control body weight, provided they are eaten instead of energy-dense foods [5]. Regularly consuming the recommended amount vegetables and fruits reduces the risk of many non-communicable diseases, including obesity, cardiovascular diseases, hypertension, diabetes and some cancers, as well as the risk of all-cause mortality [6-8]. Experts from the European Food Safety Authority (EFSA) indicate that increasing vegetables and fruits consumption to 5 servings per day (or 3 servings of vegetables and 2 servings of fruits) reduces the risk of all-cause mortality by 3-5% for each additional serving (approximately 80 g/day) [9]. Low consumption of vegetables and fruits by children and adolescents is considered one of the main nutritional mistakes in this age group [10]. Improper eating habits may result

Corresponding author: Anna Harton, Department of Dietetics, Institute of Human Nutrition Sciences, Warsaw University of Life Sciences (WULS), 159C Nowoursynowska St, 02-776, Warsaw, Poland; email: anna_harton@sggw.edu.pl; phone: +48 22 59 370 22

This article is available in Open Access model and licensed under a Creative Commons Attribution-Non Commercial 4.0 International License (CC BY-NC) (<https://creativecommons.org/licenses/by-nc/4.0/>)

Publisher: National Institute of Public Health NIH - National Research Institute

in health consequences already in childhood, but they also persist throughout life. That is why it is so important to develop healthy eating habits from early childhood, including appropriate consumption of vegetables and fruits [11].

The aim of this study was to assess the consumption of vegetables and fruits by children and adolescents with excess body weight and diagnosed dyslipidemia before participating in the nutritional intervention program.

MATERIAL AND METHODS

The study was conducted in 2019-2020 among 64 patients (including 44 boys and 20 girls) aged 8-16 diagnosed with overweight or obesity and dyslipidemia, living in Poland, in the Mazowieckie Voivodship. These were patients of the Children's Memorial Health Institute in Warsaw referred by a pediatrician to participate in the nutritional intervention program. Body weight was assessed based on body mass index (BMI) and compared with the BMI percentile charts in children and adolescents in Poland [12]. Overweight was defined as a BMI between 85th and 95th percentile, and obesity as >95th percentile for age and gender, as defined by the International Obesity Task Force (IOTF) [13]. Dyslipidemia was defined as the presence of at least 1 lipid abnormality, such as high total cholesterol (TC), high low-density lipoprotein (LDL-C), high triglycerides (TG), or low high-density lipoprotein cholesterol (HDL-C) according to the American College of Cardiology [14].

Patients were qualified to participate in the nutritional intervention program by a pediatrician based on a medical interview. Data regarding current and habitual food intake were collected and analyzed by a dietitian before the start of the program. The dietitian also provided dietary counseling and performed anthropometric measurements. To assess current food intake, a 3-day food record was used, with patients receiving a template and instructions for completing it. They were asked to carefully record all food they ate and drank on 2 weekdays and 1 day off from school before they began the nutritional intervention. On this basis, the amount (in grams) and sources of vegetables and fruits consumption, including raw products, processed products (e.g. cooked, fermented, canned) and juices, were analyzed [15]. The amounts of processed vegetables/fruits and juices were converted into raw products using appropriate conversion factors [16]. Then, the intake values were compared to the WHO recommendations set as a minimum 400 g of vegetables and fruits per day [2]. The amount of vegetables and fruits consumed was additionally presented per 1000 kcal of diet. Calculations of energy value from the food records were made by the dietitian

with the use of a table of nutritional value of food products and dishes [17]. Data on habitual food intake of products from 8 food groups, including vegetables and fruits, were also collected using the validated Food Frequency Questionnaire (FFQ-6) [18].

The study protocol was approved by the Ethics Committee of the Faculty of Human Nutrition and Consumer Science, Warsaw University of Life Sciences WULS, Poland (10p/2017, 17 May 2017). More details about the design and study are provided in the study protocol [19].

Statistical analysis

All statistical analyses were conducted using Statistica version 13.1 (Copyright©StatSoft, Inc., 1984–2014, Cracow, Poland).

The Shapiro-Wilk test was used to assess the normality of distributions. Nonparametric tests were used in statistical analyses due to the lack of normal distribution in groups. The Mann-Whitney U test was used to compare the amount of vegetables and fruits consumed by patients with overweight and patients with obesity. All quantitative data are expressed as mean \pm standard deviation (SD). The *Chi*-squared test was used to examine the relationship between qualitative variables. Statistical tests used for analysis are described separately in each data table. For all tests, $p < 0.05$ was considered significant.

RESULTS

The average age of the study participants was 12.78 ± 2.65 years. Patients with overweight constituted 44% ($n=28$) of the respondents, and 56% ($n=36$) were diagnosed with obesity. The average consumption of vegetables and fruits from all sources in the total study group was 593 ± 311 g per day. Table 1 shows the average consumption of vegetables and fruits in two groups of participants: patients with overweight and patients with obesity. Consumption was expressed separately for vegetables and fruits, together and per 1000 kcal of diet. No statistically significant differences were observed in the grams of vegetables and fruits consumed (for the whole diet) separately and together between patients with overweight and obesity ($p \geq 0.05$). Significant differences ($p < 0.05$) were noted after calculating the consumption per 1000 kcal of diet. Children and adolescents with obesity consumed more vegetables compared to overweight people (Table 1).

To assess the frequency of vegetables and fruits consumption, the criterion of eating them at least once a day or less often was adopted (Table 2). It was shown that vegetables were consumed at least once a day by only half of the respondents. Similarly in the case of fruits—4 out of 10 patients included it in their diet at least once a day. No significant differences were observed

in the frequency of vegetables and fruits consumption between patients with overweight and obesity. The vegetables most frequently chosen by children and adolescents were tomatoes and cucumbers, followed by root vegetables and leafy vegetables. Among the

fruits, these were primarily apples and pears, followed by berries and bananas.

Table 3 presents data on the consumption of different types of vegetables and fruits, including raw, processed and juices. For both vegetables and fruits,

Table 1. Consumption of vegetables and fruits by children and adolescents with overweight or obesity [mean \pm SD]

Products	Patients	Total (n=64)	Patients with overweight (n=28)	Patients with obesity (n=36)	p-value (Mann-Whitney U test)
Vegetables [g]		286 \pm 163	235 \pm 106	327 \pm 188	ns
Fruits [g]		306 \pm 199	305 \pm 170	308 \pm 223	ns
Vegetables and fruits [g]		593 \pm 311	540 \pm 177	635 \pm 382	ns
Vegetables per 1000 kcal of diet [g]		134 \pm 71	118 \pm 67	147 \pm 71	0.034
Fruits per 1000 kcal of diet [g]		145 \pm 97	147 \pm 71	143 \pm 114	ns
Vegetables and fruits per 1000 kcal of diet [g]		279 \pm 142	265 \pm 89	290 \pm 172	ns

ns – not significant ($p \geq 0.05$)

Table 2. Frequency of vegetables and fruits consumption by children and adolescents with overweight or obesity [% of participants]

Type of product	Patients	Total (n=64)	Patients with overweight (n=28)	Patients with obesity (n=36)	p-value (Chi-squared test)
Vegetables	Less than once a day	50	43	56	ns
	At least 1 time a day	50	57	44	
Fruits	Less than once a day	59	50	67	ns
	At least 1 time a day	41	50	33	

ns – not significant ($p \geq 0.05$)

Table 3. Types of vegetables and fruits consumed by children and adolescents with overweight or obesity [mean \pm SD]

Type of products	Patients	Total (n=64)	Patients with overweight (n=28)	Patients with obesity (n=36)	p-value (Mann-Whitney U test)
Raw vegetables [g]		157 \pm 107	96 \pm 94	205 \pm 92	<0.001
Processed vegetables [g]		120 \pm 135	134 \pm 114	110 \pm 149	0.032
Vegetable juices [g]		9 \pm 30	5 \pm 18	13 \pm 37	ns
Raw fruits [g]		236 \pm 183	194 \pm 76	263 \pm 234	ns
Processed fruits [g]		16 \pm 57	10 \pm 23	21 \pm 73	ns
Fruit juices [g]		62 \pm 105	101 \pm 134	32 \pm 64	0.026

ns – not significant ($p \geq 0.05$)

Table 4. Implementation of recommendations regarding the consumption of vegetables and fruits [% of participants]

Recommendations	Patients	Total (n=64)	Patients with overweight (n=28)	Patients with obesity (n=36)	p-value (Chi-squared test)
Consumption of at least 400 g of vegetables and fruits per day	Yes	84	93	78	ns
	No	16	7	22	
Greater participation in the implementation of recommendations	Vegetables	41	64	44	ns
	Fruits	59	36	56	

ns – not significant ($p \geq 0.05$)

patients consumed most raw products (58% and 75% of total intake, respectively). Among all vegetables, the share of processed products was almost 40% for the entire study group. Compared to patients with overweight, children and adolescents with obesity consumed more than twice as much raw vegetables and 2 times less processed vegetables (statistically significant differences). Significantly higher (over 3 times) consumption by participants with overweight was recorded for fruit juices ($p < 0.05$). In the case of vegetable juices, raw fruits and processed fruits, there were no statistically significant differences in their consumption between children and adolescents with overweight and obesity ($p \geq 0.05$).

Comparison of consumption with the recommendations showed that 8 out of 10 respondents consumed at least 400 g of vegetables and fruit per day (Table 4). In total, 41% of patients implemented the recommendations with a greater participation of vegetables than fruits, with no significant differences between children and adolescents with overweight and obesity ($p \geq 0.05$).

DISCUSSION

Consuming the recommended amount of vegetables and fruits is the main element of dietary recommendations necessary to maintain health, as well as used in the prevention and treatment of diet-related diseases [20]. They should be eaten every day and added to every meal, preferably raw, but also in the form of soups, salads or cocktails. Our study shows that 84% of children and adolescents with excess body weight and dyslipidemia met the WHO recommendations for vegetables and fruits consumption set at a minimum of 400 g per day. It also did not differ significantly between patients with overweight and obesity. However, analysis of the frequency of consumption showed that about half of the patients consumed vegetables and fruits less than once a day. Insufficient consumption of vegetables and fruits is also observed in children and adolescents from other age groups. It was noted among primary and lower secondary school students in Poland [21]. It was also shown that among lower secondary school students, 62% of boys and 56% of girls did not eat fruits every day, and 65% of boys and 58% of girls did not eat vegetables every day. Although Hetmańczyk et al. [22] showed that most children aged 10-15 ate vegetables and fruits at least once a day (94% and 95% of respondents, respectively). The problem of insufficient consumption of vegetables and fruits is also observed among secondary school students in Poland in other study [23]. The authors showed that less than half of young people confirmed eating vegetables and fruits several times a day. Similarly, among students

aged 16-19, 69% and 67% of respondents, respectively, consumed vegetables and fruits less frequently than every day [24]. Low intake of vegetables and fruits is also reported among younger children. In preschoolers, it was shown that almost 9 out of 10 children did not eat enough vegetables, and every third child did not eat enough fruits [25]. Insufficient consumption of vegetables and fruits is also observed among children and adolescents from other countries. The Health Behavior in School-aged Children (HBSC) conducted in 2021/2022 in 44 countries and regions shows that only 38% of students aged 11-15 consume vegetables and fruits every day, with higher consumption among girls. Moreover, it was shown that half of the surveyed adolescents did not eat vegetables or fruits every day [10], which was consistent with our results. Similarly, low consumption of vegetables and fruits is observed in the adult population. Analysis of vegetables consumption data from 162 countries shows that in 88% of countries their intake was below the recommended level of ≥ 240 g/day [26]. Many researchers also point out that the consumption of vegetables and fruits decreases with age of children [21, 25, 27]. This is disturbing because the older children and adolescents become, the greater their ability to make independent decisions regarding food choices. This may result from incorrect developing eating habits and indicate a great need for education both among children of all ages and their parents [28].

Recommendations for the consumption of vegetables and fruits define their total amount, generally indicating that there should be more vegetables [2, 3]. There is no consistency in the recommendations of different countries and scientific societies regarding the ideal proportion of vegetables and fruits. In our study, children and adolescents consumed a similar amount of vegetables and fruits (286 ± 163 g and 306 ± 199 g, respectively). This differs from the Healthy Eating Recommendations for the Polish population, which indicate that the diet should include more vegetables than fruits due to their lower content of simple sugars [3]. For many years, WHO has been drawing attention to the high intake of sugars in the diet, especially in children, which is one of the risk factors for the development of diet-related diseases [29]. According to the guidelines of the Committee of Human Nutrition Science of the Polish Academy of Sciences children aged 7-9 should consume 350 g of vegetables and 250 g of fruits per day [30]. In turn, the 2021 recommendations of the European Society of Cardiology regarding nutrition in the prevention of cardiovascular diseases [31] include information that it is recommended to consume ≥ 200 g of fruits per day ($\geq 2-3$ servings) and ≥ 200 g of vegetables per day ($\geq 2-3$ servings), as shown in this study. Different proportions have been established for hospital patients – it is

recommended to eat 430 g of vegetables and 300 g of fruits per day [32]. However, these recommendations were issued much earlier and, according to many specialists, they are difficult to implement.

Vegetables and fruits are a source of many valuable nutrients, but their content largely depends on the degree of processing of the product. Fresh vegetables and fruits are characterized by a larger volume and lower energy value compared to other products [5]. For this reason, they are especially important in ensuring satiety after a meal while providing fewer calories [33]. It is most recommended to eat raw vegetables and fruits due to the highest nutritional value [9]. In our study, most vegetables and fruits consumed by children and adolescents were raw. Recommendations in different countries are not consistent as to whether juices and processed vegetables and fruits should be included in the total amount of vegetables and fruits consumed. However, in most countries, these products are included, but it is suggested that they be limited in the diet [9]. According to the recommendations of the American Academy of Pediatrics, a maximum of 1 serving of fruits/vegetables can be replaced with 1 glass of juice in the diet of children and adolescents [34]. Juices are devoid of valuable dietary fiber and contain more simple sugars, which may result in a lack of satiety despite the intake of large amounts of calories [35]. Therefore, recommending them instead of fruits, especially among the pediatric population, is inconsistent with promoting healthy eating habits [34]. A meta-analysis of studies on the effects of regular juice consumption on body weight found that in children, each additional daily serving of 100% fruit juice was associated with an increase in BMI [35]. However, it seems that in adults, their moderate consumption does not increase the risk of obesity, type 2 diabetes or cardiovascular diseases [36].

Although the direct impact of vegetables and fruits consumption on body weight in children and adolescents is not clear, many researchers point to certain relationships. In children aged 6-7 and adolescents aged 13-14, it was observed that consuming vegetables and fruits at least three times a week was associated with a lower BMI compared to participants who declared eating them occasionally or not at all [37]. Among Polish youth aged 13-19, no relationship was observed between vegetables consumption and body weight, but teenagers with obesity most often declared regular fruits consumption [27]. Zalewska et al. [23] noticed that more than half of girls with overweight or obesity ate vegetables several times a day, but significantly less often than those with normal body weight. No such relationship was observed among boys.

Vegetables and fruits are as a source of valuable nutrients with anti-inflammatory effects. Many studies

have confirmed that regular consumption of vegetables and fruits reduces the risk of cardiovascular diseases and improve cardiometabolic parameters [26, 38]. Data from epidemiological studies indicate that a diet based on the principles of healthy eating, including a greater consumption of vegetables and fruit, contributes to a lower incidence of cardiovascular events [31]. Study among children and adolescents aged 5-19 years showed that moderate fruits consumption, approximately 150-300 g per day for 6-7 days a week, was associated with a reduced risk of dyslipidemia compared to those consuming fruits for 0-2 days a week [39]. In adolescents, an inverse relationship is also observed between vegetables and fruits consumption and systolic blood pressure, abdominal obesity, triglycerides, high-density lipoprotein cholesterol and metabolic syndrome [40]. The study assessed the consumption of vegetables and fruits among children and adolescents with excess body weight and the resulting dyslipidemia, which is one of the health consequences of excess body weight increasing the risk of cardiometabolic diseases [41].

This study has several limiting factors. First, a small study group that is not representative of the general population. However, it results from the sample size calculated for our intervention study, which included children and adolescents with excess body weight and resulting dyslipidemia. The calculated sample size is representative of our intervention study [19]. Another limiting factor is the research methods used. The 3-day food record method refers to the current food intake, which is only part of the overall diet. Its use carries the risk of inaccurate recording. Therefore, this method may be subject to underestimation or overestimation error. The latter situation seems more likely, especially in the case of healthy products such as vegetables and fruits. Patients participating in the program, perhaps wanting to make a better impression, may have overestimated their usual consumption of these products. The second method of data collection in the study was the use of the FFQ-6 questionnaire. Data collected using this method may be overestimated, and completing the survey is time-consuming and requires a lot of patient involvement. However, it is a proven, repeatable method that gives an overview of the entire diet. The use of two different methods of nutritional assessment (current and retrospective) is intended to verify the collected data and reduce the risk of error. It is worth bearing in mind that the assessment of human consumption is always subject to error, which is the sum of various errors, including those related to the method used, the researcher and the respondent, and accidental ones [42].

CONCLUSIONS

Most children and adolescents with excess body weight and dyslipidemia before participating in the nutritional intervention program consumed enough vegetables and fruits. The average consumption of vegetables and fruits was higher than the amounts recommended by WHO. It is necessary to conduct educational activities aimed at promoting the consumption of several portions of vegetables and fruits every day. While following the recommendations, patients should also pay attention to the share of vegetables and fruits in their diet.

Conflict of interest

The authors declare no conflicts of interest.

REFERENCES

- Wallace TC, Bailey RL, Blumberg JB, Burton-Freeman B, Chen CO, Crowe-White KM, et al. Fruits, vegetables, and health: A comprehensive narrative, umbrella review of the science and recommendations for enhanced public policy to improve intake. *Crit Rev Food Sci Nutr.* 2019;60(13):2174-2211. doi: 10.1080/10408398.2019.1632258.
- World Health Organization (WHO). Healthy diet – key facts [Internet]. 2020. [cited 2024 Oct 26] Available from: <https://www.who.int/news-room/fact-sheets/detail/healthy-diet>.
- National Institute of Public Health NIH – National Research Institute. Healthy Eating Recommendations [Internet]. 2020. [cited 2024 Oct 26] Available from: <https://ncez.pzh.gov.pl/wp-content/uploads/2021/03/Talerz-Zdrowego-Zywienia-Zalecenia-1.pdf>.
- Pal M, Molnár J. Growing importance of fruits and vegetables in human health. *International Journal of Food Science and Agriculture.* 2021;5(4):567-569. doi: 10.26855/ijfsa.2021.12.001.
- Abdul Hakim BN, Yahya H, Shahar S, Abdul Manaf Z. Influence of fruit and vegetable intake on satiety and energy intake: a review. *Sains Malaysiana.* 2018;47:2381-2390. doi: 10.17576/jsm-2018-4710-14.
- Bujtor M, Turner AI, Torres SJ, Esteban-Gonzalo L, Pariante CM, Borsini A. Associations of dietary intake on biological markers of inflammation in children and adolescents: a systematic review. *Nutrients.* 2021;13(2):356. doi: 10.3390/nu13020356.
- Aune D, Giovannucci E, Boffetta P, Fadnes LT, Keum N, Norat T, et al. Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality – a systematic review and dose-response meta-analysis of prospective studies. *Int J Epidemiol.* 2017;46(3):1029-1056. doi: 10.1093/ije/dyw319.
- Miller V, Mente A, Dehghan M, Rangarajan S, Zhang X, Swaminathan S, et al. Fruit, vegetable, and legume intake, and cardiovascular disease and deaths in 18 countries (PURE): a prospective cohort study. *Lancet.* 2017;390(10107):2037-2049. doi: 10.1016/S0140-6736(17)32253-5.
- EFSA NDA Panel. Scientific Opinion on the scientific advice related to nutrient profiling for the development of harmonised mandatory front-of-pack nutrition labelling and the setting of nutrient profiles for restricting nutrition and health claims on foods. *EFSA Journal* 2022;20(4):7259. doi: 10.2903/j.efsa.2022.7259.
- Rakić JG, Hamrik Z, Dzielska A, Felder-Puig R, Oja L, Bakalár P, et al. A focus on adolescent physical activity, eating behaviours, weight status and body image in Europe, central Asia and Canada: Health Behaviour in School-aged Children international report from the 2021/2022 survey [Internet]. World Health Organization. Regional Office for Europe; 2024. [cited 2024 Oct 26] Available from: <https://iris.who.int/handle/10665/376772>.
- Małachowska A, Jeżewska-Zychowicz M. Does examining the childhood food experiences help to better understand food choices in adulthood? *Nutrients.* 2021;13(3):983. doi: 10.3390/nu13030983.
- Kułaga Z, Rózdzyńska-Świątkowska A, Grajda A, Gurszkowska B, Wojtyło M, Gózdź M, et al. Percentile charts for growth and nutritional status assessment in Polish children and adolescents from birth to 18 year of age. *Stand Med Pediatr.* 2015;12:119-135.
- Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity world wide: international survey. *BMJ.* 2000;320(7244):1240-3. doi: 10.1136/bmj.320.7244.1240. doi: 10.1136/bmj.320.7244.1240.
- American College of Cardiology. 2018 Guideline on the management of blood cholesterol. *J Am Coll Cardiol.* 2018. doi: 10.1161/CIR.0000000000000625.
- Li M, Ho KKHY, Hayes M, Ferruzzi MG. The roles of food processing in translation of dietary guidance for whole grains, fruits, and vegetables. *Annu Rev Food Sci Technol.* 2019;10:569-596. doi: 10.1146/annurev-food-032818-121330.
- Wieczorek-Chełmińska Z. Principles of nutrition and applied dietetics. Warsaw: Wyd. PZWL; 1977.
- Kunachowicz H, Przygoda B, Iwanow K, Nadolna I. Tables of nutritional value of food products and dishes. Database – full version. National Institute of Public Health – National Institute of Hygiene, Warsaw, Poland, 2017.
- Wądołowska L, Niedźwiedzka E. Food Frequency Questionnaire with 6 answers. 2018 [Internet]. 2018. [cited 2024 Oct 26] Available from: <http://www.uwm.edu.pl/edu/lidiawadolowska/>.
- Bondyra-Wiśniewska B, Harton A. Effect of the nutritional intervention program on body weight and selected cardiometabolic factors in children and adolescents with excess body weight and dyslipidemia: study protocol and baseline data. *Nutrients.* 2023;15(16):3646. doi: 10.3390/nu15163646.
- Tian Y, Su L, Wang J, Duan X, Jiang X. Fruit and vegetable consumption and risk of the metabolic syndrome: a meta-analysis. *Public Health Nutr.* 2018;21(4):756-765. doi: 10.1017/S136898001700310X.

21. Wolnicka K, Jaczewska-Schuetz J, Taraszewska A, Charzewska J, Jarosz M. Częstość spożycia warzyw i owoców przez dzieci i młodzież w szkołach podstawowych i gimnazjach w Polsce [Frequency of consumption of vegetables and fruits by children and adolescents in primary and lower secondary schools in Poland]. *Żyw Człow Metab.* 2017;44(4):258-267.
22. Hetmańczyk M, Polaniak R, Brukało K, Grochowska-Niedworok E. Eating habits of children aged 10-15 years in reference to nutrition status. *International Journal of Medical and Health Sciences.* 2019;13(5), 202-205.
23. Zalewska M, Zakrzewska M, Zakrzewski M, Maciorkowska E. The consumption of vegetables and fruits by teenagers and their nutritional status. *Med Og Nauk Zdr.* 2021;27(1):60-64. doi: 10.26444/monz/133463.
24. Kocka K, Bartoszek A, Fus M, Rząca M, Łuczyk M, Bartoszek A, et al. School students' dietary habits and physical activity as a risk factor of the obesity. *Journal of Education, Health and Sport.* 2016;6(7):439-452. doi: 10.5281/zenodo.58452.
25. Harton A, Florczak J, Myszkowska-Ryciak J, Gajewska D. Fruit and vegetable consumption by preschool children. *Probl Hig Epidemiol.* 2015;96(4):732-736.
26. Kalmipourzidou A, Eilander A, Talsma EF. Global vegetable intake and supply compared to recommendations: a systematic review. *Nutrients.* 2020;12(6):1558. doi: 10.3390/nu12061558.
27. Myszkowska-Ryciak J, Harton A, Lange E, Laskowski W, Gajewska D. Nutritional behaviors of Polish adolescents: results of the Wise Nutrition – Healthy Generation Project. *Nutrients.* 2019;11(7):1592. doi: 10.3390/nu11071592.
28. Decyk-Chęcel A. Children's and adolescents' eating habits. *Probl Hig Epidemiol.* 2017;98(2):103-109.
29. World Health Organization. *Guideline: Sugars intake for adults and children.* Geneva: World Health Organization; 2015.
30. Weker H, Friedrich M, Zabłocka-Słowińska K, Sadowska J, Długosz A, Hamułka J, et al. Position paper on nutrition of children aged 4-6 years and 7-9 years of the Committee of Human Nutrition Science of the Polish Academy of Sciences. *Stand Med Pediatr.* 2023;20:481-503.
31. Visseren FLJ, Mach F, Smulders YM, Carballo D, Koskinas KC, Bäck M, et al. 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice. *Eur Heart J.* 2021;42(34):3227-3337. doi: 10.1093/eurheartj/ehab484.
32. Dzieniszewski J, Szponar L, Szczygieł B, Socha J, editors. *Scientific basis of nutrition in hospitals.* Warsaw: Instytut Żywności i Żywienia; 2001.
33. Majewska K, Kobylńska M, Tchorzewska-Skrobich M, Korcz-Iżykowska M, Kedzia A. Modyfikacje bilansu energetycznego w leczeniu otyłości u dzieci [Modifications of energy balance in the treatment of childhood obesity]. *Pie Pol.* 2020;75(1):57-63. doi: 10.20883/pielpol.2020.7.
34. Heyman MB, Abrams SA, Section on Gastroenterology, Hepatology, and Nutrition, Committee on Nutrition. Fruit juice in infants, children, and adolescents: current recommendations. *Pediatrics.* 2017;139(6):e20170967. doi: 10.1542/peds.2017-0967.
35. Nguyen M, Jarvis SE, Chiavaroli L, et al. Consumption of 100% Fruit Juice and Body Weight in Children and Adults: A Systematic Review and Meta-Analysis. *JAMA Pediatr.* 2024;178(3):237-246. doi:10.1001/jamapediatrics.2023.6124.
36. Ruxton CHS, Myers M. Fruit juices: are they helpful or harmful? An evidence review. *Nutrients.* 2021;13(6):1815. doi: 10.3390/nu13061815.
37. Wall C, Stewart A, Hancox R, et al. The ISAAC Phase Three Study Group Association between Frequency of Consumption of Fruit, Vegetables, Nuts and Pulses and BMI: Analyses of the International Study of Asthma and Allergies in Childhood (ISAAC). *Nutrients.* 2018; 10: 316. doi: 10.3390/nu10030316.
38. Angelino D, Godos J, Ghelfi F, Tieri M, Titta L, Lafranconi A, et al. Fruit and vegetable consumption and health outcomes: an umbrella review of observational studies. *Int. J. Food Sci. Nutr.* 2019;70(6), 652-667. doi: 10.1080/09637486.2019.1571021.
39. Liu J, Li Y, Wang X, Gao D, Chen L, Chen M, et al. Association between fruit consumption and lipid profile among children and adolescents: a national cross-sectional study in China. *Nutrients.* 2022;14(1):63. doi: 10.3390/nu14010063.
40. Collese TS, Nascimento-Ferreira MV, de Moraes ACF, et al. Role of fruits and vegetables in adolescent cardiovascular health: a systematic review. *Nutr Rev.* 2017;75(5):339-349. doi:10.1093/nutrit/nux002.
41. Sahoo K, Sahoo B, Choudhury AK, Sofi NY, Kumar R, Bhadoria AS. Childhood obesity: causes and consequences. *J. Fam.Med. Prim. Care.* 2015;4:187-192. doi: 10.4103/2249-4863.154628.
42. Gronowska-Senger A. *Methodological guide for dietary research.* Warsaw: Committee of Human Nutrition Sciences of the Polish Academy of Sciences, 2013.

Received: 04.11.2024

Revised: 06.12.2024

Accepted: 16.12.2024

Published online first: 13.02.2025