Family Medicine & Primary Care Review 2024; 26(1): 93–105, https://doi.org/10.5114/fmpcr.2024.134710

ORIGINAL PAPERS

ISSN 1734-3402, eISSN 2449-8580

Dietary patterns of children between the ages of 6–10 years from primary schools in Lesser Poland

JAŚMINA ŻWIRSKA[1, A, B, D–F], IZABELA BOLESŁAWSKA[2, A,D–F], PAWEŁ JAGIELSKI[1, C–E],
ORCID ID: 0000-0003-2001-3813 ORCID ID: 0000-0001-6780-3105 ORCID ID: 0000-0001-7583-8965
EWA BŁASZCZYK-BĘBENEK[1, D–F], JULIUSZ PRZYSŁAWSKI[2, E], RAFAŁ J. NOWAK[1, E], PAWEŁ KAWALEC[1, E]
ORCID ID: 0000-0003-0010-9009 ORCID ID: 0000-0001-9205-2817 ORCID ID: 0000-0002-0653-7664 ORCID ID: 0000-0002-0125-0947

[1] Department of Nutrition and Drug Research, Institute of Public Health, Faculty of Health Science, Jagiellonian University Medical College, Cracow, Poland
[2] Department of Bromatology, Poznan University of Medical Sciences, Poznan, Poland

A – Study Design, **B** – Data Collection, **C** – Statistical Analysis, **D** – Data Interpretation, **E** – Manuscript Preparation, **F** – Literature Search, **G** – Funds Collection

Summary **Background.** Knowledge of dietary patterns is crucial for dietary behaviours interventions.
Objectives. The aim of the study was to describe the dietary patterns of children between the ages of 6–10 years from primary schools in Lesser Poland.
Material and methods. The study was carried out between 2008–2012 and included 1,140 children and their parents. The questionnaire for parents included socio-economic questions about the family, parents' education and frequency of consuming selected food products by children. The Food Frequency Questionnaire covered 21 selected food groups, and fast food and snacking were also asked about. Based on anthropometric measurements, the body mass index (BMI) was calculated for each child. Factor analysis and cluster analysis were used to identify individual dietary patterns of children.
Results. Three cluster groups were distinguished showing the eating patterns of the children. Children from cluster 1 (healthy) showed the most health-promoting model of nutrition. They often consumed butter, vegetable oils, groats, pasta and rice, wholemeal bread, fish and fish products, red meat, eggs, raw vegetables, cooked vegetables, pulses, unsalted nuts and yellow cheese. The cluster representing the mixed feeding model (2) least frequently consumed salty snacks. Children from cluster 3 (unhealthy) more often consumed chips, crisps and salty sticks than cluster 2 and were more often overweight and obese than children from cluster 1. The education level and average monthly income were significantly higher in the families of children from the healthy cluster compared with those from the unhealthy cluster.
Conclusions. Dietary patterns in children are influenced by socio-economic and parental education factors. Overweight and obese children presented unhealthy nutrition behaviours.
Key words: child, schools, cluster analysis, nutritional status.

Żwirska J, Bolesławska I, Jagielski P, Błaszczyk-Bębenek E, Przysławski J, Nowak RJ, Kawalec P. Dietary patterns of children between the ages of 6–10 years from primary schools in Lesser Poland. *Fam Med Prim Care Rev* 2024; 26(1): 93–105, doi: https://doi.org/10.5114/fmpcr.2024.134710.

Background

The health status of the population is one of the main indicators reflecting the effectiveness of the health system. Prevention, as well as treatment from an early age, of excessive body weight is a crucial element in preventing metabolic disorders. Child health assessments, in the practice of GPs, aim, among other things, at the initial identification of developmental disorders and diseases and should include the prompt and effective implementation of actions before the child has serious health and social consequences. Appropriate education and promotion of healthy lifestyles, including healthy living habits, are of major significance.

Childhood is a critical period for child development. Inadequate nutrition during childhood and adolescence contributes to deficiencies in energy, nutrients, vitamins (B_{12}, D), protein and minerals, which can lead to impaired physical and mental growth, as well as impaired well-being [1]. Poor nutrition is also responsible for the early development of diet-related risk of chronic diseases such as cardiovascular disease, type 2 diabetes, cancer, obesity and osteoporosis [2]. Inappropriate dietary behaviours and choices during childhood are also an exponent of health in adulthood and are associated with the risk of chronic diseases such as obesity, cardiovascular disease, type 2 diabetes or some types of cancer [3]. Finally, eating behaviours in childhood play a key role in shaping future food choices, diet quality and weight status and are central to health-promoting eating habits [4].

Eating behaviours are affected by many different interrelated factors [5], including physiological, environmental, psychological, cultural, socio-economic and genetic factors. The complex interaction between them has not been fully understood so far [3]. In simpler terms, these factors are divided into economic and non-economic, as well as external and internal, factors [6]. In highly developed countries, such as Poland, some factors are of particular importance. They encompass environmental, psychological and socio-cultural factors, including education, occupation, lifestyle, customs, age, gender and place of residence [5]. Some investigators also reported the level of nutritional knowledge to influence food preferences [7]. Although not all factors influencing eating behaviour are modifiable, many of them can be shaped. The environment and food experiences have been consistently shown to be key in the development of children's eating behaviour. Furthermore, preferences formed early in life tend to persist into adulthood [8].

A major determinant of human eating behaviour is social modelling, in which people use the eating behaviour of others as a guide to what and how much they should eat [9]. During infancy and early childhood, children model dietary preferences and behaviours by watching their parents, who pass on both their genes and environment [4, 10]. Children reproduce the existing adult behaviours uncritically, especially at preschool age. For them, the family, and later the peer group, is a model of behaviour, including behaviours related to nutrition [11]. When starting school, children enter the stage of development that causes changes in lifestyle and diet. At this time, the child is very receptive and learns new behaviours by imitating others. This is when the school environment – teachers and peers – begins to play an equally important role as a parent [5]. Cruwys et al. [9] reported that modelling is enhanced when individuals wish to identify themselves with or perceive themselves as similar to a model and is at least partly mediated by behavioural imitation, which occurs without awareness.

Children's eating behaviour is known to be significantly related to the level of parental education and the family's financial capacity. A higher level of education and a higher family income are associated with a lower incidence of unhealthy dietary patterns [12]. Children in the first three grades of primary school show a slower rate of physical development. This is influenced by a sedentary lifestyle, which results in a reduced need for energy [13]. Proper nutrition protects against ischaemic heart disease, stroke, type 2 diabetes and some types of cancer. It consists in the consumption of a large amount of fruit and vegetables, fibre, foods containing unsaturated fatty acids, as well as limiting compound sugars and salt in the diet. Research indicates that consumption of fruit and vegetables in youth has a direct protective effect on the incidence of cancer. On the other hand, the easy availability of high energy-dense foods, rich in sugar, fat and salt, encourages food preferences that do not conform to dietary guidelines. This may promote excessive weight gain and obesity, as well as the development of other diet-related diseases [12]. Understanding eating patterns is critical to the design of interventions that address eating behaviours.

The aim of the study was to determine the relationships between dietary patterns according to food consumption and background characteristics, socio-economic status and nutrition of schoolchildren from the Myslenice district (mostly rural region south of Cracow). To the best of our knowledge, this was the first study aimed at identifying nutritional patterns in the nutrition of schoolchildren from Myslenice. Therefore, it is important to recognise inappropriate eating habits at this stage of life in order to reflect and intervene for health promotion and disease reduction throughout life. Considering the gap in literature on the subject, especially with regard to children between the ages of 6 to 10 years from such a region, the authors conducted a study in which the eating patterns of school-aged children were identified and related factors were assessed.

Objectives

The aim of this study was to describe dietary patterns based on the food intake of children between the ages of 6–10 years from primary schools in Lesser Poland.

Material and methods

The study was carried out in the Myslenice district and in Cracow between 2008 and 2012. It included primary school children between the ages of 6–10 years and their parents. The planned number of children covered by the survey (Myslenice district and Cracow city) was 3,350. A total of 2,280 questionnaires were returned. Differences between the planned and executed surveys result from unforeseen situations, such as floods in the Myslenice district. The place of residence of the children was not the same as the place where they attended school. The completed questionnaire had a variable number of answers as some parents did not answer all the questions. Therefore, the response percentages given refer to the number of answers given by parents in relation to a specific question. After removing incomplete questionnaires, a final total of 1,140 questionnaires from participants were included in the study (Figure 1).

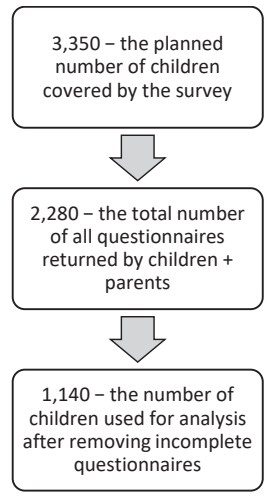

Figure 1. Flow diagram for study participants

The study in the Myslenice district was conducted upon the invitation of its administrative head as part of the Norwegian project "Possibilities of using non-budgetary funds in health promotion and obesity prevention on the example of the Myslenice district" co-financed by the EEA Financial Mechanism – priority 5 "Health care and child care" and the Myslenice District Office [14]. All the necessary consents were collected from the school headmasters and parents by the Department of Promotion and Health Protection in the Myslenice District Office. This department was also responsible for the medical segment of the project. In this case, the approval of the bioethics committee was not required as the research concerned the prevention and control of obesity-related risks within the framework of the Norwegian project. At the end of the Norwegian project in the Myslenice district, preparations were made to conduct the same research in Cracow. The study in Cracow was approved by the Bioethics Committee of the Jagiellonian University (No. KBET/94/B/2012) and was conducted after obtaining consent from the school management, as well as the legal guardians of the children and the children themselves. The study consisted of a questionnaire survey and anthropometric measurements. The questionnaire surveys were conducted among parents and children. Both in the Myslenice and Cracow districts, children who did not present consent from their parents were excluded. No children were excluded because of numerical limitations, and no children felt "inferior" or eliminated for reasons unknown to them.

Questionnaire surveys

The survey used a self-administered questionnaire developed for the study purpose – in line with current survey methodology. The questionnaires were administered with the involvement of school management, who helped pass them on to parents during class meetings or through the pupils. Teachers informed parents about the purpose and method of the survey. The questionnaire for parents included socio-economic questions about the family, parents and frequency of consuming selected food products by children. The children completed a questionnaire to find out how much they liked selected food products, but this part was not included in this paper due to the purpose of the study. Data from the questionnaires cov-

ered a two-year period, which precludes misinterpretation of the results related to the seasonality of product consumption. Questions on the frequency of consumption covered 21 selected food groups (groats, pasta, rice; wheat bread; whole meal bread; milk; white cheeses; yellow cheeses; yoghurts; fish and fish products; poultry; red meat; eggs; vegetable oils, margarine; butter; raw vegetables; cooked vegetables; raw fruit and fruit juices; legume seeds; nuts, unsalted; sweets; sugar; crisps, chips, salty sticks) and eight beverage groups (fruit and vegetable juices; milk; mineral water; black tea; compotes; fruit tea; carbonated beverages; green tea). Responses were obtained on a 6-point Likert food frequency scale [15]: (1 – does not eat, 2 – less often, 3 – once a month, 4 – 1–2 times a week, 5 – 3–4 times a week, 6 – every day) and a 4-point beverage frequency scale (1 – does not drink, 2 – less than 1 glass, 3 – 1–2 glasses, 4 – 3–5 glasses). In addition, parents were asked about their children's frequency of fast food consumption (response scale: 1 – does not eat, 2 – once a month, 3 – 2–3 times a month, 4 – once a week, 5 – more often) and snacking between meals (scale 1 – does not eat, 2 – less often, 3 – once a month, 4 – 1–2 times a week, 5 – 3–4 times a week, 6 – every day). The numerical data obtained in the study was transposed into numerical scales. A 2-point scale was used (1 – no, 2 – yes), along with a 4-point scale (average monthly income: 1 – less than 1,500 PLN, 2 – 1,500–2,999 PLN, 3 – 3,000–4,999 PLN, 4 – above 5,000 PLN), as well as a 5-point scale of material situation (1 – very bad, 2 – bad, 3 – neither good nor bad, 4 – good, 5 – very good).

Anthropometric measurements

Anthropometric measurements included body weight, height, percentage of body fat, as well as waist and hip circumference. They were performed only in children who did not object to the measurements and whose parents provided consent for participation. The measurements were taken in the nurse's office or in a designated room, separately for girls and boys. They were performed according to the recommendations of the Institute of Mother and Child [16, 17]. Body weight and percentage of body fat were measured using an electronic scale TANITA BF 556 with an accuracy of 0.1 kg. Waist and hip circumferences were measured with a measuring tape with a scale graduated to 1 mm. Finally, height was measured with a TANITA height gauge. Based on the results, body mass index (BMI) was calculated for each child. Body height, body weight and BMI were referred to centile grids developed according to the OLAF project [18]. A BMI exceeding the 95th centile defined for age and gender classified the child as obese, and a BMI between the 85th and 95th centiles as overweight. A BMI between the 15th and 85th centiles was considered normal. Body weight deficiency was defined as a BMI found for values between the 5th and below the 15th centiles. Finally, severe body weight deficiency was identified when the BMI was below the 5th centile [18].

Statistical analysis

For the purpose of statistical analysis, all data was coded in Excel 2010 and then imported into the statistical package, Statistica 10.0 PL (StatSoft). An α-value of 0.05 was adopted as the level of statistical significance. The numbers and percentages of people characterised by a given trait were used to describe the structure of the study population. Quantitative variables were presented using mean and standard deviation. Factor analysis and cluster analysis were employed to discern distinct dietary patterns rooted in the habits of children. This approach is increasingly gaining traction in research concerning the dietary behaviours of children and adolescents [19, 20]. Bronkowska [20] utilised the k-means clustering method to extract pertinent clusters, a technique commonly applied in nutritional research. This method involves reallocating objects between clusters to minimise intra-cluster variability while maximising inter-cluster variability. Consequently, various potential k averages are generated. The resultant clusters exhibit minimised internal variability and maximised external variability. The determination of cluster count (representing feeding patterns) was derived through reconciling outcomes from the analysis of variance. In cases of multiple possibilities, this reconciliation was based on the significant probability value obtained from the F-test [20]. The factor analysis was aimed to reduce the number of baseline variables and to identify and extract the main factors (Table 1). Questions about the frequency of consumption of specific foods were used as output variables. On the basis of Cattell's scree plot, 6 factors were set. The Jollitfe criterion was applied, and those components whose loads were greater than 0.7 were selected [21]. Out of the 6 factors, 5 were included in the cluster analysis – with a factor of 2 and 6, there were no products with a factor of more than 0.7. Using the cluster analysis, on the basis of the 5 factors extracted during the factor analysis, 3 cluster groups were then formed corresponding to the models of food consumption by the examined children. The factor analysis used the k-means algorithm, while the distance measure was Euclidean distance. To test for differences between the 3 groups for quantitative or qualitative variables, a Kruskal-Wallis ANOVA or chi-square test was used. Moreover, to determine the differences between the 3 clusters of parameters for which the significance of differences was shown ($p < 0.05$), post hoc tests were performed.

Table 1. Matrix of factor loadings obtained for individual factors after orthogonal Varimax rotation of the raw factors

Food products	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Groats, pasta, rice	0.23	0.05	0.05	-0.03	0.00	0.68
Wheat bread	-0.11	0.05	-0.04	**0.74**	0.07	0.02
Wholemeal bread	0.48	-0.02	0.15	-0.54	-0.03	0.03
Milk	0.20	-0.16	-0.02	0.32	0.38	-0.12
White cheeses	0.57	-0.07	0.10	0.14	0.24	-0.17
Yellow cheeses	0,45	-0.04	-0.05	0.19	0.14	0.10
Yoghurts	0.01	0.10	0.14	0.06	**0.73**	0.11
Fish and fish products	0.46	-0.02	0.03	0.07	-0.10	0.13
Poultry	0.01	0.00	-0.01	-0.06	0.27	0.58
Red meat	0.39	0.13	0.21	0.12	-0.09	0.15
Eggs	0.32	0.00	-0.02	0.11	-0.12	0.41
Vegetable oils, margarine	0.32	0.16	-**0.73**	0.10	-0.12	0.05
Butter	0.23	0.02	**0.81**	0.00	0.00	0.06
Raw vegetables	0.56	-0.02	-0.21	-0.15	0.09	-0.05

Table 1. Matrix of factor loadings obtained for individual factors after orthogonal Varimax rotation of the raw factors						
Food products	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**	**Factor 6**
Cooked vegetables	0.63	-0.08	-0.07	-0.07	-0.02	0.22
Raw fruit and fruit juices	0.41	0.18	-0.11	-0.15	0.43	-0.10
Legume seeds	**0.71**	-0.08	0.04	-0.08	-0.08	0.06
Nuts, unsalted	0.50	0.06	0.14	-0.35	0.04	0.13
Sweets	-0.10	0.62	0.15	-0.06	0.20	-0.06
Sugar	0.13	0.38	0.09	0.45	-0.36	-0.11
Crisps, chips, salty sticks	-0.03	0.68	-0.18	0.09	-0.09	0.21
How often do you eat fast food?	-0.12	0.60	-0.13	0.03	0.04	0.11
How often does the child snack?	0.02	0.59	-0.03	0.04	0.11	-0.28

Table 2. Characteristics of children's demographic features by gender				
Population characteristics	**General (*n*) %**	**Boys (*n*) %**	**Girls (*n*) %**	**Significance level (*p*)**
Age (Years) X ± SD	***n* = 1140**	***n* = 560**	***n* = 580**	*p* = 0.117
	8.72 ± 0.79	**8.68 ± 0.8**1	**8.76 ± 0.77**	
Place of residence	***n* = 1140**	***n* = 560**	***n* = 580**	*p* = 0.079
Village	(616) 54.1	(293) 52.3	(323) 55.7	
City	(308) 27.0	(146) 26.1	(162) 27.9	
Cracow	(216) 18.9	(121) 21.6	(95) 16.4	
Number of persons in the household X ± SD	***n* = 1123** 4.90 ± 1.66	***n* = 553** 4.76 ± 1.49	***n* = 570** 5.03 ± 1.80	***p* = 0.03**
Number of children in the family X ± SD	***n* = 1136** 2.42 ± 1.14	***n* = 557** 2.39 ± 1.09	***n* = 579** 2.45 ± 1.17	*p* = 0.425
Mother's education	***n* = 1132**	***n* = 554**	***n* = 578**	
Primary education	3.1	(19) 3.4	(16) 2.8	
Elementary vocational	(335) 29.6	(153) 27.6	(182) 31.5	
Secondary education	(362) 32.0	(164) 29.6	(198) 34.3	*p* = 0.056
Higher vocational	(71) 6.3	(36) 6.5	(35) 6.0	
Higher	(329) 29.0	(182) 32.9	(147) 25.4	
Mother's education X ± SD	3.29 ± 1.25	3.38 ± 1.29	3.20 ± 1.21	
Father's education	***n* = 1115**	***n* = 543**	***n* = 572**	
Primary education	(57) 5.1	(28) 5.2	(29) 5.1	
Elementary vocational	(500) 44.8	(234) 43.1	(266) 46.5	
Secondary education	(308) 27.6	(139) 25.6	(169) 29.5	*p* = 0.091
Higher vocational	(47) 4.2	(33) 6.1	(14) 2.4	
Higher	(203) 18.2	(109) 20.1	(94) 16.4	
Father's education X ± SD	2.86 ± 1.18	2.93 ± 1.22	2.79 ± 1.14	
Financial situation	***n* = 1110**	***n* = 546**	***n* = 564**	
Very bad	(1) 0.1	(1) 0.2	(0) 0.0	
Bad	(11) 1.0	(7) 1.3	(4) 0.7	
Neither good nor bad	(317) 28.6	(149) 27.3	(168) 29.8	*p* = 0.633
Good	(702) 63.2	(350) 64.1	(352) 62.4	
Very good	(79) 7.1	(39) 7.1	(40) 7.1	
Financial situation X ± SD	3.76 ± 0.59	3.77 ± 0.60	3.76 ± 0.58	
Average monthly income [PLN]	***n* = 943**	***n* = 457**	***n* = 486**	
Less than 1,500	(198) 21.0	(93) 20.4	(105) 21.6	
1,500-2,999	(454) 48.1	(211) 46.2	(243) 50.0	
3,000-4,999	(224) 23.8	(117) 25.6	(107) 22.0	*p* = 0.155
More than 5,000	(67) 7.1	(36) 7.8	(31) 6.4	
Average monthly income X ± SD	2.17 ± 0.84	2.21 ± 0.86	2.13 ± 0.82	
Number of hours a child spends at school X ± SD	***n* = 1102** 5.62 ± 1.04	***n* = 536** 5.64 ± 1.06	***n* = 566** 5.61 ± 1.02	*p* = 0.669

N – number of subjects, *n* – number of subjects in subgroup, X ± SD – mean ± standard deviation.

Results

Demographic characteristics of the studied children

Among the 1,140 children studied, there were 560 (49.1%) boys and 580 (50.9%) girls. The mean age of children was 8.72 ± 0.79 years (range, 6–10 years). More than half of them lived in the countryside (54.0%), 27.0% in the city, and only 19% in Cracow. Almost half of the children (47.3%) had at least one brother or sister, while 15.5% did not have any sibling. Most often, the families were composed of four persons (35.5%). The mean number of children per family was 2.42 ± 1.14. Mothers most often reported having secondary education (32.0%), followed by elementary vocational (29.6%) and primary education (3.1%). Among fathers, most had received basic vocational education (44.8%) and secondary education (27.6%), while the lowest proportion reported receiving higher vocational education (5.1%). The material situation of the family was reported as good by 63.2% of the respondents. The average monthly income of the family was reported to be below 1,500 PLN by 21% of responders, to be between 1,500 and 2,999 PLN by 48.1%, and to exceed 3,000 PLN, by 30.9%. Children usually spent 5 hours at school (55.4%). The demographic characteristics of the study group are presented in Table 2.

The distribution of BMI in children according to gender is shown in Figure 2. Weight deficiency was reported in 9.8% of the children (10.3% of boys and 9.20% of girls) (BMI between 5th and 25th percentile), while severe weight deficiency in 4.40% (BMI < 5th percentile). The majority of the children (65.9% of boys and 67.8% of girls) had a BMI within the normal range (BMI between 15th–85th percentile). A small proportion of children were overweight and obese (5.6%). The differences in BMI distribution between boys and girls were not significant (p = 0.9778).

Cluster analysis

On the basis of the factor analysis conducted for the frequency of consumption of specific foods, five groups of food products with high load (above 0.7) were distinguished: the frequency of consumption of wheat bread; yogurts; vegetable oils or margarine; butter; legume seeds (Table 1). Based on the 5 factors extracted during the factor analysis, the cluster analysis was then used to create 3 cluster groups corresponding to the food consumption patterns of the studied children. These clusters are illustrated in Figure 3.

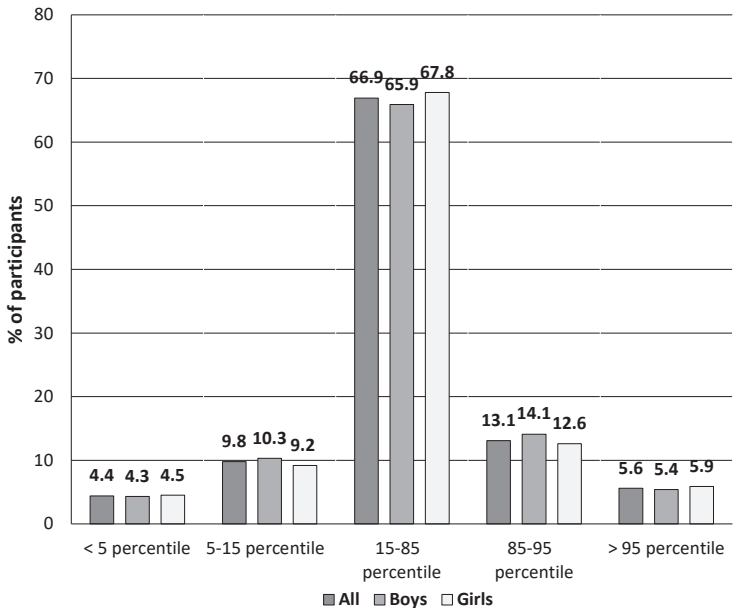

Figure 2. Distribution of children's BMI according to gender

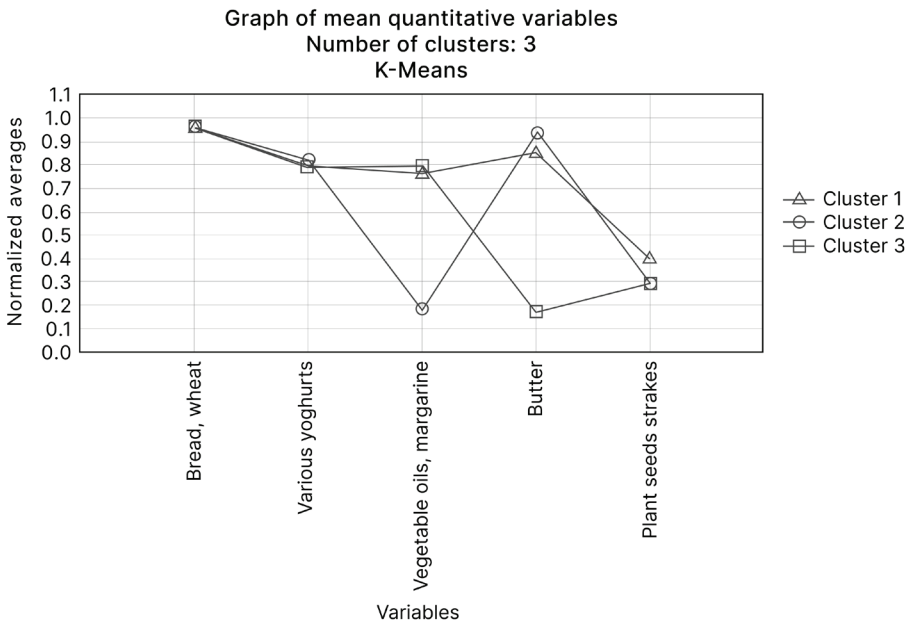

Figure 3. Quantitative variables for products selected after factor analysis by dietary cluster

Compared with children from clusters 2 and 3, those from cluster 1 (healthy eating pattern), representing 48.1% of the surveyed population, more often consumed groats, pasta and rice, wholemeal bread, fish and fish products, red meat, eggs, raw vegetables, cooked vegetables, pulses and unsalted nuts, yellow cheese, vegetable oils and margarine, and less often butter. In addition, children from cluster 1 more often consumed chips, crisps and salty sticks than children from cluster 2 and more often consumed white cheese and raw fruit than children from cluster 3. Children from cluster 2 (mixed feeding model), representing 21.7% of the study population, least frequently consumed chips, crisps and salty sticks. Moreover, they consumed vegetable oils and margarines less frequently, while butter more frequently, than children from cluster 3. The frequency of consumption of other products was similar for children from clusters 2 and 3. Children from cluster 3 (an unhealthy eating pattern) more often consumed chips, crisps and salty sticks than children from cluster 2. This cluster represented 30.2% of the study population. As for beverage consumption, children from the healthy cluster (1) drank black tea and compote significantly more often than children from mixed feeding model cluster (2), while children from the unhealthy cluster (3) drank mineral water less often than those from the healthy and mixed feeding model clusters. The results are presented in Table 3.

Children from the healthy cluster (1) came from families with a similar level of parental education and a similar average monthly income as children from the mixed feeding model cluster (2). However, the education level and average monthly income was significantly higher in the families of children from the healthy cluster (1) compared to those from the unhealthy cluster (3). The material situation was rated highest by parents of children from cluster 2. On the other hand, parents of children from the unhealthy cluster (3) had the lowest education level and the lowest average monthly income. Children from the unhealthy cluster (3) came from families with the highest number of people in the household, while children from the mixed feeding model cluster (2), from families with the lowest number of children in the family. The results are presented in Table 4.

Table 3. Frequency of consumption of food items of respondents by dietary cluster

Food products *	Nutritional focus			Significance level (*p*)
	Cluster 1 X ± SD *n* = 465	Cluster 2 X ± SD *n* = 210	Cluster 3 X ± SD *n* = 292	
Groats, pasta, rice	4.61 ± 0.69[b,c]	4.39 ± 0.73[a]	4.36 ± 0.75[a]	**< 0.0001**
Wheat bread	5.78 ± 0.63	5.80 ± 0.72	5.85 ± 0.56	0.189
Wholemeal bread	3.09 ± 1.58[b,c]	2.61 ± 1.59[a]	2.32 ± 1.42[a]	**< 0.0001**
Milk	5.29 ± 1.18	5.20 ± 1.30	5.22 ± 1.18	0.574
White cheeses	3.75 ± 1.28[c]	3.47 ± 1.35	3.32 ± 1.32[a]	**< 0.0001**
Yellow cheeses	4.37 ± 1.20[b,c]	3.86 ± 1.35[a]	3.89 ± 1.33[a]	**< 0.0001**
Yoghurts natural or flavoured	5.01 ± 0.92	5.13 ± 0.93	4.93 ± 1.02	0.097
Fish and fish products	3.71 ± 0.81[b,c]	3.33 ± 1.06[a]	3.32 ± 0.99[a]	**< 0.0001**
Poultry	4.30 ± 0.59	4.31 ± 0.60	4.27 ± 0.67	0.99
Red meat	3.68 ± 0.92[b,c]	3.39 ± 1.12[a]	3.26 ± 1.15[a]	**< 0.0001**
Eggs	4.15 ± 0.73[b,c]	3.79 ± 1.10[a]	3.80 ± 0.95[a]	**< 0.0001**
Vegetable oils, margarine	4.83 ± 0.83[b,c]	1.92 ± 0.80[a,c]	5.00 ± 1.49[a,b]	**< 0.0001**
Butter	5.26 ± 0.86[b,c]	5.70 ± 0.77[a,c]	1.87 ± 0.82[a,b]	**< 0.0001**
Raw vegetables (vegetable juices)	4.29 ± 1.38[b,c]	3.67 ± 1.61[a]	3.69 ± 1.50[a]	**< 0.0001**
Cooked vegetables	4.28 ± 1.34[b,c]	3.49 ± 1.57[a]	3.64 ± 1.57[a]	**< 0.0001**
Raw fruit and fruit juices	5.43 ± 0.80[c]	5.22 ± 0.98	5.22 ± 0.98[a]	**0.003**
Legume seeds	2.98 ± 1.08[b,c]	2.47 ± 1.10[a]	2.41 ± 1.06[a]	**< 0.0001**
Nuts, unsalted	2.65 ± 1.13[b,c]	2.29 ± 1.09[a]	2.10 ± 1.01[a]	**< 0.0001**
Sweets	5.05 ± 0.85	5.01 ± 0.94	5.00 ± 0.92	0.846
Sugar	5.52 ± 1.14	5.25 ± 1.43	5.33 ± 1.43	**0.028**
Crisps, chips, salty sticks	3.59 ± 1.16[b]	3.37 ± 1.16[a,c]	3.71 ± 1.14[b]	**0.003**
Milk	2.65 ± 0.68	2.60 ± 0.71	2.54 ± 0.67	**0.077**
Black tea	2.55 ± 0.90[b]	2.35 ± 0.94[a]	2.45 ± 0.94	**0.028**
Green tea	1.15 ± 0.44	1.11 ± 0.39	1.10 ± 0.36	**0.226**
Fruit tea	2.19 ± 0.88	2.03 ± 0.88	2.11 ± 0.85	**0.08**
Fruit and vegetable juices	2.66 ± 0.76	2.62 ± 0.82	2.64 ± 0.68	**0.865**
Compotes	2.23 ± 0.77[b]	2.05 ± 0.79[a]	2.20 ± 0.81	**0.023**
Carbonated drinks	1.61 ± 0.71	1.65 ± 0.72	1.69 ± 0.70	**0.223**
Mineral water	2.59 ± 0.93[c]	2.63 ± 0.94[c]	2.34 ± 0.99[a,b]	**0.001**

X ± SD – mean ± standard deviation, N – number of children; *Drinking frequency scale: 1 – does not eat, 2 – less often, 3 – once a month, 4 – 1–2 times a week, 5 – 3–4 times a week, 6 – every day. Drinking frequency scale: 1 – does not drink, 2 – less than 1 glass, 3 – 1–2 glasses, 4 – 3–5 glasses; a – statistically significant difference with cluster 1, b – statistically significant difference with cluster 2, c – statistically significant difference with cluster 3.

Table 4. Sociological characteristics of the respondents by dietary clusters				
Population characteristics	**Cluster 1 (*n*) %**	**Cluster 2 (*n*) %**	**Cluster 3 (*n*) %**	**Significance level (*p*)**
Gender	***n* = 465**	***n* = 210**	***n* = 292**	
Boys	(234) 50.3	(103) 49.0	(137) 46.9	0.66
Girls	(231) 49.7	(107) 51.0	(155) 53.1	
Place of residence	***n* = 461**	***n* = 209**	***n* = 289**	
Rural	(258) 56.0	(97) 46.4	(197) 68.2	**< 0.0001**
City	(106) 23.0	(62) 29.7	(65) 22.5	
Cracow	(97) 21.0	(50) 23.9	(27) 9.3	
Number of persons in the household X ± SD	***n* = 460** 4.91 ± 1.70	***n* = 209** 4.62 ± 1.55[c]	***n* = 288** 5.09 ± 1.64[b]	**0.002**
Number of children in family X ± SD	***n* = 465** 2.45 ± 1.21[b]	***n* = 209** 2.22 ± 0.98 [a,]	***n* = 292** 2.46 ± 1.06[b]	**0.008**
Mother's education	***n* = 464**	***n* = 209**	***n* = 292**	
Primary education	(14) 3.0	(2) 1.0	(12) 4.1	
Elementary vocational	(114) 24.6	(49) 23.4	(107) 36.6	**< 0.0001**
Secondary education	(152) 32.8	(53) 25.4	(97) 33.2	
Higher vocational	(30) 6.5	(16) 7.7	(18) 6.2	
Higher	(154) 33.2	(89) 42.6	(58) 19.9	
Mother's education X ± SD	3.42 ± 1.26[c]	3.67 ± 1.27[c]	3.01 ± 1.18[a,b]	
Father's education	***n* = 454**	***n* = 206**	***n* = 289**	
Primary education	(20) 4.4	(5) 2.4	(26) 9.0	
Elementary vocational	(180) 39.6	(76) 36.9	(154) 53.3	
Secondary education	(133) 29.3	(58) 28.2	(69) 23.9	**< 0.0001**
Higher vocational	(24) 5.3	(9) 4.4	(9) 3.1	
Higher	(97) 21.4	(58) 28.2	(31) 10.7	
Father's education X ± SD	3.00 ± 1.22[c]	3.19 ± 1.27[c]	2.53 ± 1.07 [a,b]	
Financial situation	***n* = 461**	***n* = 205**	***n* = 285**	
Very bad	(0) 0.0	(1) 0.5	(0) 0.0	
Bad	(5) 1.1	(1) 0.5	(1) 0.4	
Neither good nor bad	(134) 29.1	(35) 17.1	(98) 34.4	**< 0.0001**
Good	(294) 63.8	(143) 69.8	(172) 60.4	
Very good	(28) 6.1	(25) 12.2	(14) 4.9	
Average monthly family income X ± SD	***n* = 389**	***n* = 171**	***n* = 250**	**< 0.0001**
	2.26 ± 0.84[c]	2.33 ± 0.86[c]	2.00 ± 0.80 [a,b]	

N – number of individuals, *n* – number of individuals, X ± SD – mean ± standard deviation; average monthly income: 1 – less than 1,500 PLN, 2 – 1,500–2,999 PLN, 3 – 3,000–4,999 PLN, 4 – above 5,000 PLN; a – statistically significant difference with cluster 1, b – statistically significant difference with cluster 2, c – statistically significant difference with cluster 3.

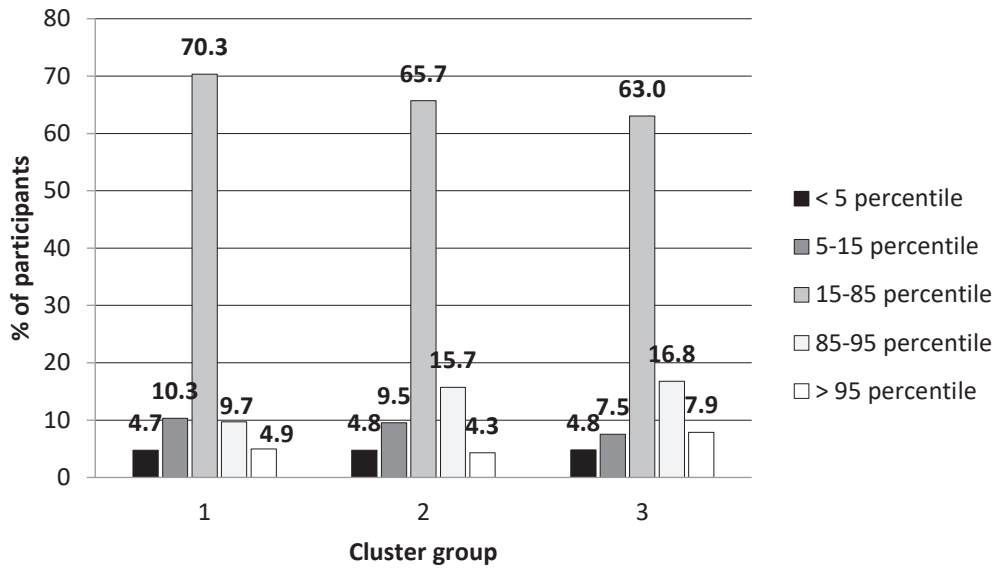

Figure 4. Nutritional status of children by cluster

Table 5. Anthropometric data of children and parents by dietary cluster				
Anthropometric data	Nutritional focus			
	Cluster 1 X ± SD *n* = 465	Cluster 2 X ± SD *n* = 210	Cluster 3 X ± SD *n* = 292	Significance level (*p*)
Mother's BMI [kg/m^2]	23.34 ± 3.24	22.92 ± 2.78	23.82 ± 3.90	0.17
Father's BMI [kg/m^2]	26.49 ± 3.02	26.58 ± 2.94	26.73 ± 3.03	0.724
Child's height [cm]	133.63 ± 7.15	133.50 ± 6.88	133.97 ± 6.51	0.674
Child's body weight [kg]	30.56 ± 7.20	30.81 ± 6.73	31.53 ± 7.11	0.089
Child's BMI [kg/m^2]	3.00 ± 0.77^c	3.05 ± 0.78	3.15 ± 0.85^a	**0.012**

X ± SD – mean ± standard deviation, *n* – number of children; a – statistically significant difference with cluster 1, b – statistically significant difference with cluster 2, c – statistically significant difference with cluster; BMI: 1 – below 5th centile, 2 – between 5 and 15, 3 – between 15 and 85, 4 – between 85 and 95,5 – above 95.

The nutritional status of children from the healthy cluster (1) according to BMI was not significantly different from that of children from the mixed feeding model cluster (2), but it was significantly lower than that of children from the unhealthy cluster (3). Children from the unhealthy cluster (3) were more often overweight and obese compared to children from the healthy cluster (24.7% and 14.6% of children, respectively). There were no significant differences in BMI of the mothers and fathers of the studied children depending on the cluster (Table 5, Figure 4).

Discussion

Our study group consisted of early-school children between the ages of 6 and 10 years, when eating behaviour changes due to the increasing influence of peers, teachers and media but is still strongly shaped by the family home [5]. The vast majority of the examined children lived in rural areas. In our study, most families consisted of four members, and almost half of the children had at least one brother or sister. Mothers most often declared having secondary education, least often primary education. Fathers, on the other hand, most often had a basic vocational education and least often higher vocational education. The vast majority of parents described their family's financial situation as good, although in almost two-thirds of families, the monthly income did not exceed PLN 2,999.

In a self-reported study among children from southern Poland, three cluster groups characterised by a different consumption pattern were distinguished and named the healthy cluster (1), mixed feeding model cluster (2) and unhealthy cluster (3). The most numerous healthy cluster (almost half of the respondents) were children who often consumed both butter and vegetable oils. Compared with children from the mixed model cluster and unhealthy cluster, these children more often consumed health-promoting products such as groats and rice, wholemeal bread, fish and fish products, eggs, raw vegetables, cooked vegetables, pulses and unsalted nuts. A high intake of fish and nuts was observed in the healthy cluster, too. On the other hand, healthy cluster children revealed a higher intake of pasta, red meat and yellow cheese than children in the mixed feeding model cluster and unhealthy cluster. The frequency of intake of most of the products analysed between the mixed feeding model cluster and unhealthy cluster showed no significant differences, except for the highest frequency of butter intake and the lowest frequency of vegetable oil and margarine intake, as well as crisps, chips and salty sticks among children from the mixed feeding model cluster. In contrast, children from the unhealthy cluster consumed crisps, chips and salty sticks most frequently and mineral water least frequently. The frequency of consumption of fish, whole-grain bread, eggs, all types of fruit and vegetables, pulses and nuts in the mixed feeding model cluster and unhealthy cluster was similar but lower than in the healthy cluster. Children from the healthy cluster and mixed feeding model came from families with a similar level of parental education and average monthly income but were at a higher level when compared to the families of children from the unhealthy cluster. Children from the mixed feeding model cluster came from families with the smallest number of children in the family and the highest rating of material situation. On the other hand, parents of children from the unhealthy cluster had the lowest education level, the lowest average monthly income and the highest number of people in the household, which translated into the least health-promoting eating behaviour.

In our study, weight deficiency affected 10% of the children and severe weight deficiency affected 4.40% of the participants. A small percentage of children were also overweight and obese, which is consistent with other observations showing that the prevalence of obesity in Poland varies between 2.5% and 12% for children and adolescents depending on the region [22]. The majority of children in our study (over 65% of boys and girls) had normal BMI. The nutritional status was similar in children from the healthy cluster and mixed feeding model cluster, and BMI was significantly lower than that of children from the unhealthy cluster, where the percentage of overweight and obese children was almost twice as high as in the healthy cluster.

Place of residence is a factor that strongly differentiates the dynamics and structure of household income and expenditure in Poland. In 2019, the average monthly disposable income per person in households was higher by almost 30% in urban areas than in rural areas [23]. According to a 2012 report by the Central Statistical Office, food consumption is strongly related to the place of residence. A study comparing high-income urban (Warsaw) with low-income rural areas found that dietary habits were better in rural areas [24]. In contrast to the above reports, the place of residence did not appear to determine the consumption of specific food groups during childhood and adolescence [25].

Numerous studies indicated a relationship between the eating behaviour of children at early-school age and the level of parental education. The higher the level of education reported by parents, the less frequent the irregularities in diet. Food intake is also shaped by the financial capacity of the family, and a higher income level is an important factor influencing dietary behaviour [12]. It provides an opportunity to choose products recommended as part of a healthy diet, such as fish and fruit or fruit juices, which are generally expensive. In the socio-economic Polish setting, income and prices were reported among the most important factors shaping food consumption [23].

Obesity in children is a serious threat to public health worldwide, including Poland [26, 27]. The condition results from complex interactions between biological, behavioural, social, environmental and economic factors, which can result in a positive energy balance [28]. In the United States, more than two thirds of adults and one third of children are overweight or obese. In Poland, a growing trend for overweight and obesity among children has also been observed [29]. Malnutrition is another

serious problem. Although the prevalence of malnutrition has significantly decreased over the past 30 years, it remains the leading cause of disease and death among children worldwide, especially in low- and middle-income countries [30]. The prevalence of obesity in Poland varies between 2.5% and 12% of children and adolescents depending on the region [22]. Comparison with the results of other studies is challenging due to variations in sample size and the criteria used to define overweight and obesity among children in Poland. Some researchers utilise centile grids created by the Institute of Mother and Child or regional grids to evaluate nutritional status, while others adhere to the criteria set forth by the International Obesity Task Force (IOTF). In 2007, the OLAF study, conducted by the Children's Health Centre on a representative sample of Polish children and adolescents between the ages of 7–18 years, revealed that based on IOTF criteria, 14% of girls and 18% of boys were classified as overweight or obese, and a total of 12% were categorised as underweight (10% for boys and 13.7% for girls). The study also indicated that within the 9-year-old age group, the combined prevalence of overweight and obesity was 22% for boys and 10.6% for girls. Furthermore, it reported a higher incidence of excess body weight among boys and noted a greater prevalence of excess body weight in larger cities [31, 32]. Available research showed [33] that obesity is most prevalent in families with many children. In other countries, this effect can be neutralised as families are able to engage children in extracurricular sport activities. In Poland, unemployment has a significant impact on family finances. Families with a limited budget often decide to buy new clothes, food and household items and limit spending on education and recreation.

Eating habits can be related to the health and behaviour of young people. In the present study, the cluster analysis was used to show the dietary patterns of the studied children. Unlike in the study by Potempa-Jeziorowska et al., where the number of fruit/vegetables consumed was shown to increase with BMI among 10-year-old boys [34], in our study, lower BMI was associated with higher fruit and vegetable intake (healthy cluster). Similar results were obtained by Basiak-Rasała et al. – children with obesity consumed vegetables significantly less often than very lean, slim and normal-weight children [35]. A study by Justamente et al. also found that obese children were more likely to consume less fruit and vegetables [36]. A study by Wall et al. in adolescents (13–14 years) and children (6–7 years) confirmed that adolescents who consumed fruit and vegetables three or more times a week had a lower BMI than the group the never or occasionally consumed fruit and vegetables [37].

The study encompassed 1,643 children between the ages of 7–12 years attending primary schools in the Biala Podlaska county. Among these children, fruits and vegetables were the most frequently consumed items between main meals, with 51% of girls and 42.4% of boys opting for these choices [38].

Lower BMI (in the healthy cluster) was also associated with increased consumption of whole-grain bread. Dark bread, which provides dietary fibre along with numerous minerals and vitamins, is not consumed frequently enough by schoolchildren. The study by Basiak-Rasała et al. and also found a negative correlation between BMI and frequency of wholemeal flour bread consumption in 10-year-old girls [35]. The study by Dolipska et al. found that only 17.49% of primary school students reported eating wholemeal bread more than once a day [39]. Bielaszka et al. [40] demonstrated that only 8% of children consume dark bread daily, while 49% consume it less than a few times a week. An examination of children's preferences for dark bread revealed that 20% of them do not enjoy it, a sentiment echoed by 33% of parents. Conversely, an almost equal proportion of children (21%) reported a strong liking for dark bread, a sentiment shared by 14% of parents. A lack of consumption of dark bread was reported by 29% of the participants. In the study by Potempa-Jeziorowska et al., a notable 20.6% of respondents indicated their children consume brown bread several times a week, whereas 19.9% reported that their child never eats brown bread [34].

Children with the lowest BMI (healthy cluster) had the highest frequency of consumption of fish, eggs and nuts. Fish is an important source of high-quality protein, vitamins A (retinol), D and E, iodine, selenium and fat, particularly n-3 long-chain polyunsaturated fatty acids. There is also growing evidence that fish consumption is beneficial for development and learning in children, supports vision and eye health and protects against cardiovascular disease and some types of cancer [41]. Unfortunately, fish consumption is very low in Poland [42]. More than half of the children in the study conducted by Potempa-Jeziorowska et al. consume fish once a week, while approximately 30% consume it even less frequently [34]. Another health-promoting food is eggs. A number of biological effects have been associated with egg components, including antimicrobial, antiadhesion, immunomodulatory, anticancer, antihypertensive and antioxidant activities [43]. They contain protease inhibitors, nutrients and functional lipids, which highlights the importance of its consumption for human health, as well as disease prevention and treatment [44]. Higher egg consumption was negatively associated with a reduced chance of being metabolically unhealthy obese (MUO) in overweight/obese adolescents, especially in boys and overweight individuals [45]. In addition, the use of satiety-inducing foods, such as eggs, can improve adherence to a calorie-restricted diet in children and improve outcomes. The use of eggs for breakfast in 8–12-year-old children resulted in moderate weight loss [46]. A study by Wall et al. found that adolescents who consumed nuts three or more times a week had a lower BMI than the group describing their consumption as never or occasionally. Consuming nuts three or more times a week was associated with a statistically lower BMI than in the never group [37]. Although nuts are a high-calorie food, they contain fatty acids, plant proteins, fibre, vitamins, minerals, carotenoids and phytosterols with potential antioxidant effects [47]. Therefore, the high levels of nut consumption found in children in our study seems to be beneficial.

A high frequency of legume consumption (three or more times per week) was associated with lower BMI [37], similar to our study. Pasta, red meat and yellow cheese are not recommended in the diet due to their association with an elevated risk of developing diet-related diseases, including obesity. Interestingly, in our study, children with the lowest BMI had the highest intake of red meat, yellow cheese and pasta compared to the other two clusters. Snack consumption has been identified as a potential contributor to overweight and obesity in children and may play a particularly important role among children from socio-economically disadvantaged households, which generally have higher rates of obesity [48]. The unhealthy cluster identified in our study was characterised by a high prevalence of consumption of salty snacks, chips and salty sticks. Crisps, extruded corn-based snacks and other savoury snacks are very popular, especially among the younger generation. However, these products can be a potential source of acrylamide, a toxic compound that can be formed during frying and baking processes [49]. Research showed that consumption of crisps was associated with higher levels of anxiety, depression and emotional distress, as well as somatic symptoms, cognitive difficulties and fatigue, compared to fruit consumption [50]. Surprisingly, a study by Walsh et al. found that neither salty nor sweet snack consumption was significantly associated with children's weight status, after accounting for demographic and household factors [48]. Other studies have also found no association between snacking on salty or sweet snacks and BMI [51–53]. Although sugar is known to adversely affect the development of obesity, our study found that the group of children with the lowest BMI consumed sugar most frequently compared to the other separate groups. The results of other studies also remain controversial. Studies on total, added or free sugars, depending on the definition chosen, were inconclusive regarding their impact on body

weight in children and adolescents [54–56]. A literature review indicated that about 40–60% of adolescents drink fruit juices and sweetened drinks on a daily basis. It is important to note that increasing the intake of water and drinks is one of the most important health-promotion activities [57]. A statistically significant positive correlation was found between BMI and frequency of mineral water drinking in 9-year-old girls [35]. Our study shows that the highest frequency of mineral water intake was seen in the healthy cluster, to which children with the lowest BMI belonged, while children from the unhealthy cluster (highest BMI) had the lowest frequency of water drinking.

In a self-reported study among children from southern Poland, the dietary patterns that emerged were related to the type of fats consumed. Similarly, the Donald study (Dortmund Nutritional Anthropometric Longitudinally Designed Study) in children and adolescents between the ages of 2 to 18 years found four clusters with different patterns of percentage energy content from fat [58]. Significant differences in mean intake of food groups between groups were found only for Meat/Fish/Egg and Fats/Oils (highest intake in clusters with constant and high fat intake) and Fruit/Vegetables (highest intake in low and medium fat intake groups). Among Chinese children between the ages of 7–17 years participating in the China Health and Nutrition Survey (CHNS), three dietary patterns were identified: modern (high intake of milk, fast food and eggs), traditional northern (high intake of wheat, tubers and other cereals) and traditional southern (high intake of vegetables, rice and pork). Children with a modern dietary pattern and a traditional northern dietary pattern had a higher risk of obesity [59]. The type of food consumed by children affected the amount and type of dietary fat in the diet of children between the ages of 6–11 years from the Kostecka study [60].

As indicated in the cluster analysis of the Geraets and Heinz study, among adolescents, positive health and behaviour are linked to healthy eating habits, while health issues are associated with unhealthy eating habits. Furthermore, unhealthy eating behaviour is correlated with risky conduct during adolescence [61]. The goal of the study by Northstone et al. was to establish dietary patterns using cluster analysis for children participating in the Avon Longitudinal Study of Parents and Children at the ages of 7, 10 and 13. The outcomes of this cited study demonstrated that maternal education exerted the most significant influence on remaining within the healthy cluster – children whose mothers possessed the highest level of education were nine times more likely to persist in that cluster compared to those with the lowest level of education [62]. Data gathered from 2,765 adolescents between the ages of 13–15 years, drawn from the Slovak segment of the Health Behaviour in School-Aged Children (HBSC) study, revealed the frequent occurrence of unhealthy eating habits among adolescents. Additionally, parental rule-setting pertaining to eating was connected to the eating behaviours of adolescents. Lack of parental rule-setting on eating is associated with a wide range of adolescent unhealthy eating behaviours, both for boys and girls [63]. This confirms previous observations on the relationship between parental education and the financial situation of the family and eating behaviour. Considering the irregularities in the diet of children between the ages of 6–10 years, there is an ongoing need for education of both children and parents. Not following the principles of rational nutrition may result either in nutrient deficiency or excess body weight [40].

The results of the CSO household budget survey showed a significant spatial differentiation of food consumption in Poland. The differences between rural and urban households and the varied value systems adopted by both types of communities contribute to reporting a different demand for goods and services, which implies differences in consumption patterns [64]. However, it was observed that traditional rural consumption patterns are transforming to reflect the urban patterns as a result of economic and socio-demographic changes among other factors [65]. The consumption pattern reflects consumer food preferences and habits, as well as eating traditions and habits [66].

School education is designed to teach children about health values and help them transfer the acquired skills into practice. Research showed that health behaviours of students are not properly shaped, and in order to eliminate unhealthy habits, the principles of self-worth and taking responsibility for one's own health should be promoted [67]. Therefore, as a result of the research, an educational workshop was prepared for children to promote proper eating behaviour. These took the form of a multimedia presentation along with a discussion triggered by the presentation [14].

The strengths of the survey research lie in its methodology, specifically in the utilisation of the survey method for data collection. This approach facilitated the extensive collection of information from numerous individuals, offering insights into the attitudes and attributes of a sizable cohort. Questionnaire surveys also exemplify a dependable research technique due to their standardisation; participants are presented with identical questions, formulated in precisely the same manner. The conducted survey focused on parents and children residing in the mountainous regions of Malopolska, an inclusion that is infrequently accounted for in nationwide surveys. Furthermore, to our knowledge, it is one of the first conducted in this age group in the area. They are characterised by specific features resulting mainly from the mountainous (or sub-mountainous) rural areas, implying accessibility to selected activities (e.g. large shopping centres). It would not have been possible to carry out the survey in such conditions without the cooperation of local authorities. A strength of the survey is also its two-year period, which precludes incorrect interpretation of the results related to seasonality of product consumption. The area covered by the survey (large city vs. poorly urbanised mountainous area) is poorly surveyed. It is also a strength that little research has been carried out in this age group, and thus this study fills this gap.

Limitations of the study

The study does, however, possess some limitations that warrant acknowledgment. The research was carried out between 2008 and 2012, over a decade ago. Urban areas under scrutiny in this study have experienced heightened urbanisation, accompanied by augmented accessibility to fast food, confections and snacks. Conversely, eating patterns in the predominantly rural locales where a majority of respondents resided (Myslenice and its environs) have exhibited comparatively less change. This divergence can be attributed to the distinctive characteristics of the study region, characterised by its mountainous terrain and limited urban development. We did not take into account children's physical activity, which may have influenced consumption patterns. We concur that this study is cross-sectional in nature, thereby precluding the assumption of causality for the observed correlation between food intake and dietary patterns with child overweight/obese status. Nonetheless, the recognition of dietary patterns akin to those identified in other research endeavours contributes to our understanding of the public health objective of delineating optimal dietary patterns across diverse settings.

Conclusions

Socio-economic factors, place of residence and nutritional status are associated with the eating behaviour of children. The results of studies assessing the nutritional status of children 6–10 years of age emphasised the high prevalence not only of overweight and obesity but also of deficiencies in body weight. Three cluster groups were distinguished showing the eating patterns of the children studied. Children from the healthy cluster (1) showed the most health-promoting model of nutrition. They often consumed butter as well as vegetable oils, groats, pasta and rice, wholemeal bread, fish and fish products, red meat, eggs, raw vegetables, cooked vegetables, pulses, unsalt-

ed nuts and yellow cheese. These children also drank black tea and compote significantly more often than children from mixed feeding model cluster (2) and unhealthy cluster (3). This group from healthy cluster (1) had the lowest BMI. Children from the unhealthy cluster were more often overweight and obese than children from the healthy cluster. They were also more likely to consume margarines and oils and least likely to consume butter and mineral water. The second cluster had a similar BMI to the unhealthy cluster, with the lowest frequency of consumption of oils and margarines and chips and salty snacks and the highest frequency of butter. A distinct nutritional model emerged among families with the lowest income and educational levels. Correspondingly, these children exhibited a higher likelihood of being overweight or obese. This underscores the potential for promoting healthier dietary choices, particularly within middle socio-economic groups, through health promotion initiatives. The study identified the dietary patterns of early school children influencing BMI values. It showed a strong need for educational behaviors among children and their parents, aimed at drawing attention to an appropriate selection of products to reduce the risk of overweight/obesity among children and, as a consequence of poor nutrition, in adulthood.

Source of funding: This work was funded from the authors' own resources.
Conflicts of interest: The authors declare no conflicts of interest.

References

1. John CC, Black MM, Nelson CA. Neurodevelopment: The Impact of Nutrition and Inflammation During Early to Middle Childhood in Low-Resource Settings. *Pediatrics* 2017; 139: 59–71.
2. Ogata BN, Hayes D. Position of the Academy of Nutrition and Dietetics: Nutrition Guidance for Healthy Children Ages 2 to 11 Years. *J Acad Nutr Diet* 2014; 114: 1257–1276.
3. Emilien C, Hollis JH. A Brief Review of Salient Factors Influencing Adult Eating Behaviour. *Nutr Res Rev* 2017; 30: 233–246.
4. Scaglioni S, De Cosmi V, Ciappolino V. et al. Factors Influencing Children's Eating Behaviours. *Nutrients* 2018; 10: 706.
5. Socha J, Stolarczyk A, Socha P. Food behaviour – from genetics to socio-cultural environment. *Nowa Pediatr* 2002; 3: 212–217.
6. Kirchner H. *Zdrowie i jego uwarunkowania*. In: Gawęcki J, Roszkowski W, eds. *Żywienie człowieka a zdrowie publiczne*. Warszawa: Wydawnictwo Naukowe PWN; 2009: 13–20 (in Polish).
7. Czarnocińska J, Anioła J, Grabowska J. et al. Food preferences, frequency and intake by schoolgirls. *Pol J Food Nutr Sci* 2009; 59: 251–254.
8. Nicklaus S, Boggio V, Chabanet C. A Prospective Study of Food Preferences in Childhood. *Food Qual Prefer* 2004; 7–8: 805–818.
9. Cruwys T, Bevelander KE, Hermans RCJ. Social Modeling of Eating: A Review of When and Why Social Influence Affects Food Intake and Choice. *Appetite* 2015; 86: 3–18.
10. Newerli-Guz J, Kulwikowska K. Eating behaviour and preferences of preschool children. *Zesz Nauk Akad Morskiej w Gdyni* 2014; 86: 80–89.
11. Charzewska J, ed. *Recommendations for Nutrition Practitioners on the Principles of Good Nutrition for Preschool Children.* Warszawa: Instytut Żywności i Żywienia; 2011.
12. Babicz-Zielińska E, Jeżewska-Zychowicz M. [The influence of environmental factors on food choice and consumption]. *Handel Wewnętrzny* 2015; 2(355): 5–18 (in Polish).
13. Sigmund E, Sigmundová D, El Ansari W. Changes in physical activity in pre-schoolers and first-grade children: longitudinal study in the Czech Republic. *Child Care Health Dev* 2009; 35(3): 376–382.
14. Żwirska J, Bajer M, Styczeń A, et al. Possibilities of using non-budgetary funds in health promotion and obesity prevention on the example of Myślenice district. *Probl Hig Epidemiol* 2011; 92: 778–782.
15. Tarka P. Properties of 5- and 7-point Likert scales in the context of Kaufman and Rousseeuw normalization of variables. *Scientific Papers of Wrocław University of Economics* 2015; 385: 286–295.
16. Palczewska I, Szilagyi-Pagowska I. Assessment of Somatic Development in Children and Adolescents. *Med Prakt Pediatr* 2002; 3: 140–169.
17. Jodkowska M, Woynarowska B, Oblacińska A. *Screening test for the detection on of physical development disorders in children and adolescents of school age.* Warszawa: Instytut Matki i Dziecka; 2007.
18. Kułaga Z, Różdżyńska-Świątkowska A, Grajda A, et al. Centile grids for the assessment of growth and nutritional status of Polish children and adolescents from birth to 18 years of age. *Stan Med Pediatr* 2015; 12; 119–135.
19. Łoboda D, Gawęcki J, Długosz A. The influence of snack and beverage consumption on the occurrence of body mass deviations in a selected group of junior high school students in Bydgoszcz. *Probl Hig Epidemiol* 2015; 96: 652–655.
20. Bronkowska M. *Study on dietary patterns of healthy people and people burdened with obesity and its selected complications in the aspect of nutritional status*. Wrocław: Wydawnictwo Uniwersytetu Przyrodniczego; 2012.
21. Górniak J. Analiza czynnikowa i analiza głównych składowych. *ASK* 1998; 7: 83–102 (in Polish).
22. Sikorska-Wiśniewska G. [Overweight and obesity in children and young people]. *Żywn Nauka Technol Jakość* 2007; 6: 71–80 (in Polish).
23. Błaszczyk-Bębenek E, Jagielski P, Bolesławska I, et al. Nutrition Behaviors in Polish Adults before and during COVID-19 Lockdown. *Nutrients* 2020; 12: 3084.
24. GUS. [Household budgets in 2012] [cited 1.11.2021]. Available from URL: https://stat.gov.pl/obszary-tematyczne/warunki-zycia/dochody-wydatki-i-warunki-zycia-ludnosci/budzety-gospodarstw-domowych-w-2012-r-,9,7.html (in Polish).
25. Samaniego-Vaesken ML, Partearroyo T, Ruiz E, et al. The Influence of Place of Residence, Gender and Age Influence on Food Group Choices in the Spanish Population: Findings from the ANIBES Study. *Nutrients* 2018; 10: 392.
26. Wang Y, Lim H. The Global Childhood Obesity Epidemic and the Association between Socio-Economic Status and Childhood Obesity. *Int Rev Psychiatry* 2012; 24: 176–188.
27. Khan IA, Singh G, Singh KV. Overweight and Obesity among Primary School Going Children in Urban Agra. *Healthline* 2021; 12: 63–69.
28. Wang Y, Cai L, Wu Y, et al. What Childhood Obesity Prevention Programmes Work? A Systematic Review and Meta-Analysis. *Obes Rev* 2015; 16: 547–565.
29. Obuchowicz A. Epidemiology of Overweight and Obesity – A Growing Health Problem in the Child and Adolescent Population. *Endokrynol Otyłość* 2005; 1: 9–12.
30. Rytter MJ, Michaelsen KF, Friis H, et al. Acute malnutrition in children. *Ugeskr Laeger* 2017; 179: V03170193.
31. Kułaga Z, Różdżyńska A, Palczewska I, et al. Grupa Badaczy OLAF. Percentile Charts of Height, Body Mass and Body Mass Index in Children and Adolescents in Poland – Results of the OLAF Study. *Stand Med Pediatr* 2010; 7: 690–700.

32. Nawarycz T, Ostrowska-Nawarycz L. Body mass index in the school age children and youth from the city of Lodz. *Pol Merkuriusz Lek* 2007; 23: 264–270.
33. Mazur A. [Epidemiology of Childhood Overweight and Obesity in the World, in Europe and in Poland]. *Prz Med Uniw Rzesz Nar Inst Leków* 2011; 2: 158–163 (in Polish).
34. Potempa-Jeziorowska M, Jonczyk P, Świętochowska E. et al. The Analysis of the Nutritional Status and Dietary Habits among Children Aged 6–10 Years Old Attending Primary Schools in Poland. *Int J Environ Res Public Health* 2022; 19: 953, doi: 10.3390/ijerph19020953.
35. Basiak-Rasała A, Górna S, Krajewska J, et al. Nutritional habits according to age and BMI of 6–17-year-old children from the urban municipality in Poland. *J Health Popul Nutr* 2022; 41: 17, doi: 10.1186/s41043-022-00296-9.
36. Justamente I, Raudeniece J, Ozolina-Moll L, et al. Comparative Analysis of the Effects of Daily Eating Habits and Physical Activity on Anthropometric Parameters in Elementary School Children in Latvia: Pach Study. *Nutrients* 2020; 12(12): 3818, doi: 10.3390/nu12123818.
37. Wall CR, Stewart AW, Hancox RJ, et al. 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.
38. Galczak-Kondraciuk A, Stempel P, Czeczelewski J. Assessment of nutritional behaviours of children aged 7–12 attending to primary schools in Biala Podlaska, Poland. *Rocz Panstw Zakł Hig* 2018; 69(1): 71–77.
39. Dolipska A, Majerczyk M, Góra A, et. al. Eating behaviours of primary school pupils from Śląskie, Malopolskie and Opolskie Voivodeships in Poland. *Rocz Panstw Zakl Hig* 2019; 69(2): 193–201.
40. Bielaszka A, Grochowska-Niedworok E, Kiciak A. Dietary preferences of children aged 7–10 years. *Ann Acad Medicae Silesiensis* 2014; 68(4): 187–191.
41. Watterson A, Little D, Young JA, et al. Towards Integration of Environmental and Health Impact Assessments for Wild Capture Fishing and Farmed Fish with Particular Reference to Public Health and Occupational Health Dimensions. *Int J Environ Res Public Health* 2008; 5: 258–277.
42. Bober J, Wiśniewska K, Okręglicka K. Eating Behaviours of Polish and Portuguese Adults – Cross-Sectional Surveys. *Nutrients* 2023; 15(8): 1934, doi: 10.3390/nu15081934.
43. Lee JH, Paik H-D. Anticancer and immunomodulatory activity of egg proteins and peptides: a review. *Poultry Science* 2019; 98(12): 6505–6516.
44. Puglisi MJ, Fernandez ML. The Health Benefits of Egg Protein. *Nutrients* 2022; 14(14): 2904, doi: 10.3390/nu14142904.
45. Tabatabaeyan A, Lotf K, Mirzaei S. et al. The association between egg consumption and metabolic health status in overweight and obese adolescents. *Sci Rep* 2023; 13: 2778, doi: 10.1038/s41598-023-30018-y.
46. Boutelle K, Manzano M, Strong D, et al. Evaluating the Acceptability and Feasibility of Providing Egg or Cereal Breakfast during a Family-Based Treatment for Children with Overweight/Obesity: The Families and Breakfast Pilot Trial. *Childhood Obesity* 2019; 15: 502–509.
47. de Souza RGM, Schincaglia RM, Pimentel GD, et al. Nuts and Human Health Outcomes: A Systematic Review. *Nutrients* 2017; 9: 1311.
48. Walsh CE, Seguin-Fowler R, Ammerman A, et al. Snacking, sugar-sweetened beverage consumption and child obesity in low-income households. *Nutr Food Sci* 2021; 51: 151–163, doi: 10.1108/NFS-02-2020-0048.
49. Esposito F, Nardone A, Fasano E, et al. Determination of Acrylamide Levels in Potato Crisps and Other Snacks and Exposure Risk Assessment through a Margin of Exposure Approach. *Food Chem Toxicol* 2017; 108: 249–256.
50. Smith AP, Rogers R. Positive Effects of a Healthy Snack (Fruit) versus an Unhealthy Snack (Chocolate/Crisps) on Subjective Reports of Mental and Physical Health: A Preliminary Intervention Study. *Front Nutr* 2014; 1: 10, doi: 10.3389/fnut.2014.00010.
51. Phillips S, Bandini M, Naumova LG, et al. Energy-dense snack food intake in adolescence: longitudinal relationship to weight and fatness. *Obes Res* 2004; 12(3): 461–472, doi: 10.1038/oby.2004.52.
52. Field A, Austin S, Gillman M, et al. Snack food intake does not predict weight change among children and adolescents. *Int J Obes* 2004; 28: 1210–1216, doi: 10.1038/sj.ijo.0802762.
53. Jakobsen DD, Brader L, Bruun JM. Association between Food, Beverages and Overweight/Obesity in Children and Adolescents – A Systematic Review and Meta-Analysis of Observational Studies. *Nutrients* 2023; 15(3): 764, doi: 10.3390/nu15030764.
54. Farajian P, Risvas G, Panagiotakos D. et al. Food sources of free sugars in children's diet and identification of lifestyle patterns associated with free sugars intake: The GRECO (Greek Childhood Obesity) study. *Public Health Nutrition* 2016; 19(13): 2326–2335, doi: 10.1017/S1368980015003146.
55. Nicklas TA, O'Neil CE, Liu Y. Intake of added sugars is not associated with weight measures in children 6 to 18 years: National Health and Nutrition Examination Surveys 2003–2006. *Nutr Res* 2011; 31(5): 338–346, doi: 10.1016/j.nutres.2011.03.014.
56. Lommi S, Figueiredo RAO, Tuorila H, et al. Frequent use of selected sugary products associates with thinness, but not overweight during preadolescence: a cross-sectional study. *Br J Nutr* 2020; 124(6): 631–640 doi: 10.1017/S0007114520001361.
57. Szczepańska J, Wądołowska L, Słowińska MA, et al. Comparison of frequency of consumption of fruit juices and sweetened drinks among adolescents of different ages. *Probl Hig Epidemiol* 2011; 92: 832–835.
58. Alexy U, Sichert-Hellert W, Kersting M, et al. Pattern of long-term fat intake and BMI during childhood and adolescence – results of the DONALD Study. *Int J Obes Relat Metab Disord* 2004; 28(10): 1203–1209, doi: 10.1038/sj.ijo.0802708.
59. Zhang J, Wang H, Wang Y, et al. Dietary patterns and their associations with childhood obesity in China. *Br J Nutr* 2004; 113(12): 1978–1984, doi: 10.1017/S0007114515001154.
60. Kostecka M. Fatty acid composition of diets of early school-age children and its health implications. *Pak J Med Sci* 2015; 31(6): 1467–1471, doi: 10.12669/pjms.316.7614.
61. Geraets AFJ, Heinz A. The associations of dietary habits with health, well-being, and behavior in adolescents: a cluster analysis. *Child* 2023; 49(3): 497–507.
62. Northstone K, Smith AD, Newby PK, et al. Longitudinal comparisons of dietary patterns derived by cluster analysis in 7- to 13-year-old children. *Br J Nutr* 2013; 109(11): 2050–2058, doi: 10.1017/S0007114512004072.
63. Holubcikova J, Kolarcik P, Madarasova Geckova A, et al. Lack of parental rule-setting on eating is associated with a wide range of adolescent unhealthy eating behaviour both for boys and girls. *BMC Public Health* 2016; 16: 359, doi: 10.1186/s12889-016-3002-4.
64. Gutkowska K, Piekut M. Consumption in rural households. *Wieś Rol* 2014; 4: 159–178.
65. Piekut M. *Consumption patterns by rural household type between 2004 and 2014*. Warszawa: Difin; 2017.
66. Halicka E, Rejman K. Food consumption patterns in Poland. *Wieś Rol* 2010; 4: 75–94.
67. Roszko-Kirpsza I, Olejnik B, Zalewska M, et al. Selected Eating Habits and Nutritional Status of Children and Adolescents in the Podlasie Region. *Probl Hig Epidemiol* 2011; 92: 799–805.

Tables: 5
Figures: 4
References: 67

Received: 17.10.2023
Reviewed: 06.11.2023
Accepted: 13.11.2023

Address for correspondence:
Ewa Błaszczyk-Bębenek, PhD
Department of Nutrition and Drug Research
Institute of Public Health
Faculty of Health Science
Jagiellonian University Medical College
8 Skawińska St
31-066 Cracow
Poland
Tel.:+48 12 4332820, ext. 9034
E-mail: ewa.blaszczyk@uj.edu.pl