

Comparison of factors determining voluntarily fortified food consumption between children and adolescents in Central-Eastern Poland

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Summary

The aim of this study was to compare socio-demographic and lifestyle determinants of voluntarily fortified food (VFF) consumption in 1578 children and adolescents. Data were collected among parents of children (5–12 years) and among adolescents (13–20 years) who attended public schools in Central-Eastern Poland. Socio-demographic characteristics, health, lifestyle status and consumption of VFFs with vitamin/mineral were assessed by a self-administered questionnaire. Multivariate-adjusted logistic regression models were used to estimate odds ratios with 95% confidence intervals to determine the predictors of VFF consumption. A statistically significantly higher number of children compared to adolescents were VFF consumers (71.0 % versus 63.8 %, respectively; $P = 0.002$). In children, VFF consumers compared to non-consumers were younger (each 1-year increment was associated with 25% lower VFF consumption), used dietary supplements more often, usually ate four meals per day, and suffered from chronic diseases less frequently. In adolescents, VFF consumers more often than non-consumers assessed their socio-economic status as very good or good, health status as at least good, had higher physical activity level, used dietary supplements and intentionally included some food products in their diet. Knowledge of factors of VFF consumption create the possibility to adjust the education and public health policy to consumer needs.

Keywords

children; enriched product; food choice; intake; youth

Food fortification is defined as the practice of deliberately increasing the content of vitamins and minerals in food products in order to improve their nutritional value and to provide a public health benefit with minimal risk to health [1]. Fortified foods can reduce the risk of micronutrient deficiency and may supply nutrients crucial for the development of children and young people. Fortification can be either mandatory or voluntary. Mandatory fortification takes place when a government legally obliges food producers to add specified micronutrients to particular processed foods, whereas voluntary fortification occurs when a food manufacturer freely chooses to fortify particular foods in response to permission given by food law. In many countries, mandatory

and/or voluntary fortification of specific foodstuffs is a part of the improvement of public health. For example, consumption of milk and cereal products fortified with multiple micronutrients can be an effective way of reducing anemia in young children in developing countries [1, 2]. On the other hand, food manufacturers can take the initiative of adding one or more micronutrients to some foodstuffs in order to increase sales and profitability without taking into account the dietary needs of the population. This may create a risk of excessive consumption of some vitamins and/or minerals in developed countries. In the United States, the Food and Drug Administration's fortification policy discourages fortification of certain foods, including cookies, candies, cakes, chips, and carbonated

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beverages. Nevertheless, some manufacturers add nutrients to snack foods. It may contribute to shaping poor dietary habits in particular among children and young people [3]. On the Polish [4, 5], the United Kingdom [6] and the Spanish [7] markets, a large part of voluntarily fortified foods (VFFs) targeted at children are of low nutritional quality, i.e. contain too much sugar, salt and/or fat. In Europe, the proportion of children consuming VFFs is higher than that of adults [8], thus the knowledge of determinants influencing the use of VFFs in children and adolescents is important from the public health point of view and would allow the introduction of targeted nutrition education. According to the best of our knowledge, studies in this area were limited mainly to adults [9–12]. Therefore, the aim of the study was to compare socio-demographic and lifestyle determinants of consumption of VFFs in school children and adolescents in Central-Eastern Poland.

MATERIALS AND METHODS

Study design

The cross-sectional study was conducted from 2005 to 2010 among 5–20-year-old school children and adolescents who attended public schools. The primary and secondary schools were selected randomly and were located in different districts of Central-Eastern Poland. The survey was conducted only in those schools in which headmasters gave consent to it. The inclusion criteria of the students participating in the study were attendance to a public primary or secondary school in Central-Eastern Poland and the age of participants ranging from 5 to 20 years. The criteria of exclusion were presence of a disease requiring special dietary treatment, pregnancy or lactation (this concerned adolescents only) and incomplete or incorrectly filled out questionnaire on health and lifestyle.

All procedures performed in the study were in accordance with the 1964 Helsinki declaration and its later amendments. The study design and protocol were approved by the Department of Human Nutrition (Warsaw University of Life Sciences, Warsaw, Poland). By completing the questionnaires, the respondents agreed to participate in the study.

Data collection

Data were collected using the health and lifestyle questionnaire, which was distributed among 1200 parents of children (age ≤ 12 years) at school meetings and among 1200 adolescents (age > 12 years) during classroom sessions. The

respondents were instructed on how to complete the questionnaire and they were asked to return it to the school's teachers within one week. All completed questionnaires were verified by trained interviewers. A total of 1624 respondents returned the questionnaires (67.7%). However, 46 were excluded due to being incorrectly filled out or incomplete. Finally, 1578 children and adolescents were included in the study.

The questionnaire included 27 questions and consisted of the five following sections: socio-demographic characteristics, health and lifestyle status, eating habits, dietary supplements usage, and VFFs usage.

Socio-demographic characteristics were age, gender, place of living, mother's educational level and economic status of the family.

Health and lifestyle status questions regarded self-reported health status, occurrence of current chronic diseases, use and type of special diet, self-reported physical activity level as well as its type and time spent being physically active (how many hours per week). Moreover, self-reported height and weight of participants were collected and used to calculate the body mass index [13, 14].

Eating habits questions provided data on the number of meals consumed habitually during the day, regularity of main meal consumption and on intentional inclusion and/or exclusion of some food products.

Dietary supplement usage questions regarded the use of vitamin and/or mineral supplements during the year before the study. The name and brand of dietary supplements, the period of application, daily doses and the reason of usage or no usage were collected. A supplement user was considered to be a person who used at least 1 vitamin and/or mineral dietary supplement for at least one week or longer over the past 12 months.

VFF usage questions regarded the use of VFFs with vitamins and/or minerals in their habitual diet. All participants were also asked if they paid attention to the fact whether the product was or was not fortified while making a purchase. When the respondents declared consumption of fortified products, they were asked to give the reason for including these foods in their diet by marking one or more predefined reasons: "VFFs is beneficial to the health", "these products are tasty", "respondent's diet is poor in nutrients," "VFFs are recommended by physician/pharmacist" as well as they could list their own reason. VFF consumers were also asked to provide a source of information for their knowledge about VFFs. When respondents declared not using VFFs, they were asked about the reason for avoiding them, being

asked to mark one or more of the following statements: “these products have no impact on health”, “no need to use such products because of proper nutrition of participant”, “such products are too expensive”, “they taste bad”, “I have never heard about such products” as well as they could list their own reason. In addition, to collect data about the frequency and quantity of consumed VFFs, a semi-quantitative food frequency questionnaire (FFQ) was used with listed 58 food items available on the Polish market. Detailed methodology was presented elsewhere [15].

The pilot study suggested that the questionnaire was generally comprehensible. However, because it was revealed that the term “fortified products” was not clear to some participants, a definition of this term was provided before the VFF usage section. The health and lifestyle questionnaire was based on a questionnaire developed at the Department of Human Nutrition (Warsaw University of Life Sciences) for adult people, being previously used in a study among 1019 adult respondents from Central and Eastern Poland in 1993–1995 [16]. The questionnaire was modified and adopted for different age groups including children [17], adolescents and students [18, 19], and was verified among students [20, 21].

Study population

Due to the fact that food consumption preferences may change along with growing up and may consequently influence the diet quality, the study included both children and adolescents. In the case of children, parents are usually responsible for food choice decision, while adolescents can partially make the decision on their own. Taking the above into consideration, the assumption was made that factors affecting VFF consumption are different between children and adolescents.

The study population constituted 762 children and 816 adolescents. The average age of children was 8.6 ± 1.4 years (range 5–12 years) and adolescents was 17.1 ± 2.1 years (range 13–20 years). The average self-reported body weight and height were 33.6 ± 8.9 kg (range 15–64 kg) and 137 ± 11 cm (100–174 cm) in children, respectively, and 60.8 ± 11.7 kg (range 36–105 kg) and 168 ± 8 cm (range 145–198 cm) in adolescents, respectively.

Statistical analysis

The results were presented separately for the group of children (≤ 12 years) and the group of adolescents (>12 years). The statistically significant differences between categorical variables and VFF usage (consumers vs non-consumers)

were determined using the Chi-square test. To examine the associations between VFF usage and parameters that might constitute determinants of VFF consumption, the univariate (Model 1: crude data) as well as multivariate-adjusted (Model 2) odds ratios (ORs) with 95% confidence intervals (95% CIs) were calculated using logistic regression models. In addition, according to the backward elimination method, the stepwise regression model (Model 3) was used where only statistically significant variables associated with VFF consumption were left. Hosmer-Lemeshow criterion was used to evaluate the models' goodness-of-fit.

The multivariate-adjusted models included the following variables: age of participants (continuous variable), gender (female, male), residential area (urban, rural), mother's education level (primary, high school or university), self-reported family socio-economic status (very good/good, average, or poor), self-reported physical activity level (low, moderate, or high), body mass index (< 18.5 kg·m⁻², 18.5 – 24.9 kg·m⁻² or ≥ 25 kg·m⁻²), self-reported health status (at least good, average or poor), current chronic diseases (no, yes), using special diet (no, yes), number of meals consumed per day (≤ 3 , 4, or ≥ 5), intentionally including some food products (no, yes), intentionally excluding some food products (no, yes), use of vitamin and/or mineral dietary supplements (no, yes). Missing data on place of residential area (1.4 %), educational level of mother (39.7 %), socio-economic status of the family (6.5 %), physical activity (2.5 %), body mass index (1.4 %) and health status (2.5 %) were included in the models as separate categories. Respondents who did not declare consumption of VFFs were considered as a reference category. The statistical analyses were performed using SPSS version 23.0 (IBM, Armonk, New York, USA). The level of statistical significance was set at $P \leq 0.05$.

RESULTS AND DISCUSSION

Consumption of voluntarily fortified food

Consumption of VFFs was found to be widespread among school children and adolescents, an overall number of 67.3 % of participants consuming them in a habitual diet. A statistically significantly higher number of children compared to adolescents used these products (71.0 % vs 63.8 %, respectively; $P = 0.002$).

VFFs consumed by participants contained the addition of 12 vitamins (vitamins A, E, D, C, B₁, B₂, B₆, B₁₂, niacin, folic acid, biotin, pantothenic acid) and 2 minerals (calcium, iron). Ce-

Tab. 1. Consumption of groups of voluntarily fortified foods by children and adolescents.

Group of fortified foods	Children ≤ 12 years			Adolescents >12 years		
	Consumers (n = 536)	Number of servings per week	Weight of one serving	Consumers (n = 706)	Number of servings per week	Weight of one serving
	[%]	Median (min.–max.)	Mode (min.–max.)	[%]	Median (min.–max.)	Mode (min.–max.)
Cereal products	92.5 ^a	2.0 (0.2–12)	30 g (10–140 g)	85.3 ^b	2.0 (0.5–14)	30 g (10–180 g)
Juices and non-alcoholic beverages	76.9 ^a	3.0 (0.6–14)	330 ml (50–400 ml)	88.3 ^b	2.0 (0.3–14)	330 ml (100–500 ml)
Dairy products	73.3 ^a	3.0 (0.3–14)	50 ml (50–300 ml)	81.3 ^b	2.8 (0.3–14)	100 ml (30–500 ml)
Sweets	53.4 ^a	1.0 (1–18)	25 g (5–40 g)	60.9 ^b	1.0 (0.3–10)	25 g (6–100 g)
Instant beverages	53.2 ^a	2.0 (0.5–10)	20 g (5–35 g)	69.3 ^b	2.0 (0.3–8)	20 g (5–40 g)
Desserts	43.3 ^a	2.0 (0.5–8)	100 g (33–250 g)	60.0 ^b	1.0 (0.3–7)	50 g (40–250 g)

Number *n* represents all subjects who reported consumption of at least one of the products from the food frequency questionnaire list over the past month. Different small letters in superscript in a row indicate statistically significant differences between group of children and adolescents at the level of $P < 0.05$ determined by Chi-square test. Instant beverages are given as a powder.

Tab. 2. Reasons for consuming or non-consuming of voluntarily fortified foods by children and adolescents.

Parameters	Children ≤ 12 years		Adolescents >12 years	
	Consumers (n = 541)	Non-consumers (n = 221)	Consumers (n = 521)	Non-consumers (n = 295)
	[%]	[%]	[%]	[%]
Declaration of paying attention whether the product is or not fortified	73.8 ^A	24.7 ^B	65.6 ^A	27.2 ^B
Reason for inclusion of voluntarily fortified foods				
Beneficial effect on the health	70.0 ^a		88.3 ^b	
Taste preferences	52.1 ^a		35.5 ^b	
Diet poor in nutrients	30.3 ^a		13.4 ^b	
Physician/pharmacist recommendation	13.7 ^a		10.4 ^b	
Other	2.4		1.0	
Main source of information about voluntarily fortified foods				
TV and internet websites	22.4 ^a		46.3 ^b	
Physician	17.9		15.2	
Newspapers and books	7.6 ^a		17.3 ^b	
School and parents	0.9 ^a		16.6 ^b	
Food labels	6.5		6.3	
Other	1.7		6.7	
Reason for avoidance of voluntarily fortified foods				
Proper nutrition		52.0 ^a		46.4 ^b
Lack of impact on health		26.7 ^a		13.9 ^b
Too high price		21.3		24.4
Products taste bad		11.3		18.3
Never heard about such products		12.2		9.2
Other		5.4		2.7

Voluntarily fortified food consumer was considered a person who in the health and lifestyle questionnaire declared using voluntarily fortified food. Each respondent could select one or more answers for the reason for inclusion or avoidance of voluntarily fortified foods.

Different capital letters in superscript in a row indicate statistically significant differences between consumers and non-consumers within the same age group at the level of $P < 0.001$ determined by Chi-square test. Different small letters in superscript in a row indicate statistically significant differences between group of children and adolescents at the level of $P < 0.05$ determined by Chi-square test.

real products, juices and non-alcoholic beverages as well as dairy products were the most common VFF groups consumed by children (92.5 %, 76.9 % and 73.3 %, respectively) and adolescents (85.3 %, 88.3 % and 81.3 %, respectively; Tab. 1). In both population groups, the median consumption of fortified foodstuffs was from one to three servings per week, and the most common servings were from 20 g of instant beverages (instant cacao and tea) to 330 ml of juices and non-alcoholic beverages. VFF consumption by the group of children (6–12 years old) was described in detail elsewhere [15].

Reasons for consuming or non-consuming of voluntarily fortified food

When making a purchase, statistically significantly more VFF consumers than non-consumers paid attention whether the product was or was not fortified in children (73.8 % vs 24.7 %, respectively) and adolescents (65.6 % versus 27.2 %, respectively; Tab. 2). As the main reasons for consumption of VFFs, parents of children and adolescents declared the beneficial effect on the health (70.0 % and 88.3 %, respectively) and taste preferences (52.1 % and 35.5 %, respectively). The main sources of information about these products for parents of children were commercials and programmes on TV, internet websites as well as physicians (22.4 % and 17.9 %, respectively); while adolescents pointed out commercials and programmes on TV, internet websites as well as newspapers and books (46.3 % and 17.3 %, respectively). Parents declared the reasons for not consuming these products as proper nutrition of children and a lack of impact of these products on health (52.0 % and 26.7 %, respectively). Adolescents pointed out to proper nutrition and claimed that these products were too expensive (46.4 % and 24.4 %, respectively).

Determinants of voluntarily fortified food consumption in children

Socio-demographic and lifestyle parameters stratified by consumption of VFFs in children are presented in Tab. 3. Only the number of eating meals and the use of dietary supplements differed statistically significantly between VFF consumers and non-consumers. Eating 4 or more meals during the day was declared more often in VFF consumers than non-consumers (90.2 % vs 80.6 %, respectively). Compared to non-consumers, VFF consumers used dietary supplements over the past 12 months more often (47.1 % vs 20.8 %, respectively). A description of selected factors associated with the consumption of VFFs by a part of the

younger respondents, i.e. group of children aged 6–12 years, was also presented elsewhere [22].

Results of a comprehensive analysis, which included all analysed factors of VFF use in the logistic regression models, are presented in Tab. 4. An inverse statistically significant trend ($P < 0.001$) between age of children and consumption of VFFs was observed. Each 1 year increment in age was associated with a 25% (95% CI: 15–34 %) lower probability of consumption of VFFs (Model 2). Children who consumed 4 meals per day were 2.31-fold (95% CI: 1.41–3.80) more likely to be VFF consumers compared to children who ate ≤ 3 meals per day. Prevalence of VFF consumption was 3.93-fold (95% CI: 2.63–5.87) higher among those who used dietary supplements (Tab. 4, Model 2). All disclosed factors associated with consumption of VFFs were confirmed by the stepwise logistic regression analysis (Model 3) and additionally one more determinant was disclosed, namely, the presence of chronic diseases. Children with chronic diseases were less likely to be VFF consumers (OR: 0.58, 95% CI: 0.37–0.91) than those without chronic diseases.

Determinants of voluntarily fortified food consumption in adolescents

Socio-demographic and lifestyle parameters stratified by consumption of VFFs in adolescents are presented in Tab. 3. Significantly more mothers of VFF consumers compared to non-consumers had university education (18.0 % vs 7.5 %, respectively). Compared to non-consumers, VFF consumers evaluated their socio-economic status as very good or good (58.7 % vs 47.4 %, respectively), physical activity as high (35.1 % vs 29.9 %, respectively) and health status as at least good (85.0 % vs 76.6 %, respectively) more often. Moreover, VFF consumers declared health-related behaviours, such as including some food products in their diet (e.g. fruits, vegetables; 20.9 % vs 11.5 %, respectively) or excluding them (e.g. sweets, crisps; 21.7 % vs 12.2 %, respectively) more frequently than non-consumers. Over the past 12 months, almost 26.1 % of those who consumed VFFs simultaneously used vitamin and/or mineral dietary supplements. Factors like gender, residential area, body mass index and presence of chronic diseases as well as use of a special diet and number of meals were not statistically significantly different between VFF consumers and non-consumers.

Based on the logistic regression models, determinants of VFF consumption were identified. Poor socio-economic status was associated with a lower probability of consumption of VFFs compared with those with very good or good socio-

Tab. 3. Socio-demographic and lifestyle parameters stratified by consumption of voluntarily fortified foods in children and adolescents.

Parameter	Children ≤ 12 years			Adolescents > 12 years		
	Consumers (n = 541)	Non-consumers (n = 221)	P-value	Consumers (n = 521)	Non-consumers (n = 295)	P-value
	[%]	[%]		[%]	[%]	
Gender						
Female	50.3	48.9	0.724	67.8	64.7	0.381
Male	49.7	51.1		32.2	35.3	
Residential area						
Urban	85.1	84.5	0.835	42.3	43.4	0.778
Rural	14.9	15.5		57.7	56.6	
Mother's education level						
Primary	12.0	12.3	0.191	24.1	41.8	0.014
High school	32.5	39.1		57.9	50.7	
University	55.5	48.6		18.0	7.5	
Socio-economic status						
Very good or good	69.1	64.7	0.411	58.7	47.4	< 0.001
Average	26.3	29.0		31.7	32.9	
Poor	4.6	6.3		9.6	19.7	
Physical activity						
Low	5.6	7.7	0.265	4.6	11.7	< 0.001
Moderate	48.4	52.0		60.3	58.4	
High	46.0	40.3		35.1	29.9	
Body mass index						
< 18.5 kg·m ²	14.5	13.0	0.673	12.8	12.5	0.980
18.5–24.9 kg·m ²	57.0	55.6		73.4	73.3	
≥ 25 kg·m ²	28.5	31.4		13.8	14.2	
Health status						
At least good	94.3	90.5	0.061	85.0	76.6	0.003
Average or poor	5.7	9.5		15.0	23.4	
Current chronic diseases						
No	84.8	81.4	0.248	94.0	95.6	0.348
Yes	15.2	18.6		6.0	4.4	
Special diet						
No	93.9	93.2	0.723	87.9	90.5	0.257
Yes	6.1	6.8		12.1	9.5	
Number of meals per day						
≤ 3	9.8	19.5	< 0.001	38.6	46.1	0.089
4	62.3	49.8		44.3	37.3	
≥ 5	27.9	30.8		17.1	16.6	
Including some food products						
No	84.3	87.8	0.216	79.1	88.5	< 0.001
Yes	15.7	12.2		20.9	11.5	
Excluding some food products						
No	78.6	77.4	0.720	78.3	87.8	< 0.001
Yes	21.4	22.6		21.7	12.2	
Dietary supplements use						
No	52.9	79.2	< 0.001	73.9	89.8	< 0.001
Yes	47.1	20.8		26.1	10.2	

Consumer was considered a person who in the health and lifestyle questionnaire declared using voluntarily fortified foods. Dietary supplement user was considered a person who used at least 1 vitamin and/or mineral dietary supplement for at least one week or longer over the past 12 months.

P-value was determined using Chi-square test.

Tab. 4. Logistic regression of consumption of voluntarily fortified foods by socio-demographic and lifestyle determinants in children and adolescents.

Study factors	Children ≤ 12 years (n = 762)			Adolescents >12 years (n = 816)		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Age (years)	0.76 (0.67–0.84)	0.75 (0.66–0.85)	0.75 (0.66–0.84)	0.99 (0.92–1.06)	1.05 (0.90–1.21)	
P for trend	< 0.001	< 0.001	< 0.001	0.72	0.54	
Gender						
Female	1.00	1.00		1.00	1.00	
Male	0.95 (0.69–1.29)	1.01 (0.72–1.43)		0.87 (0.65–1.18)	0.79 (0.56–1.12)	
Residential area						
Urban	1.00	1.00		1.00	1.00	
Rural	0.96 (0.62–1.48)	0.87 (0.52–1.47)		1.04 (0.78–1.40)	1.09 (0.76–1.55)	
Mother's education level						
Primary	1.00	1.00		1.00	1.00	
High school	0.84 (0.50–1.43)	0.77 (0.42–1.41)		1.89 (1.04–3.79)	1.73 (0.88–3.41)	
University	1.16 (0.70–1.92)	0.98 (0.52–1.85)		4.20 (1.41–12.5)	2.64 (0.84–8.34)	
Socio-economic status						
Very good or good	1.00	1.00		1.00	1.00	1.00
Average	0.85 (0.60–1.21)	0.79 (0.52–1.19)		0.78 (0.56–1.07)	0.85 (0.60–1.21)	NS
Poor	0.68 (0.35–1.35)	0.86 (0.39–1.92)		0.39 (0.26–0.61)	0.49 (0.31–0.78)	0.50 (0.33–0.77)
Physical activity						
Low	1.00	1.00		1.00	1.00	1.00
Moderate	1.28 (0.68–2.41)	1.04 (0.50–2.13)		2.64 (1.50–4.66)	2.59 (1.38–4.84)	2.53 (1.36–4.68)
High	1.57 (0.82–2.98)	1.25 (0.60–2.60)		3.00 (1.66–5.44)	3.16 (1.62–6.14)	2.86 (1.49–5.47)
Body mass index						
< 18.5 kg·m ⁻²	1.09 (0.67–1.77)	0.95 (0.56–1.62)		1.03 (0.66–1.60)	1.27 (0.79–2.03)	
18.5–24.9 kg·m ⁻²	1.00	1.00		1.00	1.00	
≥ 25 kg·m ⁻²	0.88 (0.62–1.26)	0.93 (0.63–1.39)		0.97 (0.64–1.48)	1.08 (0.68–1.72)	
P for trend	0.23	0.65		0.40	0.47	
Health status						
At least good	1.00	1.00		1.00	1.00	1.00
Average or poor	0.58 (0.32–1.03)	0.82 (0.42–1.60)		0.58 (0.40–0.83)	0.67 (0.43–1.02)	0.67 (0.45–0.99)
Current chronic diseases						
No	1.00	1.00	1.00	1.00	1.00	
Yes	0.78 (0.52–1.19)	0.64 (0.39–1.05)	0.58 (0.37–0.91)	1.37 (0.71–2.67)	1.36 (0.65–2.83)	
Special diet						
No	1.00	1.00		1.00	1.00	
Yes	0.89 (0.47–1.68)	1.01 (0.47–2.15)		1.31 (0.82–2.10)	1.03 (0.59–1.80)	
Number of meals per day						
≤ 3	1.00	1.00	1.00	1.00	1.00	
4	2.49 (1.57–3.92)	2.31 (1.41–3.80)	1.90 (1.35–2.66)	1.41 (1.03–1.94)	1.29 (0.91–1.82)	
≥ 5	1.80 (1.10–2.95)	1.32 (0.77–2.25)	NS	1.21 (0.80–1.83)	1.06 (0.67–1.67)	
Including food products						
No	1.00	1.00		1.00	1.00	1.00
Yes	1.34 (0.84–2.13)	1.29 (0.72–2.34)		2.03 (1.34–3.08)	1.52 (0.90–2.57)	1.90 (1.23–2.94)
Excluding food products						
No	1.00	1.00		1.00	1.00	
Yes	0.93 (0.64–1.36)	0.74 (0.45–1.23)		1.99 (1.33–2.99)	1.51 (0.91–2.52)	
Dietary supplements use						
No	1.00	1.00	1.00	1.00	1.00	1.00
Yes	3.39 (2.35–4.89)	3.93 (2.63–5.87)	3.88 (2.64–5.72)	3.12 (2.04–4.78)	2.68 (1.71–4.22)	2.98 (1.92–4.62)

Values represent odds ratio. Values in brackets represent 95% confidence interval.

Model 1 – univariate model (crude data), Model 2 – multivariate-adjusted model, Model 3 – stepwise regression model.

Dietary supplement user was considered a person who used at least 1 vitamin and/or mineral dietary supplement for at least one week or longer over the past 12 months.

NS – not statistically significant in the stepwise regression model.

economic status (*OR*: 0.49, 95% *CI*: 0.31–0.78) (Tab. 4, Model 2). In comparison to respondents with a low physical activity level, those with moderate and high physical activity had significantly higher ratios of odds (*OR*: 2.59, 95% *CI*: 1.38–4.84 and *OR*: 3.16, 95% *CI*: 1.62–6.14, respectively). Moreover, adolescents who reported dietary supplement usage were 2.68-fold (95% *CI*: 1.71–4.22) as likely to be VFF consumers as those who were supplement non-users. All the disclosed factors based on Model 2 were confirmed in Model 3 and, additionally, adolescents who declared average or poor health status were less likely to be VFF consumers than those who declared at least a good health status (*OR*: 0.67, 95% *CI*: 0.45–0.99). Respondents who declared intentionally including food products had a 1.90-fold (95% *CI*: 1.23–2.94) higher probability of consumption of VFFs.

DISCUSSION

Our study is important to understand the factors affecting the use of VFFs in children and adolescents. It examines the determinants of VFF consumption separately in children and adolescents, and compares factors associated with use of VFFs between both groups. The use of fortified food is one of the strategies to reduce micronutrient deficiencies in nutrition health policy. However, knowledge about the consumption of such products in Poland and other countries seems to be insufficient [23]. In children, VFF consumers compared to non-consumers were younger, used dietary supplements more often, usually ate four meals per day, and suffered from chronic diseases less frequently. In adolescents, VFF consumers assessed their socio-economic status as very good or good more often, health status as at least good, had higher physical activity level, used dietary supplements and intentionally included some food products in their diet. Taking into consideration that the majority of the analysed health-related factors were associated with VFF use, it was surprising that respondents who used special diets were not more likely to use VFFs, and no significant association between body mass index and VFF consumption was found.

Some studies demonstrated association between higher probability of specific fortified food consumption and determinants such as age [9, 12], healthy lifestyle behaviours like lower intake of alcohol and lower likelihood of smoking [10], nutrition knowledge [11] and higher consumption of fruits [10, 12], vegetables [12] as well as fibre [9]. Taking into account that fortified

products share many characteristics with functional foods (e.g. fermented dairy products, yogurt fortified with fibre, cholesterol-lowering fat spreads) and are similarly defined as foods that can reduce diseases risk and/or promote optimal health [24], the discussion will be based on both VFF and functional food consumption.

In our study, the association between VFF consumption and age was confined in the case of children, each 1 year increment of age being associated with a 25 % lower probability of VFF consumption. No such relation was observed in adolescents. In studies conducted in different countries, age was a determinant of VFF consumption among adult populations [9, 12, 25], though the results were not unequivocal. In a Finnish study ($n = 918$, age 25–64 years), VFF consumers were younger than non-consumers [12] and in a Dutch study ($n = 1183$, aged 19–91 years), lemonade and/or sweets with extra vitamins and minerals were significantly more frequently consumed by younger (19–34 years) than older (≥ 35 years) participants [9]. In contrast, in a Belgian survey of military men ($n = 5000$, age 20–59 years), consumption of a certain type of functional food increased with age [25].

In our study, the nutrition knowledge of parents of children and adolescents was not analysed, while parents' education was not a significant determinant of consumption of VFFs. In adult Greeks, the increase of nutrition knowledge was associated with higher probability of consuming iron-fortified products [11]. Similarly, in an intervention study, Spanish consumers who received health education related to the beneficial effect of high fibre consumption had higher scores, in comparison to a control group, on average attitudes towards foods enriched with fibre [26]. In the present study, the most common sources of information about VFFs for participants were commercials and programmes on TV, internet websites, physician as well as newspapers and books. Similarly, the main sources of information about functional foods in Swedish citizens ($n = 972$, age 17–75 years) were commercials on TV and advertisements in newspapers or magazines [27]. This indicates the potential impact of marketing on consumers' behaviour.

In our study, more VFF consumers than non-consumers declared health-related behaviours such as inclusion of some food products in the diet, usage of dietary supplements and consuming four meals per day. In addition, in adolescents, VFF consumers declared at least a good health status and a higher physical activity level more often than non-consumers. Similar to this,

in a Belgian survey of military men, the physical activity level and usage of vitamin supplements were predictors of functional food consumption [25]. Results of the study conducted among Swedish citizens [27] indicated that consumption of functional foods was related to health-consciousness rather than to socio-demographic variables, as respondents with diet-related problems were more likely to consume that type of foods than people without diet-related problems. Consumers with a general health interest were found to have a positive attitude towards functional foods, perceive these foods as necessary and recognize them as beneficial. These respondents were users of dietary supplements as well [27].

The use of fortified foods may not always be a conscious choice. It may be a result of the fact that non-fortified options are not available on the market [12], such as mandatory iodized table salt and fat spreads enriched with vitamin A and D in Poland [28]. In the present study, in order to verify information about the consumption of VFFs, an extra semi-quantitative food frequency questionnaire with listed specific VFFs was used. The results suggested that the respondents were often unaware that they consumed fortified products [15]. Therefore, product choice may be based on attributes other than fortification, such as healthiness, taste and pleasure, security and familiarity, convenience and price [29]. In Polish adults ($n = 1000$, age 18–83 years), health and food quality motivated participants to eat cereal products enriched with fibre [30]. Taste was considered as the most meaningful factor of food choice [31]. In the present study, VFF consumers indicated that taste preferences were one of the main reason for inclusion of VFFs in the diet. On the other hand, non-consumers, which constituted more than 11 % of children and 18 % of adolescents, considered that VFFs tasted bad. In a Greek study, more than 11 % of participants indicated that iron-fortified foods had a worse taste than similar unfortified foods [11]. VERBEKE [32] found that the willingness to compromise on taste may vary to some extent, depending on the specific product category and recognition of the impact of this product on health. Willingness to try functional foods was found to be driven by its attractiveness, credibility and uniqueness, which suggests that not only the healthy image of a functional food determines its consumer acceptance [33]. Some VFFs, like sweets, ready-to-eat breakfast cereals or sweetened beverages are often targeted at children [5] and could result in inappropriate eating habits.

The present study has several strengths, including the large number of participants as well as

VFF consumers, and the detailed information on participants' socio-demographic and lifestyle factors. In addition, the available data on the potential determinants of VFF consumption allowed us to use the logistic regression models to determine factors significantly associated with VFF consumption. However, as in all observational studies, unmeasured or residual confounding cannot be disregarded. In the study, we tested a limited number of determinants and it is highly probable that some of important factors of VFF consumption were not taken into account. Another limitation of this study was that the study was carried out only in schools in which headmasters gave consent to it. Therefore, the survey might not be representative for all primary and secondary school students from Central-Eastern Poland. In addition, the methodology was not uniform, as in children (≤ 12 years), the survey was completed by parents, while in adolescents (> 12 years) by themselves. This could have an effect on the outcomes. In fact, most of the food-purchasing decisions were made by the parents, although some of the children might have not informed their parents about buying some food items. Additionally, it is possible that respondents with a more health-oriented lifestyle were more likely to participate in the study.

CONCLUSIONS

The study shows the differences in the determinants influencing the use of VFFs among children and adolescents. The determinants of VFF consumption could be different in other populations due to different health-related behaviours including eating habits and diversity of available fortified foodstuffs. Understanding the factors associated with VFF consumption in populations creates the possibility to adjust the nutrition education and public health policy to consumer needs. Therefore, further research on the topic is warranted in different age groups.

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