Polish Journal of Food and Nutrition Sciences

DE GRUYTER OPEN

Pol. J. Food Nutr. Sci., 2015, Vol. 65, No. 3, pp. 211–221
DOI: 10.2478/pjfns-2013-0013
http://journal.pan.olsztyn.pl

Original article
Section: Nutritional Research

Consumption Frequency of Fruit Juices and Sweetened Beverages: Differences Related to Age, Gender and the Prevalence of Overweight Among Polish Adolescents

Justyna W. Wuenstel, Lidia Wądołowska, Małgorzata A. Słowińska, Ewa Niedźwiedzka, Joanna Kowalkowska, Lidia Antoniak*

Department of Human Nutrition, University of Warmia and Mazury Olsztyn, Ul. Słoneczna 44a, 10–718 Olsztyn, Poland

Key words: fruit juices, sweetened beverages, adolescents, BMI

The aim of the study was to analyse the differences in the consumption frequency of fruit juices and sweetened beverages according to gender, age and the prevalence of overweight. The study involved 1,700 adolescents aged 13–19 from north-eastern Poland. The frequencies of juices and beverages consumption are presented in 5 categories: from less than once a week to daily. On the basis of measurements of body weight and height the relative body mass (rBMI) is calculated, using standardization by Cole. The study showed that 77.8% of the sample had normal weight and 16.9% were overweight. Girls more often consumed fruit juices than boys and sweetened beverages less often. Girls with age drank less frequently fruit juices and sweetened beverages. Among boys, only the frequency of fruit juice consumption decreased with age. Daily consumption of sweetened beverages among young people increased the risk of being overweight by more than 60% compared to young people consuming them once a week. The frequency of consumption of fruit juices and sweetened beverages was more strongly related to age and sex than to body mass. The prevalence of overweight among adolescents was associated with the frequency of sweetened beverage consumption, but not with the frequency of fruit juice consumption.

INTRODUCTION

In recent years, the consumption of fruit juices and sweetened beverages by children and adolescents has increased [Malik *et al.*, 2006, 2010]. Fruit juices are a rich source of mono- and disaccharides, vitamins and some minerals and also contain some fibre and small quantities of protein and fat. Sweetened beverages have a high content of sugars, including colorants, aromas, organic acids, preservatives and stimulants and carbonated beverages also contain carbon dioxide [Forshee *et al.*, 2008]. Fruit juices and sweetened beverages, because of the high consumption, are an important source of fluid and energy in the diets of adolescents [Belpoggi *et al.*, 2006; Malik *et al.*, 2006; Mattes *et al.*, 2011]. One of the three top sources of energy for 2- to 18-year-olds was soda (118 kcal/day), overall "sugar-sweetened beverages (soda and fruit drinks combined) provided 173 kcal/day" [Reedy & Krebs-Smith, 2010]. The growth of the consumption of fruit juices and sweetened beverages is responsible for an energy increase of 20% in diets of children aged 6–11 [Wang *et al.*, 2008]. Among adolescent aged 14–18, the consumption of added sugar from soft drinks was 260 kcal/day on average [Reedy & Krebs-Smith, 2010]. Furthermore, a high consumption level of soft drinks displaces milk and fruit juices in children's and adolescent's diets and was related to a lower intake of calcium, riboflavin, vitamin A, folate and vitamin C [Harnack *et al.,* 1999].

The sugars contained in fruit juices and sweetened beverages are easily digestible carbohydrates which "raise blood glucose and insulin concentrations rapidly and dramatically" [Malik *et al.*, 2010]. Insulin insensitivity is associated with the loss of hormonal satiety signals [Bray *et al.*, 2004; Bocarsly *et al.*, 2010]. However, there is a difference in insulin response depending on the kind of added sugar to food. The digestion, absorption, and metabolism of fructose differ from those of glucose [Bray *et al.*, 2004]. Results from both short-term and long-term studies show that fructose consumption results in decreased circulating levels of insulin and leptin when compared with glucose [Stanhope & Havel, 2008]. Insulin and leptin act as key signals in the long-term regulation of energy balance, trough *inter alia* regulation of food consumption [Bray *et al.*, 2004; Stanhope & Havel, 2008]. Long-term consumption of high fructose-diet can lead to an increasing energy intake and decreasing energy expenditure, consequently contributing to overweight and obesity [Bray *et al.*, 2004; Stanhope & Havel, 2008]. Fructose and glucose differently affect also lipids homeostasis. Hepatic metabolism of fructose favors *de novo* lipogenesis [Bray *et al.*, 2004]. High consumption of fructose increases postprandial triacylglycerol concentrations, plasma apoB-concentrations and cholesterol LDL [Stanhope & Havel, 2008]. In long-term

* Corresponding Author: E-mail: justyna.szczepanska@uwm.edu.pl (J.W. Wuenstel)

studies, plasma apoB-concentrations and small, dense LDL are increased in subjects who consumed fructose-sweetened, but not glucose sweetened, beverages for 10 weeks [Stanhope & Havel, 2008]. Higher consumption of high-fructose corn syrup and sucrose-sweetened beverages increases free TG concentrations to the same level as fructose alone [Stanhope & Havel, 2008]. High-fructose corn syrup is commonly used in the food industry, because of its higher sweetness than sucrose, but also because of improving the stability and functionality of food products and its lower price [Bray *et al.*, 2004]. Furthermore, fruit juices and sweetened beverages have a low satiety index and thus may affect an increase in the frequency and intake of sweetened beverages and products and other foods [Mourao *et al.*, 2007]. The review of literature indicated that high consumption of sugar-sweetened beverages was strongly associated with an increased risk of excessive body fat, diabetes, cardiovascular diseases, overall metabolic syndrome, non-alcoholic fatty liver disease and gout, but also dental caries or depression [Choi &Curhan, 2008; Cheng *et al.*, 2009; Bocarsly *et al.*, 2010; Lim *et al.*, 2010; Tappy *et al.*, 2010; Guo *et al.*, 2014].

A review of the literature shows different assessments of the impact of the excessive consumption of fruit juices and sweetened beverages on weight [Mattes *et al.*, 2011]. Some studies in animals and humans indicate that *ad libitum* consumption of fruit juices and soft drinks contributes significantly to weight gain [Mattes *et al.*, 2011]. However, there are epidemiological studies, animal studies and short-term physiological and behavioural studies that did not show such a relationship [Mattes *et al.*, 2011]. Some studies suggest an indirect effect of the consumption of sweetened beverages and fruit juices on weight, which depends on the consumption of these beverages and other foods. Children who drink a lot of fruit juices compared to children with a low intake had a lower intake of fat, saturated fat, added sugar and milk and a higher intake of whole fruit [Dennison *et al.*, 1997; O'Neil *et al.*, 2010]. A high consumption of sweetened beverages by adolescents was associated with a higher consumption of fast foods [Wądołowska, 2010]. The role of the frequent consumption of fruit juices and soft drinks in the development of overweight and obesity requires further study.

The differences in the consumption of sugar-sweetened beverages and fruit juices are related to age and gender. A national and international literature review shows that the consumption of fruit juices in childhood is prevalent and the habit of drinking fruit juice is replaced by the consumption of sugar-sweetened beverages in adolescents [Wądołowska, 2010]. What is not sufficiently understood are the differences in the frequency of consumption of fruit juices and sweetened beverages between girls and boys and young people from different age groups. It is also currently not known at what age the shape and perpetuate of the negative eating habits of young people (such as the frequent consumption of sugar-sweetened beverages) are developed.

Eating habits which determine the development and adolescent health and dietary behaviours in adulthood are shaped during childhood and adolescence [Wądołowska, 2010]. Understanding the determinants of overweight is crucial for the prevention of this disease and other diseases associated with obesity [Ezzati *et al.*, 2004]. The aim of this study was, therefore, to assess the relationship between the prevalence of overweight and the consumption of sweetened beverages in adolescents.

MATERIAL AND METHODS

Participants

The study was conducted in 2010–2011 among middle and high school students, selected by chance, following the agreement of school principals and parents on participating in our research. We carried out an observational study, where the population was collected purposive. We took the sample in a way to ensure adequate numbers of persons in every age subgroup (quota sampling). The study was carried out in the areas of northern, eastern and central Poland in five regions: Warmia and Mazury (61%), Mazowieckie (23%), Kujawsko-Pomorskie (6%), Podlaskie (6%) and Lodzkie (5%). Young people came from areas with different degrees of urbanization: rural (42%), small towns (<100,000 citizens) (36%) and big cities (≥100,000 citizens) (22%).

Trained interviewers carried out the questioning (via *hall testing*) and anthropometric measurements of height and body weight. Despite the fact, that the students were familiarized with the way to fill in the questionnaires, 787 persons have given incomplete questionnaires or ones incorrectly filled in (about 30% of the initial sample), which was a cause to be excluded. We focused only on adolescents with overweight (study group) and normal weight (control group), children with underweight (BMI=18.5–20.0 kg/m^2; n=107) or malnutrition (BMI<18.5 kg/m^2; n=33) were removed from further analysis (overall 5.4% of the initial sample). Youth with too high age (≥19 years) or too low age (<13 years) were as well removed (n=80, 3.1% of initial sample). We noticed a very small number of participants with satisfactory fibre intake (n=28, 1.1% of initial sample), which was the reason for excluding them as well from further analysis.

Methods

The prevalence of overweight was assessed using BMI (kg/m^2), which was calculated on the basis of height and body mass measurements, taken with an accuracy to 0.5 cm and 0.1 kg, respectively. The BMI was calculated for each person and, according to international standards developed by Cole [Cole *et al.*, 2000, 2007], divided into categories corresponding to the cut-off points used for adults. Information on the consumption frequency of various fruit juices was collected by a validated Block questionnaire [Thompson & Byers, 1994]. The questionnaire was expanded by questions on the frequency of sugar-sweetened beverage consumption. The questions referred to carbonated and non-carbonated beverages, with sample drinks in parentheses for easier understanding.

The frequency of consumption of fruit juices and sweetened beverages was expressed in 5 categories, which are assigned by numerical values (indicated in parentheses): less than once a week (1 point), once a week (2 pts.), 2–3 times per week (3 pts.), 4–6 times per week (4 pts.) and daily (5 pts.). The mean frequency of consumption of fruit juices and sweetened beverages were calculated (in the range of 1 to 5 pts.).

TABLE 1. Participant characteristics.

Sample size	Boys and Girls n = 1700	Boys n = 790	Girls n = 910	Boys – Girls difference		p
				absolute	relative (%)	
Age ($\bar{X}$±SD)						
Total sample	15.6±1.5	15.6±1.5	15.6±1.5	0.0	0	ns
13–14.9 years	14.1±0.5	14.0±0.5	14.1±0.5	-0.1	-1	ns
15–16.9 years	15.7±0.7	15.7±0.7	15.7±0.6	0.0	0	ns
17–18.9 years	17.5±0.5	17.5±0.5	17.5±0.5	0.0	0	ns
Age (% of sample)						
13–14.9 years	38	39	38	1	2	ns
15–16.9 years	31	30	31	-1	-2	ns
17–18.9 years	31	31	31	0	0	ns
Body mass (kg) ($\bar{X}$±SD)						
13–14.9 years	56.7±9.9	59.4±10.9	54.3±8.3	5.1	1	***
15–16.9 years	62.0±10.9	68.0±9.9	56.9±9.0	11.1	16	***
17–18.9 years	64.9±11.0	72.1±9.7	58.6±7.8	13.5	19	***
Height (cm) ($\bar{X}$±SD)						
13–14.9 years	165.7±8.1	168.5±8.7	163.1±6.6	5.4	3	***
15–16.9 years	170.3±9.3	176.4±8.3	165.0±6.6	11.4	6	***
17–18.9 years	172.2±9.3	179.3±7.0	166.1±6.1	12.9	7	***
BMI (kg/m^2) ($\bar{X}$±SD)						
13–14.9 years	20.6±2.8	20.8±3.2	20.4±2.6	0.4	2	*
15–16.9 years	21.3±2.8	21.8±2.8	20.9±2.7	0.9	4	***
17–18.9 years	21.8±2.6	22.4±2.4	21.3±2.6	1.1	5	***
Distribution BMI (% of sample)						
Underweight	6	3	9	-6	-217	***
Normal weight	77	74	80	-6	-8	**
Overweight	17	23	11	12	52	***

$\bar{X}$ – mean, SD – standard deviation, ns – not significant differences, *p<0.05, **p<0.01, ***p<0.001.

All statistical analyses were performed for the total sample and in three age groups: 13–14.9 years, 15–16.9 years and 17.0–18.9 years. The statistical analysis of the consumption of juices and beverages included only young people with normal weight and overweight (including 1,593 persons), after exclusion of underweight (107 people).

The average frequencies of the consumption of drinks were compared using the Kruskal-Wallis test. The distributions of consumption frequency were compared using chi-squares. Logistic regression analysis was used to assess the relationship between the frequency of fruit juices and sweetened beverage consumption and the prevalence of overweight in girls and boys. We used logistic regression per one factor. The odds ratio (OR) of overweight was calculated according to the frequency of consumption of fruit juices and sweetened beverages among boys and girls in different age groups. The reference group (OR=1.00) were young people with a consumption frequency of less than once a week. To assess the relevant influence of frequency of consumption on body mass, the Wald statistics were used. Statistical analysis was carried out using STATISTICA StatSoft 10.0 PL.

RESULTS

Participant characteristics

Boys and girls were at the same age according to the initial assumption of quota sampling. There were no gender differences in mean values and distributions in the age groups of the young people (Table 1). The age group 13–14.9 years constituted 38.1%, 15–16.9 years constituted 30.5% and 17–18.9 years represented 31.4% of the sample.

Our research confirmed significant differences in the weight and height of adolescents related to age and gender (Table 1). Boys had higher weight, height and BMI compared to girls in all age groups. In the older age groups, the differences were larger. In the age group 13–14.9 years, boys compared to girls had higher mean values of body height by 5.4 cm, weight by 5.1 kg and BMI by 0.4 kg/m^2. The differences in the age group 15–16.9 years were 11.4 cm, 11.1 kg and 0.9 kg/m^2 and in the age group 17–18.9 years were 12.9 cm, 13.5 kg and 1.1 kg/m^2 respectively.

Furthermore, 77.8% of the sample had normal weight, 16.9% were overweight and 6.3% were underweight (Table 1). Relatively more girls than boys had normal weight

TABLE 2. Frequency of fruit juiceconsumption among boys and girls with normal weight or overweight in different age groups (% of the sample).

Frequency of consumption	Total				Normal weight (NW)				Overweight (OW)			
	Total	Boys	Girls	p	Total	Boys	Girls	p	Total	Boys	Girls	p
Sample size	1593	767	826		1310	582	723		283	185	103	
Total												
$\bar{X}$±SD (pts.)	3.49±1.25[§]	3.44±1.24	3.53±1.26[§]	*	3.51±1.24[§]	3.34±1.28	3.54±1.25[§]	*	3.39±1.29	3.34±1.28	3.50±1.31	ns
< once a week	8	8	8	ns	8	9	8	ns	9	7	10	ns
once a week	13	15	12		13	18	12		16	14	13	
2–3 times/week	29	30	28		29	29	28		29	31	27	
4–6 times/week	22	20	22		22	18	22		19	21	19	
every day	28	27	30		28	26	30		27	27	31	
13–14.9 years												
$\bar{X}$±SD (pts.)	3.60±1.28[a]	3.52±1.25	3.67±1.30[b]	ns	3.61±1.27[c]	3.57±1.23	3.65±1.31[d]	ns	3.55±1.28[e]	3.40±1.32	3.81±1.2	ns
< once a week	7[AB]	7	8[C]	ns	8[D]	7	9[E]	ns	6	8	4	ns
once a week	13	15	11		12	13	11		18	22	10	
2–3 times/week	25	26	24		25	28	23		23	21	25	
4–6 times/week	21	22	19		21	22	20		20	20	21	
every day	34	30	38		34	30	37		33	29	40	
15–16.9 years												
$\bar{X}$±SD (pts.)	3.46±1.26	3.32±1.28	3.58±1.24	ns	3.51±1.23[#]	3.42±1.26	3.58±1.2	ns	3.19±1.30[#e]	3.16±1.3	3.23±1.3	ns
< once a week	9[A]	11	8	ns	8	9	7	ns	13	13	13	ns
once a week	11	14	9		11	13	9		15	16	13	
2–3 times/week	31	32	29		31	31	31		33	35	30	
4–6 times/week	22	19	24		23	21	24		18	14	24	
every day	27	24	30		27	26	29		21	22	20	
17–18.9 years												
$\bar{X}$±SD (pts.)	3.37±1.21[a]	3.41±1.19	3.33±1.23[b]	ns	3.37±1.20[c]	3.40±1.2	3.35±1.21[d]	ns	3.35±1.27	3.42±1.18	3.20±1.44	ns
< once a week	8[B]	6	9[C]	ns	8[D]	7	8[E]	ns	9	6	16	ns
once a week	15	15	15		15	15	15		15	14	16	
2–3 times/week	33	35	31		32	34	31		33	36	28	
4–6 times/week	21	20	23		22	19	25		17	20	12	
every day	23	24	22		23	25	21		26	24	28	

$\bar{X}$ – mean, SD – standard deviation, ns – not significant differences, *$p<0.05$, **$p<0.01$, ***$p<0.001$, [§] – differences in the mean frequency of fruit juice consumption according to age for total adolescents and NW and total girl consumption and NW ($p<0.05$), [#] – differences in the mean frequency of fruit juice consumption between adolescents with NW and OW ($p<0.05$), [a-a,...,e-e] – differences in the mean frequency of fruit juices consumption between pairs compared from various age groups ($p<0.05$), [A-A,...,E-E] – comparing the distribution frequency of fruit juice consumption between pairs from various age groups ($p<0.05$).

(79.4% *vs.* 73.7%, respectively) or were underweight (9.2% *vs* 2.9%), although fewer girls than boys were overweight (11.3% *vs.* 23.4%).

Fruit juices

Every day fruit juices were consumed by 28%, but less than once a week by 8% of the adolescents (Table 2). Girls significantly more frequently consumed fruit juices than boys. Differences were found between the girls and boys in total (mean values: 3.53 *vs.* 3.44 pts., respectively) and between girls and boys with normal weight (NW) (3.54 *vs.* 3.34 pts.). Among overweight (OW) boys and girls, the mean value of fruit juice consumption frequency was similar and was at 3.39 pts. The distribution analysis did not confirm the differences in the frequency of fruit juices consumption between girls and boys.

The lowest mean value of fruit juice consumption frequency was in the oldest age group for adolescent total consumption and girls. The differences in mean value of consumption between the age groups of 17–18.9 years and 13–14.9 years were 0.23 pts. for total adolescents (3.60 *vs.* 3.37 pts., respectively, Table 2), 0.24 pts. for NW adolescents (3.61 *vs.* 3.37 pts.) and 0.34 pts. for total girls (3.67 *vs.* 3.33 pts.) and 0.30 pts. for NW girls (3.65 *vs.* 3.35 pts.).

Among OW adolescents, the mean difference in the frequency of fruit juice consumption was 0.36 pts. between age groups 13–14.9 years and 15–16.9 years (3.55 *vs.* 3.19 pts.). The differences in distributions were equally 11pp (percentage points) among total adolescents and NW (34% *vs.* 23%) and equally 16pp among total girls and NW (38% *vs.* 22% and 37% *vs.* 21%, respectively).

Our research did not find significant differences in fruit juice consumption frequency according to weight, apart from adolescents aged 15–16.9 years (Table 2). In the age group 15–16.9 years, NW adolescents had a higher mean frequency of fruit juice consumption than OW adolescents (3.51 *vs* 3.19 pts.). The regression analysis also did not show a correlation between the frequency of fruit juice consumption and weight in either girls or boys (Table 3).

Sweetened beverages

Every day, sweetened beverages were consumed by 17% and less than once a week by 19% of the adolescents (Table 4). Boys drank more frequently sweetened beverages than girls – the differences were shown for total adolescent consumption (mean values: 3.25 *vs* 2.67 pts., respectively), NW adolescents (3.25 *vs* 2.64 pts.) and OW adolescents (3.25 *vs* 2.85 pts.). Differences were noted in all age groups for total and NW adolescents. For OW adolescents, the differences were noted in two age groups: 15–16.9 years and 17–18.9 years. An analysis of the distribution of consumption frequency confirmed that boys drank sweetened beverages more often than girls. Every day, sweetened beverages were consumed by more boys than girls among total adolescents (22% *vs* 13%) and NW adolescents (20% *vs* 12%). In each age category, the differences in daily consumption of sweetened beverages between

TABLE 3. The odds ratio of overweight in adolescents with varying frequency of drinking fruit juices compared to the young people consuming these drinks less than once / week. (reference group).

Age (years)	Frequency of consumption	Boys + Girls	Boys	Girls
Total	< once a week	1.00	1.00	1.00
	once a week	1.12 (0.65, 1.93)	1.16 (0.57, 2.34)	0.90 (0.37, 2.21)
	2–3 times/week	0.84 (0.51, 1.38)	0.81 (0.42, 1.55)	0.82 (0.37, 1.79)
	4–6 times/week	0.74 (0.44, 1.25)	0.74 (0.37, 1.48)	0.72 (0.32, 1.64)
	every day	0.83 (0.51, 1.37)	0.80 (0.41, 1.56)	0.88 (0.41, 1.91)
13–14.9	< once a week	1.00	1.00	1.00
	once a week	0.53 (0.21, 1.32)	0.64 (0.20, 2.03)	0.52 (0.09, 3.00)
	2–3 times/week	0.90 (0.38, 2.15)	1.51 (0.50, 4.60)	0.44 (0.09, 2.18)
	4–6 times/week	0.83 (0.34, 1.99)	1.29 (0.42, 3.97)	0.45 (0.09, 2.26)
	every day	0.83 (0.36, 1.93)	1.19 (0.40, 3.52)	0.45 (0.10, 2.09)
15–16.9	< once a week	1.00	1.00	1.00
	once a week	0.88 (0.34, 2.24)	0.89 (0.27, 2.98)	0.80 (0.16, 3.88)
	2–3 times/week	1.50 (0.67, 3.35)	1.24 (0.44, 3.53)	0.53 (0.14, 1.97)
	4–6 times/week	2.09 (0.86, 5.05)	0.48 (0.15, 1.59)	1.89 (0.48, 7.46)
	every day	0.48 (0.20, 1.12)	0.60 (0.20, 1.81)	0.38 (0.09, 1.52)
17–18.9	< once a week	1.00	1.00	1.00
	once a week	1.25 (0.44, 3.58)	1.05 (0.22, 4.88)	1.79 (0.39, 8.24)
	2–3 times/week	1.19 (0.47, 3.01)	1.18 (0.30, 4.68)	2.11 (0.55, 8.09)
	4–6 times/week	1.56 (0.57, 4.30)	1.17 (0.27, 5.07)	3.93 (0.79, 19.7)
	every day	1.09 (0.42, 2.87)	0.90 (0.22, 3.78)	1.44 (0.37, 5.63)

() in parentheses are the 95% confidence intervals; *p<0.05.

TABLE 4. Frequency of sweetened beverages consumption among boys and girls with normal weight or overweight in different age groups (% of the sample).

Frequency of consumption	Total				Normal weight				Overweight			
	Total	Boys	Girls	p	Total	Boys	Girls	p	Total	Boys	Girls	p
Sample size	1593	767	826		1310	582	723		283	185	103	
Total												
$\bar{X}$±SD (pts.)	2.95±1.34§	3.25±1.28	2.67±1.34§	****	2.91±1.33$^{\#\S}$	3.25±1.26	2.64±1.33	****	3.11±1.39$^{\#}$	3.25±1.35	2.85±1.43	*
< once a week	19	11	26	****	19	11	26	****	17	13	24	ns
once a week	19	17	21		20	17	22		17	17	17	
2–3 times/week	27	28	26		27	29	26		27	27	26	
4–6 times/week	18	22	14		18	23	14		16	18	13	
every day	17	22	13		16	20	12		23	25	20	
13–14.9 years												
$\bar{X}$±SD (pts.)	2.96±1.36	3.17±1.31	2.77±1.39^{b}	****	2.93±1.36	3.23±1.31	2.70±1.36	****	3.13±1.34	3.14±1.29	3.13±1.44^{f}	ns
< once a week	20	14	25^{B}	****	21	14	26	****	16	14	19	ns
once a week	17	15	19		18	14	20		17	16	17	
2–3 times/week	27	30	25		27	29	26		27	31	21	
4–6 times/week	18	21	16		17	22	14		20	20	20	
every day	18	20	15		17	21	14		20	19	23	
15–16.9 years												
$\bar{X}$±SD (pts.)	3.05±1.36^{a}	3.38±1.31	2.76±1.35^{bc}	****	3.03±1.33^{d}	3.38±1.25	2.75±1.33^{e}	****	3.21±1.52	3.44±1.46	2.80±1.56	ns
< once a week	18^{A}	10	24	****	17 $^{\alpha C}$	9$^{\beta}$	24	****	19$^{\alpha}$	11 $^{\beta D}$	33	***
once a week	18	16	19		18	14	20		17	24	7	
2–3 times/week	27	27	28		29	31	28		19	13	30	
4–6 times/week	17	20	15		18	22	15		13	16	7	
every day	20	27	14		18	24	13		32	36	23	
17–18.9 years												
$\bar{X}$±SD (pts.)	2.82±1.30^{a}	3.17±1.24	2.52±1.27^{c}	****	2.79±1.30^{d}	3.17±1.22	2.47±1.27^{e}	****	2.96±1.31	3.24±1.3	2.40±1.15^{f}	**
< once a week	19^{A}	11	27^{B}	****	20^{C}	9	29	****	18	14^{D}	24	*
once a week	23	19	27		24	22	26		17	10	32	
2–3 times/week	27	29	25		25	27	25		35	36	32	
4–6 times/week	18	24	12		18	25	11		13	18	4	
every day	13	17	9		13	17	9		17	22	8	

$\bar{X}$ – mean, SD – standard deviation, ns – not significant differences, *p<0.05, **p<0.01, ***p<0.001, § – differences in the mean frequency of sweetened beverage consumption according to age for total adolescents and NW and total girls (p<0.05), $^{\#}$ – difference in the mean frequency of sweetened beverage consumption between adolescents with NW and OW (p<0.05), $^{\alpha,\beta}$ – the difference in distributions frequency of sweetened beverage consumption between adolescents with NW and OW (p<0.05), $^{a\text{-}a,\ldots,e\text{-}e}$ – comparing the mean frequency of sweetened beverage consumption between pairs from various age groups (p<0.05), $^{A\text{-}A,\ldots,E\text{-}E}$ – comparing the distribution frequency of sweetened beverage consumption between pairs from various age groups (p<0.05).

the percentage of boys and girls were from 5% to 13% for total adolescents and from 7% to 11% for NW adolescents. Among OW adolescents, more boys than girls consumed sweetened beverages daily in two age groups 15–16.9 years (about 13pp) and 17–18.9 years (about 14pp).

The frequency of the consumption of sweetened beverages depended on age. Adolescents aged 17–18.9 years compared to adolescents aged 15–16.9 years had a lower mean value of consumption frequency among: adolescents total (2.82 *vs.* 3.05 pts., Table 4), NW adolescents (2.79 *vs.* 3.03 pts.), girls total (2.52 *vs.* 2.76 pts.) and girls NW (2.47 *vs.* 2.75 pts.). Among OW girls, a higher mean value of consuming sweetened beverages was in girls aged 17–18.9 years than those aged 13–14.9 years (3.13 *vs.* 2.40 pts.). An analysis of the distribution confirmed the impact of age on the consumption frequency of sweetened beverages among total adolescents and NW adolescents. The percentage of adolescents consuming sweetened beverages daily was lower in the age group 17–18.9 years than in the group 15–16.9 years, about 7pp among total adolescents (13% *vs.* 20%) and 6pp lower among NW adolescents (13% *vs* 18%). Among the total girls, girls aged 13–14.9 years had 6pp more daily consumption of sweetened beverages than girls aged 17–18.9 years (15% *vs.* 9%). For boys, the differences in consuming sweetened beverages related to age was confirmed among the overweight group. In the OW boys, daily consumption of sweetened beverages in the age group 17–18.9 years was lower by about 14pp than in the 15–16.9-year-old age group (36% *vs.* 22%).

Our research confirmed the relation between the higher frequency of sweetened beverage consumption and increased incidence of overweight. NW adolescents had a lower average frequency of sweetened beverages consumption than OW adolescents (2.91 *vs.* 3.11 pts., Table 4). A distribution analysis showed differences in weight according to the frequency of sweetened beverage consumption in the age group 15–16.9 years for total adolescents and total boys. The daily consumption of sweetened beverages was 14pp higher for OW adolescents than NW (32% *vs.* 18%) and 12pp for OW boys than NW (36% *vs.* 24%). Among girls, there was no significant relationship between weight and the frequency of consumption of sweetened beverages. A significant value of the odds ratio of overweight was found only among total adolescents consuming sweetened beverages every day compared to total adolescents with a frequency of consumption of less than once a week (reference group). The odd ratio was 1.62 (95%CI: 1.07, 2.46, Table 5). Among total boys and total girls, who declared daily consumption of sweetened beverages, the OR of overweight did not exceed statistical significance and amounted to 1.01 (95%CI: 0.61, 1.65) and 1.71 (95%CI: 0.90, 3.25), respectively.

DISCUSSION

Seventeen percents of adolescents in our study were overweight, which was equal to the results of a nationwide project OLAF, which was carried out in 2010 [Grajda *et al.*, 2011].

TABLE 5. The odds ratio of overweight in adolescents with varying frequency of drinking sweetened beverages compared to the young people consuming these drinks less than once / week (reference group).

Age (years)	Frequency of consumption	Boys + Girls	Boys	Girls
Total	< once a week	1.00	1.00	1.00
	once a week	0.98 (0.63, 1.51)	0.83 (0.44, 1.55)	0.85 (0.45, 1.62)
	2–3 times/week	1.10 (0.74, 1.63)	0.78 (0.44, 1.37)	1.07 (0.60, 1.92)
	4–6 times/week	1.04 (0.67, 1.62)	0.68 (0.37, 1.24)	0.99 (0.53, 1.83)
	every day	1.62 (1.07, 2.46)*	1.01 (0.61, 1.65)	1.71 (0.90, 3.25)
13–14.9	< once a week	1.00	1.00	1.00
	once a week	0.82 (0.41, 1.62)	0.88(0.33, 2.3)	0.89 (0.32, 2.47)
	2–3 times/week	1.31 (0.71, 2.40)	0.96(0.41, 2.21)	1.11 (0.42, 2.92)
	4–6 times/week	1.53 (0.80, 2.94)	0.92(0.37, 2.27)	1.11 (0.42, 2.92)
	every day	1.57 (0.81, 3.02)	0.88(0.35, 2.20)	2.28 (0.86, 6.05)
15–16.9	< once a week	1.00	1.00	1.00
	once a week	1.08 (0.49, 2.38)	0.72(0.22, 2.34)	4.23 (0.86, 20.7)
	2–3 times/week	1.72 (0.81, 3.68)	2.95(0.85, 10.21)	0.75 (0.28, 2.02)
	4–6 times/week	0.65 (0.28, 1.51)	1.58(0.47, 5.30)	0.31 (0.06, 1.51)
	every day	0.63 (0.31, 1.27)	0.81(0.27, 2.41)	1.26 (0.43, 3.70)
17–18.9	< once a week	1.00	1.00	1.00
	once a week	0.81 (0.36, 1.86)	3.34 (0.92, 12.2)	1.47 (0.48, 4.53)
	2–3 times/week	1.55 (0.75, 3.22)	1.10 (0.39, 3.11)	1.55 (0.50, 4.78)
	4–6 times/week	0.86 (0.36, 2.10)	2.07 (0.66, 6.51)	0.42 (0.05, 3.73)
	every day	0.64 (0.27, 1.49)	1.13 (0.37, 3.50)	0.97 (0.17, 5.41)

() in parentheses are the 95% confidence intervals; *p<0.05.

The lowest percentage of overweight (10%) among adolescents was noted in a nationwide project in 2001 [Szponar *et al.*, 2003]. According to the data of the Central Statistical Office (CSO) in Poland from 2009, 10.6% were overweight [Central Statistical Office, 2011]. In comparison to the results of this study, the incidence of overweight reported by the CSO was higher by over 6pp.

Overweight was almost two times more frequent among boys than girls, being confirmed by WHO data [HBSC International Report, 2008]. According to WHO data for Poland, 17% of the boys and 10% of the girls in the group of 11-year-olds were overweight or obese, 14% and 8% respectively in the group of 13-year-olds and 12% and 6%, respectively in the group of 15-year-olds [HBSC International Report, 2008]. However, the literature review showed conflicting information about the prevalence of overweight in boys and girls. In general, boys have a higher BMI than girls of the same age [Central Statistical Office, 2011; Health Statistics Division at Statistics Canada, 2003]. However, many researchers show a higher prevalence of overweight among girls than boys [McCarthy *et al.*, 2003; Szponar *et al.*, 2003]. This shows that there is a need for monitoring overweight in order to determine the differences between girls and boys and to explain their reasons.

Fruit juices

Our research, along with other Polish authors, indicates that about 50–60% of adolescents consumed fruits juices several times a week, or more often [Łoboda & Gawęcki, 2011]. According to the data of the Central Statistical Office (CSO), more youth consumed fruit juices once a day or more among the age group 10–14 years than the age group 15–19 years (61.0% *vs.* 52.7%, respectively). In both age groups, young people living in cities more often drank fruit juice than young people living in rural areas (59.1% *vs* 54.5%). Among US adolescents aged 12–19, a daily consumption of fruit juices was noticed only among 23% of young people, regardless of the week day [Wang *et al.,* 2008]. In another US research, the daily consumption of 100% fruit juices was noticed among 28% of the US adolescents aged 12–18 with a mean value of an amount of 3.7 ounces (~105 g), which was equal to 2.2% of the energy intake per day [O'Neil *et al.,* 2010]. Adolescents consuming 100% fruit juices compared to non-consumers had a higher intake of carbohydrate, fibre, vitamins C and B6, folate, potassium, copper, magnesium and iron and a lower intake of fat, saturated fatty acids and added sugar [O'Neil *et al.,* 2010]. The consumption of 100% fruit juices was greater in pre-school children, than in adolescents. Among children, almost half of them (47.9%) were consuming daily 100% fruit juices [O'Connor *et al.,* 2006]. For comparison, in Germany 100% fruit juices were consumed daily only by 14.9% of boys and 16.4% of girls aged 9–18 [Libuda *et al.,* 2008]. For European countries, the mean value of energy intake from all beverages was about 385 kcal/day, whereof 18.1% was delivered from fruit juices (~70 kcal/day) [Duffey *et al.,* 2012].

The consumption of fruit juices has increased considerably. One of the causes of this has been the promotion of the pro-healthy qualities of juices in some countries and recommending them as equivalent servings of fruits [Wądołowska, 2010]. This trend has continued for many years, but in recent years the trend has started to change. Reports of the important role of an increasing consumption of fruit juices in the development of overweight and obesity caused the consumption of fruit juices to decrease, especially in countries with high nutritional education. In Norway, a decrease had been noted in the frequency of consumption of fruit juice from 3–6 times per week in 2001 to 3–4 times per week in 2008. The differences resulted mainly from a significant decrease in the frequency of consumption of juices among girls (from 3–8 times/week to 3–4 times/week) [Stea *et al.*, 2012]. The decrease in the consumption of fruit juice is more common among Caucasian families with a higher socio-economic status and higher educational level of the parents [Di Noia & Contento, 2010].

Food choice among young people is multi-factorial and depends on individual characteristics and environmental impacts, including families and the peer environment [Wądołowska, 2010]. In our study, the frequency of juice consumption significantly depended on the gender and age of the youth. The consumption frequency of fruit juices decreased with age across all categories of weight, even though with growing age the acceptance of acidic and bitter taste increases, which is identified in fruit juices [Nu *et al.*, 1996]. The frequency of the consumption of fruit juices was the highest in the youngest age groups, both in adolescents with normal weight and overweight. A higher intake of fruit juices in the youngest age groups could be due to the impact of parents on children's nutrition and their beliefs about the high nutritional value of juices [Van Lippevelde *et al.*, 2013]. A higher frequency of juice consumption among girls than among boys could be reported due to their greater attention to consuming health-promoting foods and a preference for sour taste [Wądołowska, 2010].

The weight did not depend significantly on the frequency of fruit juice consumption. A comparison of our results to those obtained by other authors is difficult because of the large variation of results. Some studies point to the strong association of the increase in the amount of consumed fruit juices or consumed energy from them and an increase in the prevalence of overweight among children [Malik *et al.*, 2006]. However, other studies do not confirm this association or confirmed it to a limited extent, *i.e.* only for already obese children or those predisposed to weight gain [Faith *et al.*, 2006; Malik *et al.*, 2006]. There are also studies showing that the consumption of 100% fruit juice improves the nutritional quality of the diet and provides significant nutritional benefits and does not increase the risk of obesity [O'Neil *et al.*, 2011]. In nutritional studies, fruit juices are sometimes treated as a separate group, but mostly as a part of soft drinks or as a part of the group of vegetables and fruit. Another limitation is a lack of differentiation for sugar-sweetened fruit juices and 100% fruit juices. Furthermore, in European countries mostly sucrose is used to sweeten fruit juices, while in the USA high-fructose corn syrup is used [Libuda *et al.,* 2008]. These differences pose difficulties in the comparison of the results and general inference. This indicates that the assessment of fruit juice consumption according to increase in overweight prevalence requires further investigation.

Sweetened beverages

Most young people have a frequent or very frequent consumption of sugar-sweetened beverages, as confirmed by the results of other Polish authors [Łoboda & Gawęcki, 2011] and review papers [Wądołowska, 2010]. According to WHO data involving 41 countries and regions, from 6% (Finland) to 50% (Bulgaria) of the adolescents aged 13–15 were consuming soft drinks on a daily basis [HBSC International Report, 2008]. The lowest levels of soft drinks consumption are found among boys and girls in northern Europe, while girls in eastern Europe have notably high rates [HBSC International Report, 2008]. In addition, 84% of the US adolescents aged 12–19 consumed sugar sweetened-beverages on a daily basis, while its overall consumption was higher in weekends than weekdays (88% *vs.* 83%) [Wang *et al.,* 2008]. In comparison to other countries, soft drinks consumption was moderately high among Polish adolescents (31–33% of the boys and 22–27% of the girls aged 13–15) [HBSC International Report, 2008]. The consumption of sweetened beverages among children is very high, despite public campaigns showing the negative aspects of their excessive consumption. In Norway, which is a country widely promoting nutritional knowledge among its population, in the last 10 years there has been a significant decrease in the frequency of consumption of sugar-sweetened beverages (from 2–7 times per week to 1–6 times per week) and a simultaneous increase in the consumption of diet soda (from 1–2 times per week to 1–6 times per week) [Stea *et al.*, 2012]. Among adolescents from Northern, Southern and Western European countries with higher parental occupational status the soft drink consumption was lower [Vereecken *et al.,* 2005]. Only in Central and Eastern European countries was a significant increase in soft drink consumption with increasing family affluence found [Vereecken *et al.,* 2005].

The consumption of sweetened beverages significantly depends on the gender and age of the youth. In infancy and childhood, boys and girl had a similar consumption of soft drinks [Vereecken *et al.,* 2005]. Among adolescents with normal weight, boys drank sweetened beverages more often than girls, regardless of age. Among overweight adolescents, there were differences only among adolescents older than 15 years. Our results in this area are similar to the results of other authors. In most of the European countries, the sweetened beverages consumption was higher in boys than girls, especially in 15-year-olds [HBSC International Report, 2008]. Among US adolescents (13–18 years), soft drinks consumption was two times higher among boys than girls [Harnack *et al.,* 1999]. There is a general tendency (more so in boys) for soft drinks consumption to increase between ages 11 and 15 [HBSC International Report, 2008]. The increase in sweetened beverage consumption was independently associated with male gender and older age groups [Forshee & Storey, 2003]. Overweight boys and boys older than 15 years had the highest average frequency of sweetened beverages consumption compared to the other groups of boys and girls [Forshee & Storey, 2003].

Our research confirmed the strong relationship between frequent consumption of sweetened beverages and an increased incidence of overweight. Many authors did not report a direct effect of an increase in the consumption of sweetened beverage on increasing BMI or changes in other somatic parameters of adolescents [Ebbeling *et al.*, 2006; Łoboda & Gawęcki, 2011; Malik *et al.*, 2006]. However, epidemiological studies in children have confirmed that a high intake of beverages plays an important role in the development of obesity [Malik *et al.*, 2006; O'Neil *et al.*, 2011]. In our study, a stronger relationship between the consumption of sweetened beverages and weight in boys than girls was reported. Among adolescents the chance of being overweight increases by 62% (OR=1.62) with a daily consumption of sweetened beverages, which was coincident with results received by Ludwig *et al.* [2001]. The odds ratio of becoming obese among children increased 1.6 times for each additional can or glass of sugar-sweetened drink that they consumed every day [Ludwig *et al.,* 2001].

STRENGTHS AND LIMITATIONS OF OUR RESEARCH

A limitation of this work is the lack of information on the level of physical activity and the overall energy of the youth diet. Those results were not collected during the study. The strength of the study is the large sample size, with a similar number of groups in terms of age and gender and a balanced pattern of urbanization of residence – which accurately reflects the structure of the nation. Carefully conducted measurements of weight and height, but also a weight distribution similar to other national studies and WHO data, enhance the strength of our study [Grajda *et al.*, 2011; HBSC International Report, 2008]. This characterization of the sample increases the inference strength and generalization of the results. The study was part of a larger research, whose major aim was to assess the relation between the consumption frequency of dietary fibre and its sources and prevalence of overweight among adolescents. The target group was a large group of pupils aged 13–18.9, thereby we used short Block screening questionnaire, which is simply to fill in and requires only a short period of time. Furthermore, the tool used to assess nutritional patterns is characterised by high reproducibility and reliability of results [Thompson & Byers, 1994]. Collecting information about energy intake requires more complex and expensive methods and tools. Even lower-cost tools like a 24-h diet recall or a food record are more complicated to conduct, require longer time and are less likely to being filled in correctly by the respondents.

CONCLUSIONS

The frequency of consumption of fruit juices and sweetened beverages was more strongly related to age and gender than to weight. Girls consumed fruit juices and less sweetened beverages more often than boys. Among girls, there was a decreased frequency of consumption of fruit juices and sweetened beverages with age. Among boys, only the frequency of fruit juices consumption decreased with age. The prevalence of overweight among adolescents was associated with the frequency of sweetened beverage consumption, but not with the frequency of fruit juice consumption.

ACKNOWLEDGEMENTS

Thanks are expressed to the participants for their contributions to the study. The study was financed from resources of the Department of Human Nutrition, University of Warmia and Mazury in Olsztyn, Poland.

REFERENCES

1. Belpoggi F., SoffrittiM., TibaldiE., Falcioni L., BuaL., Trabucco F., Results of long-term carcinogenicity bioassays on Coca-Cola administered to Sprague-Dawley rats. Ann. NY Acad. Sci., 2006, 1076, 736–752.
2. Bocarsly M.E., Powell E.S., Avena N.M., Hoebel B.G., High--fructose corn syrup causes characteristics of obesity in rats: Increased bodyweight, body fat and triglyceride levels. Pharmacol. Biochem. Behav., 2010, 97, SI, 101–106.
3. Bray G.A., Nielsen S.J, Popkin B.M., Consumption of high-fructose corn syrup in beverages may play a role in the epidemic of obesity. Am. J. Clin. Nutr., 2004, 79, 537–543.
4. Central Statistical Office. Zdrowie dzieci i młodzieży w Polsce w 2009 r., 2011, Kraków, Poland (in Polish).
5. Cheng R., Yang H., Shao M.Y., Hu T., Zhou X.D., Dental erosion and severe tooth decay related to soft drinks: a case report and literature review. J. ZhejiangUniv. Sci. B., 2009, 10, 395–399.
6. Choi H.K., Curhan G., Soft drinks, fructose consumption, and the risk of gout in men: prospective cohort study. Brit. Med. J., 2008, 336, 309–312.
7. Cole T.J., Bellizzi M.C., Flegal K.M., Dietz W.H., Establishing a standard definition for child overweight and obesity worldwide, international survey. Brit. Med. J., 2000, 320,1240–1243.
8. Cole T.J., Flegal K.M., Nicholls D., Jackson A.A., Body mass index cut offs to define thinness in children and adolescents, international survey. Brit. Med. J., 2007, 335, 194–197.
9. Ezzati M., Lopez A.D., Rodgers A., Murray C.J.L., Comparative quantification of health risks, global and regional burden of disease attributable to selected major risk factors. WHO Reports, 2004, Geneva.
10. Dennison B.A., Rockwell H.L., Baker S.L., Excess fruit juice consumption by preschool-aged children is associated with short stature and obesity. Pediatrics, 1997, 99, 15–22.
11. Di Noia J., Contento I.R., Fruit and vegetable availability enables adolescent consumption that exceeds national average. Nutr. Res., 2010, 30, 396–402.
12. Duffey K.J., Huybrechts I., Mouratidou T., Libuda L., Kersting M., De Vriendt T., Gottrand F., Widhalm K., Dallongeville J., Hallström L., González-Gross M., De Henauw S., Moreno L.A., Popkin B.M., Beverage consumption among European adolescents in the HELENA study. Eur. J. Clin. Nutr., 2012, 66, 244–252.
13. Ebbeling C.B., Feldman H.A., Osganian S.K., Chomitz V.R., Ellenbogen S.J., Ludwig D.S., Effects of decreasing sugar-sweetened beverage consumption on body weight in adolescents, a randomized; controlled pilot study. Pediatrics, 2006, 117, 673–668.
14. Faith M.S., Dennison B.A., Edmunds L.S., Stratton H.H., Fruit juice intake predicts increased adiposity gain in children from low-income families: Weight status-by-environment interaction. Pediatrics, 2006, 118, 2066–2075.
15. Forshee R.A., Storey M.L., Total beverage consumption and beverage choices among children and adolescents. Int. J. Food Sci. Nutr., 2003, 54, 297–307.
16. Forshee R.A., Anderson P.A., Storey M.L., Sugar-sweetened beverages and body mass index in children and adolescents: a meta-analysis. Am. J. Clin. Nutr., 2008, 87, 1662–1671.
17. Grajda A., Kułaga Z.,Gurzkowska B., Napieralska E., Litwin M., Regional differences in the prevalence of overweight; obesity and underweight among polish children and adolescents. Medycyna Wieku Rozwojowego, 2011, 3, 258–265 (in Polish, English abstract).
18. Guo X., Park Y., Freedman N.D., Sinha R., Hollenbeck A.R., Blair A., Chen H., Sweetened beverages, coffee, and tea and depression risk among older US adults. PLOS ONE, 2014, 9, 1–7.
19. Harnack L., Stang J., Story M., Soft drink consumption among US children and adolescents: nutritional consequences. J. Amer. Dietet. Assoc., 1999, 99, 436–441.
20. HBSC, Health Behaviour In School-Aged ChildrenInternational Report From The 2005/2006 Survey. Health Policy For Children And Adolescents, No. 5, WHO 2008.
21. Health Statistics Division at Statistics Canada. Parent and child factors associated with youth obesity. Supplement to Health Reports v.14, 2003.
22. Libuda L., Alexy U., Sichert-Hellert W., Stehle P., Karaolis--Danckert N., Buyken A.E., Kersting M., Pattern of beverage consumption and long-term association with body-weight status in German adolescents–results from the DONALD study. Br. J. Nutr., 2008, 99, 1370–1379.
23. Lim J.S., Mietus-Snyder M., Valente A., Schwarz J.M., Lustig R.H., The role of fructose in the pathogenesis of NAFLD and the metabolic syndrome. Nat. Rev. Gastroenterol. Hepatol., 2010, 7, 251–264.
24. Łoboda D., Gawęcki J., Udział płynów w żywieniu wybranej grupy gimnazjalistów a skład ich ciała. Probl. Hig. Epidemiol., 2011, 92, 83–88 (in Polish).
25. Ludwig D.S., Peterson K.E., Gortmaker S.L., Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. Lancet, 2001, 357, 505–508.
26. Malik V.S., Schulze M.B., Hu F.B., Intake of sugar-sweetened beverages and weight gain, a systematic review. Am. J. Clin. Nutr., 2006, 84, 274–288.
27. Malik V.S., Popkin B.M., Bray G.A., Després J.P., Willett W.C., Hu F.B., Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes. Diabetes Care, 2010, 33, 2477–2483.
28. Mattes R.D., Shikany J.M., Kaiser K.A., Allison D.B., Nutritively sweetened beverage consumption and body weight: a systematic review and meta-analysis of randomized experiments. Obes. Rev., 2011, 12, 346–365.
29. McCarthy H.D., Ellis S.M., Cole T.J., Central overweight and obesity in British youth aged 11–16 years, cross sectional surveys of waist circumference. Brit. Med. J., 2003, 326, 624–626.
30. Mourao D.M., Bressan J., Campbell W.W., Mattes R.D., Effects of food form on appetite and energy intake in lean and obese young adults. Int. J. Obesity, 2007, 31, 1688–1695.
31. Nu C.T., MacLeod P., Barthelemy J., Effects of age and gender on adolescents' food habits and preferences. Food Qual. Prefer., 1996, 7, 251–262.

32. O'Connor T.M., Yang S.J., Nicklas T.A., Beverage intake among preschool children and its effect on weight status. Pediatrics, 2006, 118, E1010-E1018.
33. O'Neil C.E., Nicklas T.A., Kleinman R., Relationship between 100% juice consumption and nutrient intake and weight of adolescents. Am. J. Health Prom., 2010, 24, 231–237.
34. O'Neil C., Nicklas T., Rampersaud G., Fulgoni V.L., One hundred percent orange juice consumption is associated with better diet quality; improved nutrients adequacy; and no increased risk for overweight. Nutr. Res., 2011, 31, 673–682.
35. Reedy J., Krebs-Smith S.M., Dietary sources of energy, solid fats, and added sugars among children and adolescents in the United States. J. Am. Diet. Assoc., 2010, 110, 1477–1484.
36. Stanhope K.L., Havel P.J., Endocrine and metabolic effects of consuming beverages sweetened with fructose, glucose, sucrose, or high-fructose corn syrup. Am. J. Clin. Nutr., 2008, 88, 1733S-1737S.
37. Stea T.H., Øverby N.C., Klepp K.I., Bere E., Changes in beverage consumption in Norwegian children from 2001 to 2008. Public Health Nutr., 2012, 15, 379–385.
38. Szponar L., Sekula W., Rychlik E., Oltarzewski M., Figurska K., Badania indywidualnego spożycia żywności i stanu odżywienia w gospodarstwach domowych. 2003, IŻiŻ, Warszawa, Poland (in Polish).
39. Tappy L., Lê K.A., Tran C., Paquot N., Fructose and metabolic diseases: new findings, new questions. Nutrition, 2010, 26, 1044–1049.
40. Thompson F.E., Byers T., Dietary assessment resource manual.J.Nutr., 1994, 124, S2245-S2317.
41. Van Lippevelde W., Velde S.J., Verloignea M., De Bourdeaudhuij I., Manios Y., Bere E., Jan N., Fernández-Alvira J.M., Chinapaw M.J., Bringolf-Isler B., Kovacs E., Brug J., Maes L., Associations between home- and family-related factors and fruit juice and soft drink intake among 10- to 12-year old children. The Energy project. Appetite, 2013, 61, 59–65.
42. Vereecken C.A., Inchley J., Subramanian S.V., Hublet A., Maes L., The relative influence of individual and contextual socioeconomic status on consumption of fruit and soft drinks among adolescents in Europe. Eur. J. Public Health, 2005, 15, 224–232.
43. Wang Y.C., Bleich S.N., Gortmaker S.L., Increasing caloric contribution from sugar-sweetened beverages and 100% fruit juices among US children and adolescents, 1988–2004. Pediatrics, 2008, 121, E1604-E1614.
44. Wądołowska L., Żywieniowe podłoże zagrożeń zdrowia w Polsce. 2010, Wydawnictwo Uniwersytetu Warmińsko-Mazurskiego, Olsztyn, Poland (in Polish).

Submitted: 12 February 2014. Revised: 3 May 2014. Accepted: 30 May 2014. Published on-line: 15 December 2014.