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CAFFEINE INTAKE FROM CARBONATED BEVERAGES AMONG PRIMARY SCHOOL-AGE CHILDREN

SPOŻYCIE KOFEINY Z NAPOJÓW GAZOWANYCH PRZEZ DZIECI W WIEKU SZKOLNYM

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Abstract

Aim: The aim of the study was to assess caffeine intake from cola beverages and energy drinks, as well as the consumption frequency among primary-school-age children in relation to other dietary habits.

Material and methods: The study included 329 children (aged 11-13 years) from five randomly selected schools in Warsaw. Caffeine intake was assessed from a food frequency questionnaire. The face-to-face interview method was selected.

Results: 89.7% of the children consumed carbonated beverages with caffeine, of which nearly 24% consumed energy drinks. The median caffeine intake from carbonated beverages was 0.12 mg/kg body weight/day, accounting for 4.8% of the recommended maximum daily intake from all dietary sources. Frequent consumers of cola drinks were often found to eat fast foods, as well as salty snacks.

Conclusions: Caffeine intake in the studied group of children turned out to be at a safe level. The safe dose of caffeine does not mean that consumption of carbonated drinks should not raise any concerns. The recently established legal ban on selling unhealthy foods at school is a good idea, since the school should not be a place for improper dietary models.

Key words: cola drinks, energy drinks, diet

Streszczenie

Cel: Ocena spożycia kofeiny z napojami gazowanymi (typu cola i energetyzującymi), a także częstotliwość ich konsumpcji przez dzieci w wieku szkolnym, z uwzględnieniem nawyków żywieniowych.

Materiał i metody: Badaniem objęto 329 dzieci (w wieku 11-13 lat) z pięciu losowo wybranych szkół podstawowych w Warszawie. Spożycie oceniano na podstawie kwestionariusza częstotliwości spożycia tych produktów metodą bezpośredniego wywiadu z uczniami.

Wyniki: 89,7% dzieci spożywało napoje gazowane z kofeiną, z czego prawie 24% dzieci spożywało napoje energetyzujące. Mediana spożycia kofeiny wyniosła 0,12 mg/kg masy ciała/dz., co stanowiło 4,8% dopuszczalnego dziennego spożycia ze wszystkich źródeł w diecie. Dzieci, które często spożywały napoje typu cola, również często spożywały produkty typu fast food oraz słone przekąski.

Wnioski: Spożycie kofeiny z napojów gazowanych było na poziomie bezpiecznym. Nie oznacza to jednak, że picie przez dzieci napojów z kofeiną nie budzi żadnych obaw zdrowotnych. Ustanowienie przepisów zakazujących w szkołach sprzedaży żywności o nieodpowiedniej wartości odżywczej jest dobrą inicjatywą, promującą prozdrowotne wzorce żywieniowe.

Słowa kluczowe: napoje typu cola, napoje energetyzujące, dieta

INTRODUCTION

Caffeine is a frequent component in the diet of both adults and children. Cola drinks, chocolate, and tea are the main sources of caffeine for children and adolescents [1, 2]. In recent years the range of caffeinated products has visibly expanded, including energy drinks, potato crisps, cereal products and even water, which may change the structure of caffeine sources in a diet [2-5]. The growing popularity of such foods and the lack of a legal limit for caffeine used in food may cause a significant increase of caffeine intake by children and youth. Currently, the literature even mentions the term 'caffeinating children and youth' [4, 6].

Caffeine is not a nutrient but a psychoactive substance and, as such, may have a potentially negative impact on health. The exact effect of caffeine consumption on the development and health of children remains to be elucidated [7-10]. Numerous experts emphasize that due to the fast growth of the body and the immaturity of the central nervous system, the effects of caffeine consumption on children may differ from those observed in adults [4, 9, 11]. The risk related to caffeine intake results from its negative impact on calcium balance. Insufficient consumption of calcium by children and youth, which has been observed in recent years, combined with increased caffeine intake may have a negative effect on bone mass [5, 12, 13]. High caffeine intake by children may also result in irritation, sleep disturbance and stomach problems [4, 14, 15]. Although moderate caffeine intake is known to have a positive effect on the cognitive performance in adults, it probably does not have such an effect on children [4, 8].

There is a common agreement that caffeine intake by children and adolescents should be limited, but an official recommendation on daily caffeine intake has been issued only in Canada and states that caffeine intake by children aged 12 and under should not exceed 2.5 mg/kg bw per day (i.e. 85 mg for children aged 10-12 years) [16, 18]. The Food Safety Authority in New Zealand estimated that the addition of one retail unit of energy drink to children's diet can result in exceeding the safe level of caffeine intake by 70% in children aged 5-12 years old [5].

In order to limit caffeine intake and to raise the awareness that the substance can be added to products traditionally not containing caffeine, there are new revised European Union regulations which established that foods with added caffeine must be labeled with the statement "Contains caffeine. Not recommended for children and pregnant women" in the same field of vision as the name of the food [19].

To the best of our knowledge, there were no studies on caffeine intake by children in Poland at the time our research was conducted. Therefore, the aim of our study was to estimate caffeine intake from carbonated beverages available on the Warsaw market.

THE AIM OF THE STUDY

The aim of the study was to assess caffeine intake from cola beverages and energy drinks, as well as the consumption frequency among primary-school-age children in relation to other dietary habits.

MATERIAL AND METHODS

The study covered 329 children (165 girls and 164 boys) from grades 5 and 6 of primary school (aged 11-13) at five randomly selected schools in Warsaw. The investigation was conducted in the years 2009-2010. The approval of the Ethics Committee of the National Food and Nutrition Institute in Warsaw was obtained.

Caffeine intake was estimated using a food frequency questionnaire regarding the consumption of cola-type beverages and energy drinks. It was carried out in the form of personal interviews with the school children under a dietetician's supervision, using an *album* of photographs showing food products. The unit of measurement for cola-type beverages and energy drinks were glasses (200 ml) and cans (250 ml), respectively. In order to estimate caffeine intake from carbonated drinks, the following average caffeine content was assumed in each group of products:

- cola-type drinks: 10 mg of caffeine/100 ml – according to Polish data [20],
- energy drinks: 32 mg of caffeine/100 ml – according to the labelling of energy drinks available in Warsaw at the time of the study [20].

Daily caffeine intake was expressed as a median and per kilogram of the child's body weight. The measurement of body weight was conducted by the school nurse.

The questionnaire also contained data regarding the consumption of fast foods (hamburgers, French fries, pizza, hot-dogs), salty snacks (potato crisps, crackers, salty sticks, salty snacks) and bottled water.

The relation between the frequency of consumption of cola drinks, fast foods, salty snacks and bottled water was analyzed using a non-parametric Kruskal-Wallis test. The consumption of cola drinks, fast foods and salty snacks every day or several times a week was deemed as 'often', whereas in the case of water 'often' means it was consumed every day. Calculations were made using Stata v.11.

RESULTS

Caffeine intake

Caffeine intake from carbonated beverages ranged from 0 to 224 mg/day. The median of daily caffeine intake in the entire study group was 4.0 mg, whereas in the group of consumers of cola drinks and/or energy drinks (5.71 mg).

The consumption of caffeine (median) with respect to the body weight of the children examined was 0.09 mg/kg bw/day in the entire study population and 0.12 mg/kg bw/day in the group of consumers. This consumption accounts for 3.6% and 4.8% of the recommended maximum daily caffeine intake, respectively. A small proportion of the children (0.6%) had a caffeine intake that exceeded the recommended daily limit of 2.5 mg/kg bw/day.

Consumption of carbonated beverages

Cola drinks were consumed by 89.1% of the children investigated. Although 5.8% of the respondents consumed them every day, the majority reported the use of cola

Table I. Consumption rates among the study population.

Tabela I. Częstotliwość spożycia w badanej populacji.

Cola drinks <i>Napoje typu cola</i>		
Consumption frequency <i>Częstotliwość spożycia</i>	Percentage of children <i>Odsetek dzieci</i>	Consumption volume (consumers only) <i>Wielkość spożycia (wyłącznie konsumenci)</i> Median (25%; 75%)
Total <i>Całkowicie</i>	89.1	40.0 (20; 114) ml/day
Every day <i>Codziennie</i>	5.8	400.0 (400; 600) ml/day
Several times a week <i>Kilka razy w tygodniu</i>	27.1	800.0 (600; 1000) ml/week
Several times a month <i>Kilka razy w miesiącu</i>	56.2	900.0 (600; 1200) ml/month
Energy drinks <i>Napoje energetyzujące</i>		
Consumption frequency <i>Częstotliwość spożycia</i>	Percentage of children <i>Odsetek dzieci</i>	Consumption volume (consumers only) <i>Wielkość spożycia (wyłącznie konsumenci)</i> Median (25%; 75%)
Total <i>Całkowicie</i>	23.8	20.8 (8; 42) ml/day
Every day <i>Codziennie</i>	0	-
Several times a week <i>Kilka razy w tygodniu</i>	4.0	500.0 (500; 750) ml/week
Several times a month <i>Kilka razy w miesiącu</i>	19.8	500.0 (250; 1000) ml/month
Fast foods <i>Żywność typu fast food</i>		
Consumption frequency <i>Częstotliwość spożycia</i>	Percentage of children <i>Odsetek dzieci</i>	
Total <i>Całkowicie</i>	94.5	
Every day <i>Codziennie</i>	0.3	
Several times a week <i>Kilka razy w tygodniu</i>	4.3	
Several times a month <i>Kilka razy w miesiącu</i>	27.1	
Less frequently <i>Rzadziej</i>	62.8	
Salty snacks <i>Słone przekąski</i>		
Total <i>Całkowicie</i>	100	
Every day <i>Codziennie</i>	4.8	
Several times a week <i>Kilka razy w tygodniu</i>	36.5	
Several times a month <i>Kilka razy w miesiącu</i>	35.9	
Less frequently <i>Rzadziej</i>	22.8	

Table I. Cont.

Tabela I. Cd.

Bottled water <i>Woda w butelkach</i>	
Total <i>Całkowicie</i>	98.5
Every day <i>Codziennie</i>	69.0
Several times a week <i>Kilka razy w tygodniu</i>	18.5
Several times a month <i>Kilka razy w miesiącu</i>	4.6
Less frequently <i>Rzadziej</i>	6.4

beverages at the level of 'several times a month', the median daily intake of cola drinks was small (40 ml) (tab. I). Energy drinks were consumed by 23.8% of the children, usually several times a month. In total, carbonated beverages were consumed by 89.7% of the studied children. There were no statistically significant differences in the frequency of the consumption of cola drinks between boys (90.2%) and girls (87.8%), but energy drinks were more popular among boys (29.8%) as compared to girls (17.6%) ($p < 0.01$). Cola drinks and energy drinks contributed to 83% and

17% of caffeine exposure from carbonated drinks, respectively.

The children's knowledge about energy drinks

The majority of the respondents (84.2%) stated that energy drinks can not be consumed by children, while the remaining 15.8% thought otherwise. A correlation has been found between the respondents' opinion about energy drinks and the frequency of their consumption. Those who believe that such drinks are not recommended for children drink them less often ($p = 0.0001$) (Fig. 1).

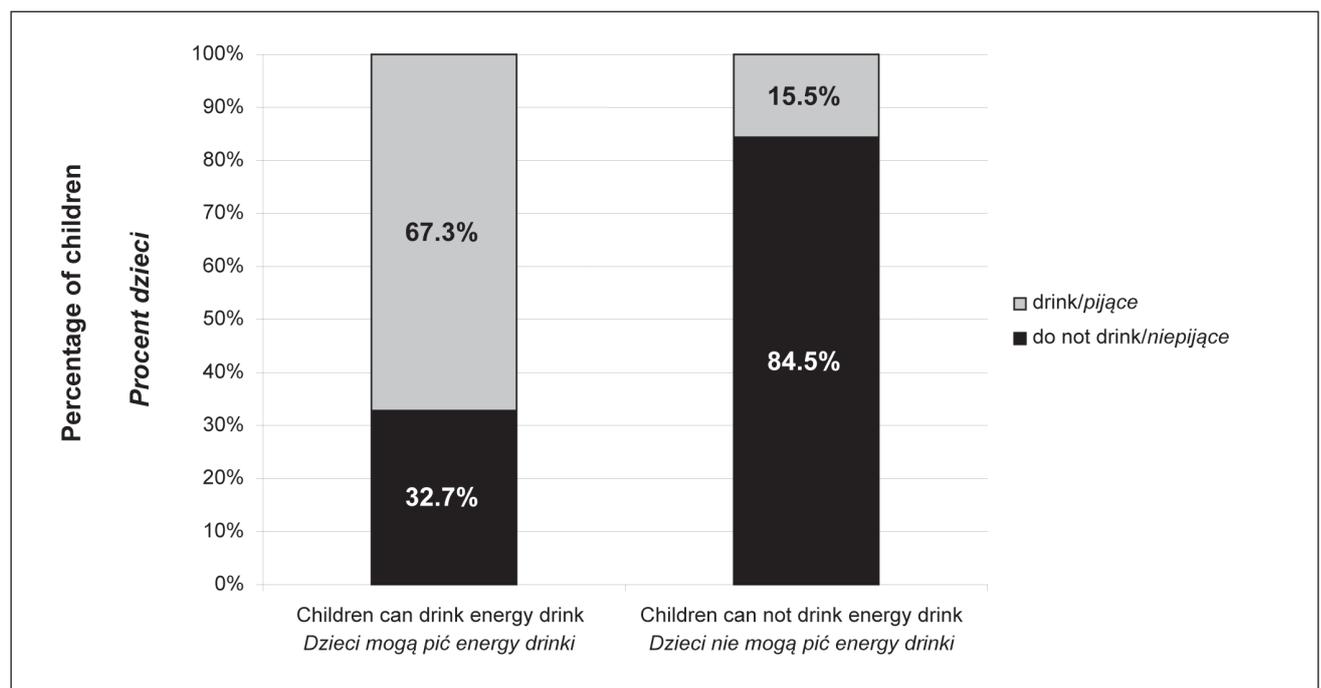


Fig. 1. Consumption of energy drinks depending on the respondents' opinions.

Ryc. 1. Spożycie napojów energetycznych w zależności od opinii respondentów.

Table II. Relations between consumption of cola drinks and selected products.

Tabela II. Zależność między spożyciem napojów typu cola oraz innymi wybranymi produktami.

Cola drinks <i>Napoje typu cola</i>	Fast foods (percentage of children) <i>Zywność typu fast food (odetek dzieci)</i>		Salty snacks (percentage of children) <i>Słone przekąski (odesetek dzieci)</i>		Bottled water (percentage of children) <i>Woda butelkowa (odsetek dzieci)</i>	
	often ^a <i>często^a</i>	seldom ^c <i>rzadko^c</i>	often ^a <i>często^a</i>	seldom ^c <i>rzadko^c</i>	every day <i>codziennie</i>	less frequently and never <i>rzadziej lub nigdy</i>
often ^a często ^a	66.6	33.4	74.9	25.1	31.8	35.3
seldom ^b and never <i>rzadko^b i nigdy</i>	31.2	68.8	30.7	69.3	68.2	64.2
p	0.002		<0.0001		>0.1	

^aEvery day + several times a week^a*Codziennie + kilka razy w tygodniu*^bSeveral times a month^b*Kilka razy w miesiącu*^cSeveral times a month+ less frequently^c*Kilka razy w miesiącu + rzadziej*

The relation between the consumption of cola drinks and other dietary habits

Our study demonstrated a correlation between the consumption of cola beverages, fast foods ($p=0.002$), and salty snacks ($p<0.0001$) (tab. II). In the group of respondents who often consumed cola drinks, the number of fast food consumers is 2-fold (66.6%) and of salty snack consumers is 3-fold higher (74.9%) than among children who seldom or never consume such drinks (33.4% and 25.1%, respectively). No correlation has been found between the consumption frequency of cola drinks and bottled water.

DISCUSSION

Caffeine intake from carbonated beverages by the children studied was low and for most children amounted to less than 5% of a potentially adverse effect level. Taking into account that caffeinated soft drinks provide 50-83% of the daily caffeine intake by children and adolescents in other countries, our findings suggest that the total caffeine intake remains at a safe level [3, 11, 17, 21]. It seems safe to conclude that the estimated caffeine intake in Poland is lower than in other countries. In Northern Europe (Sweden, Finland), cola beverages provide 9-11 mg, and in Denmark 42 mg of caffeine intake per day for adolescents aged 11-14 years [3]. According to Knight et al., in the USA, the average caffeine intake from such drinks by children aged 10-14 years amounted to 25 mg, and according to Frary et al., the daily exposure to caffeine from soft drinks by children (6-11 years) was 14.7 mg [1, 17].

The daily intake of caffeine from cola drinks and/or energy drinks (0.12 mg/kg bw/day) in our study remained below the potentially adverse effect level (2.5 mg/kg

bw/day), and was significantly lower than in Northern European countries, where it ranges between 0.3 and 1.3 mg/kg bw/day [3].

The percentage of Polish pupils consuming cola beverages (89%) is similar to the United States and Denmark (91% and 99%, respectively), and higher than in Sweden (42%). However, the consumption volume appears to be lower in Poland than in other countries. In Sweden, the mean consumption of cola drinks amounts to 161 ml/day for 11-year-old children, while in Finland 14-year-olds drink even 185 ml per day (3.17). Data indicate that the excessive intake of sugar-sweetened beverages, fast foods and snacks is the main unhealthy dietary habit of children and adolescents, and that fast food consumption is associated with the poor quality of diet [22-24]. Our findings support this conclusion. Taking it into account, it is important to note that according to new Polish regulations starting from September 2015, this kind of food can not be offered to pupils at school. This regulation set specific requirements with which food sold at school must comply, mainly the content of sugar, fat and salt [25]. Such provisions were established earlier in many European countries [24]. The relation between the frequency of the consumption of fast foods and cola beverages may also result from the common practice of fast-food chain restaurants to offer promotional prices for meals and the possibility of free refills of soft drinks.

The percentage of energy drink consumers in our study is lower (23.8%) than in European countries (average 55%) according to the new study commissioned by the European Food Safety Authority (EFSA), but is comparable to figures from the USA (28%) and much higher than in Finland (3%) and New Zealand (7%). However, children in Poland drink smaller amounts of such drinks (median:

20.8 ml daily) than children in Finland (166 ml/day). According to the EFSA research, the mean caffeine intake from energy drinks by Polish adolescents up to 18 years of age was 16.2 mg, while in other countries it varied from 8.9 to 25.1 mg daily [3, 26, 27]. However, it is difficult to compare the data due to age discrepancies among the children investigated.

Our study confirms that energy drinks are not an important source of caffeine for children, accounting for only one sixth of caffeine intake from carbonated drinks. In European countries, energy drinks on average account for 13% of the total caffeine intake and in New Zealand even less (3%) [5, 27].

Although the estimated caffeine intake among Polish children seems to be safe, the fact that 24% of the pupils from primary schools are energy drink consumers is worrying. The literature data show that energy drinks can pose a risk for the health of young people [13, 28-30].

One of the weaknesses of our study may have been an underestimation of caffeine intake due to the young age of the respondents. Nonetheless, during the face-to-face interviews with pupils, the dietitians collecting the data were able to help them understand the questions in order to ensure reliable results.

To the best of our knowledge, this has been the first study investigating caffeine intake by primary-school-age children, on a sample representative of the Warsaw population. Owing to the fact that our survey was conducted in the biggest city of Poland, where caffeinated beverages, fast food and other kinds of junk food are readily available, it seems safe to assume that the consumption of caffeine in other areas of Poland remains at a safe level.

CONCLUSIONS

Caffeine intake in the studied group of children turned out to be at a safe level. Despite the safe dose of caffeine consumption by most of the children surveyed, this does not mean that the consumption of carbonated drinks should not raise any concerns. Our data confirmed the assumption that energy drinks are consumed by school-age children. Furthermore, the consumption of cola beverages is accompanied by the frequent consumption of unhealthy foods. The recently established legal ban on selling such food at school which was implemented is a good idea, since the school should not be a place setting improper dietary models.

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