Rocz Panstw Zakl Hig 2021;72(3):273-280
http://wydawnictwa.pzh.gov.pl/roczniki_pzh/ https://doi.org/10.32394/rpzh.2021.0171

ORIGINAL ARTICLE

ASSESSMENT OF CAFFEINE INTAKE WITH FOOD BY POLISH FEMALES AND MALES

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ABSTRACT

Background. Caffeine is the most widespread psychoactive substance in the world. With long-term consumption of caffeinated beverages, there is a high probability of overtaking on caffeine.

Objective. The aim of the study was to estimate the consumption of caffeine in the daily caffeine intake of Polish consumers, determine the caffeinated products in the intake of this substance.

Materials and methods. The survey was completed by 433 respondents living in Poland. The research tool was the electronic questionnaire, which consisted of: a) questions about personal data and measurement anthropometric and the level of physical activity and smoking; b) questions regarding the portion size and frequency of consumption of coffee, tea, cocoa, chocolate, energy drinks and colacarbonated beverages.

Results. The main sources of caffeine in the respondents' diet include: coffee (Me 43.64 mg/d) and tea (Me 37.60 mg/d). Approximately 20% of respondents exceeded the threshold of daily caffeine intake (safety level for children and adolescents up to 3 mg/kg b.w, for adults up to 5.7 mg/kg b.w), considered safe.

Conclusions. Respondents who have crossed the safe dose of caffeine intake, should limit the consumption of products being its main source (coffee).

Key words: *caffeine, caffeine intake with food, Poland, women, men*

STRESZCZENIE

Wprowadzenie. Kofeina jest najbardziej rozpowszechnioną substancją psychoaktywną na świecie. Przy długotrwałym spożywaniu napojów kofeinowych istnieje duże prawdopodobieństwo wystąpienia nadmiaru kofeiny.

Cel. Celem pracy było oszacowanie spożycia kofeiny w dziennym spożyciu kofeiny przez polskich konsumentów, określenie udziału produktów zawierających kofeinę w spożyciu tej substancji.

Materiały i metody. W badaniu wzięło udział 433 respondentów mieszkających w Polsce. Narzędziem badawczym był elektroniczny kwestionariusz ankiety, który składał się z: a) pytań dotyczących danych osobowych i pomiarów antropometrycznych oraz poziomu aktywności fizycznej i palenia tytoniu; b) pytań dotyczących wielkości porcji i częstości spożycia kawy, herbaty, kakao, czekolady, napojów energetycznych i napojów gazowanych.

Wyniki. Głównymi źródłami kofeiny w diecie respondentów były: kawa (Me 43,64 mg/d) i herbata (Me 37,60 mg/d). Około 20% respondentów przekroczyło próg dziennego spożycia kofeiny (poziom bezpieczeństwa dla dzieci i młodzieży do 3 mg/kg m.c., dla dorosłych do 5,7 mg/kg m.c.), uznawany za bezpieczny.

Wnioski. Respondenci, którzy przekroczyli bezpieczną dawkę spożycia kofeiny, powinni ograniczyć spożycie produktów będących jej głównym źródłem (kawa).

Słowa kluczowe: *kofeina, spożycie kofeiny z żywnością, Polska, kobiety, mężczyźni*

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INTRODUCTION

Caffeine is the most widespread psychoactive substance in the world. The purine alkaloid is present in coffee beans, tea leaves, cocoa beans, kola nuts (cola vera) and in nearly 60 species of other plants. Caffeine annual consumption is estimated at 120,000 tonnes [17, 30]. In the daily food ration of a Central European resident, the content of this alkaloid ranges between 280-490 mg/day. In Sweden, the consumption of caffeine is greater, resulting from high consumption of coffee. Slightly less caffeine is consumed in the United States, where its average consumption ranges from 193 to 280 mg/day. Polish people consume it relatively little - about 140 mg/day [27]. Caffeine is used as an additive to non-alcoholic beverages in order to achieve a specific taste (eg. in cola). Caffeine is a component of energy drinks and slimming preparations. Through antagonistic influence, caffeine acts as a stimulant, maintains a period of wakefulness, increased mental performance, reduces and delays fatigue. Caffeine is primarily absorbed in the stomach, and, to a lesser extent, in the distal segments of the digestive tract. It is then transported to all tissues, including the brain. With long-term consumption of caffeinated beverages, there is a high probability of overtaking on caffeine, which is characterized by physical and mental disorders [10, 15, 19, 20, 21, 24, 29]. Confirmation of the above conclusions is the opinion issued in 2015 by the European Food Safety Authority, EFSA (European Food Safety Authority) about a safe dose of caffeine intake by various population groups. It was found that the intake of a single dose of caffeine up to 200 mg (about 3 mg/kg body weight of an adult with a body weight of 70 kg) by an adult does not pose a threat to health and safety. In the case of habitual consumption of caffeine from all sources, the acceptable daily intake should not exceed 400 mg for adults (approximately 5.7 mg/kg b.w. per day for 70 kg of an adult), with the exception of pregnant women. The habitual consumption of caffeine by pregnant women should be 200 mg/day without risk to the fetus. EFSA proposes a level of up to 3 mg of caffeine per kilogram of body weight per day (i.e. an individual caffeine level for adults) for regular consumption of caffeine by children and adolescents [5]. A significant increase in the interest of products containing caffeine is associated with western life style, the effect of exposure to the stimulus of advertising. Caffeine-rich products are consumed by a wide range of consumers in all age groups due to their stimulating effect and their high availability. They are very popular among young people, and more and more often among children due to their sweet taste (soft drinks, energy drinks) [4, 6, 16, 26].

The aim of the study was to estimate the consumption of caffeine in the daily food intake of Polish females and males, determine the share of selected products in the intake of this substance.

MATERIALS AND METHODS

The survey was completed by 433 respondents (pupils, students, workers, unemployed, and pensioners) living in Poland and willing to setup the questionnaire. The study was completed by means of a diagnostic survey using the CAWI (*Computer-Assisted Web/Internet Interviewing*) survey technique. A research technique in which the online survey is supervised by a computer system. Questionnaire questions are downloaded from the survey organizer's website and transmitted via the network to any point in which the respondent is located together with a computer connected to the Internet. A person examined in the CAWI system, alone or in the presence of an interviewer, reads the question content from the screen and provides answers that are recorded on the target server. Using a self-administered questionnaire, participants were asked questions regarding their socio- demographic characteristics (including gender, age, education, place of residence, type of professional activity), anthropometric measurements (weight, height), physical activity level (unsystematic physical activity, systematic physical activity, i.e. planned, structured, repeated physical activity for the purpose of maintaining or improving health, lack physical activity) and intake of caffeine-containing beverages (i.e. portion size and frequency of consumption of coffee, tea, cocoa, chocolate, energy drinks and colacarbonated beverages) [11, 13, 18]. For the needs of conducting the analyses, the respondents were divided into groups differentiated in terms of gender (females, males), age (≤18, 19-30, 31-50, ≥51 years), education (primary, vocational, secondary, higher) and place of residence (rural areas, urban areas), as well as declared physical activity (unsystematic, systematic, lack physical activity) and smoking (smoker, non-smoker). Each participant was asked to choose a product with caffeine and the portion that was consumed, and then determine the frequency of consumption of a given product. The following portion sizes were used: a) in the case of coffee, tea, cocoa and chocolate, the respondents entered the size of the portion (eg. 1 teaspoon = 2,5 g coffee beans, grounded, but 2.0 g instant coffee), regardless of the amount of infusion made from it; (b) in the case of beverages: a can with a capacity of 0.33 L or 0.25 L glass bottle with a capacity of 0.2 L, plastic bottles according to the range, and the home measurement - a glass of any indicated capacity from the range of 0.2 L to 0.5 L. The frequency of consumption of products was determined by the following categories: daily (1 time, 2 times, 3 times, 4 times, 5 times 6 times), several times a week (1 time, 2 times, 3 times, 4 times, 5 times, 6 times), several times a month (once, twice, three times), less often than once a month and never. The study also took into account the type of tea and coffee (eg. tea: leaf/ granulated/express, green/black/red, coffee: ground/granular/instant/decaffeinated/from the coffee machine or mix) and the time of brewing tea (up to 1 minute, 1 minute, 5 minutes). Caffeine content in products was adopted on the basis of data from the literature on the subject and presented in Table 1 [1, 2, 6, 7, 12, 27, 32].

The total daily caffeine intake by respondents was calculated according to the formula:

$$\text{EDI (mg/day)} = P \cdot F \cdot C \text{ or EDI (mg/kg b.w./day)} = (P \cdot F \cdot C) / W$$

Where:
EDI – Estimated Daily Intake of caffeine
P – data on the portion size (number of spoons of a loose product or volume of a liquid product expressed in liters);
F – data on the frequency of consumption of portions per day
(multiplicity of intake per day, eg. 3 times per day: 3/1;
per week, eg. 5 times per week: 5/7;
per month, eg. 2 times per month: 2/30);
C – caffeine content in the product (taking into account the type of coffee and tea, brewing time), expressed in mg per teaspoon of loose product, mg per pack of finished product or mg/L);
W – respondent's body weight (kg b.w.).

Example calculations:
eg. for ground coffee, 1 teaspoon = 2.5 g

1.83 g/100 g = 1830 mg/100 g

1830 mg /100 g x 2.5 g = 45.75 mg ground coffee / 1 teaspoon

EDI = [2 teaspoons of ground coffee x 2/1 (two times per day) x 45.75 mg/teaspoon] / 60 kg b.w. = 3.05 mg caffeine from ground coffee per 1 kg b.w.

EDI = (liquid product expressed in ml) = [1 cup of coffee drink mix "2in1" (150 ml) x 1/1 (once per day) x 78 mg/150 ml] / 65 kg b.w. = 1.2 mg caffeine from cup of coffee drink mix "2in1" per 1 kg b.w.

The most frequent drinkers were brewed ground coffee, instant coffee and cappuccino, and among teas, black express tea. The obtained results were summed up and the average daily caffeine intake from all products included in the study was determined. Share of respondents exceeding daily caffeine intake (in %) was assumed by EFSA opinion about safe dose of caffeine in children 3 mg/kg b.w. and in adults 5.7 mg/kg b.w.

Table 1. Caffeine content of selected products [1, 2, 6, 7, 12, 27, 32]

Source	Mean caffeine content
Coffee	
Ground coffee	1.83 g/100 g coffee
Coffee beans (ground before brewing)	2.27 g/100 g coffee
Instant coffee	1.65 g/100 g coffee
Coffee drink mix "2in1"	78 mg/150 ml
Coffee drink mix "3in1"	54 mg/150 ml
Cappuccino chocolate	39.0 mg/150 ml
Cappuccino peanut	44.0 mg/150 ml
Cappuccino creamy	41.0 mg/150 ml
Cappuccino with magnesium	46.0 mg/150 ml
Coffee from the machine	66 mg/150 ml
Espresso coffee	100 mg/60 ml
Decaffeinated coffee	0.1 g/100 g coffee
Decaffeinated instant coffee	0.1 g/100 g coffee
Tea	
Black express tea	14.9 mg/teabag/ 200 ml /15 second 21.8 mg/teabag/ 200 ml /1 minute
Green express tea	22.0 mg/teabag/ 200 ml/1 minute 30.5 mg/teabag/ 200 ml/5 minute
Black leaf tea	33.5 mg teaspoon/ 200 ml/5 minute
Green leaf tea	33.4 mg/teaspoon/ 200 ml/5 minute
Energy drinks	
Energy drinks	80 mg/250 ml
Cocoa/chocolate	
Cocoa/hot chocolate	4-5 mg/150 ml
Milk chocolate	20.8 mg/100 g
Bitter chocolate	66.5 mg/100 g
Cola-type drinks	
Coca-Cola	9.4 mg/100 ml
Pepsi	10.1 mg/100 ml

Statistical analysis

The hypothesis on the normal distribution of the analyzed variables was assessed using the *Shapiro-Wilk* test. *Kruskal-Wallis* ANOVA compared differences in caffeine intake among each group (age, gender, education, place of residence, physical activity, smoking). In addition, $\chi 2$ was performed to show a relationship between the number of people crossing the safe daily dose of caffeine and gender, age, education, place of residence, physical activity and smoking. All data were performed as mean, standard deviation (SD), median (Me), interquartile range (Q25-Q75) and percentage of participants exceed safe dose of caffeine. Statistical analysis was carried out using statistical program Statistica v.10.0. The level of significance was assumed at $p<0.05$.

RESULTS

Characteristics of respondents

The characteristics of the respondents are presented in Table 2. 433 respondents completed the survey and were included in the analysis. The sample contained approximately equal number of men and women. Most of the respondents were aged 19-30.

Considering the nutritional status, the majority of respondents were characterized by normal BMI. Underweight was found in 9% of respondents. Almost every fifth respondents was overweight, and the BMI indicator for obesity was slightly more than 5% of respondents. Almost 50% of respondents were characterized by secondary education. The highest percentage of respondents were workers. Among all respondents, a similar percentage of people declared a systematic or unsystematic physical activity. 3/4 of respondents are non-smokers. Most respondents inhabited urban areas.

Estimated total caffeine intake and the proportion of products in the consumption of caffeine

Table 3 shows total mean and the estimated relative total daily caffeine intake (mg/day) and the proportion of products in the consumption of caffeine. Total mean daily caffeine intake was 255.75 mg, and estimated relative total daily caffeine intake was 199.72 mg.

The amount of caffeine intake was statistically significantly determined by the type of product consumed ($p<0.0000$). The respondents consumed the most caffeine when they consumed coffee. It accounted for 60.3% of the total intake, amounting to 154.32 mg per day (median 43.64 mg per day). Tea was also an important source of caffeine. Along with it, 70.12 mg of caffeine were supplied (median 37.60 mg), and the contribution to intake was 27.4%.

Assessment of caffeine intake by vs. sex, age, education, place of residence, smoking

The total mean daily caffeine intake per kilogram of body weight was 3.78 mg, and estimated relative total daily caffeine intake was 2.88 mg/kg b.w. Significant differences in relative total daily caffeine intake (mg/kg b.w.) by gender, age, education, and smoking status shown in Table 4. Females (mean: 4.27 mg/kg b.w.; median: 3.35 mg/kg b.w.) consumed more caffeine than males (mean: 3.29 mg/kg b.w.; median: 2.61 mg/kg b.w.) ($p = 0.023$).

The highest consumption of caffeine was observed among respondents between 31 and 50 years old (mean: 5.13 mg/kg b.w.; median: 4.62 mg/kg b.w.), and the lowest in adolescents under 18 years old (mean: 2.56 mg/kg b.w.; median: 1.61 mg/kg b.w.) ($p = 0.0001$). The

Table 2. Characteristics of respondents

Variables	n	%
Total subject	433	100
Gender		
females	218	50.3
males	215	49.7
Age (years)		
≤18 (Me 16.6 y.)	58	13.4
19-30 (Me 25.5 y.)	293	67.7
31-50 (Me 41.4 y.)	65	15.0
≥51 (Me 57.9 y.)	17	3.9
Nutritional status by BMI		
<16	1	0.2
16 – 16.99	3	0.7
17 – 18.49	35	8.1
18.5 – 24.49	287	66.3
25 – 29.99	84	19.4
30 – 34.99	15	3.5
35 – 39.9	4	0.9
≥ 40	4	0.9
Education		
primary	65	15.0
vocational	19	4.4
secondary	202	46.7
higher	147	33.9
Type of professional activity		
pupils	62	14.3
student	157	36.3
workers	164	37.9
pensioner	15	3.5
unemployed	35	8.0
Physical activity		
unsystematic	175	40.4
systematic	183	42.3
lack	75	17.3
Smoking		
smoker	99	22.9
non-smoker	334	77.1
Place of residence		
rural areas	90	20.8
urban areas	343	79.2

Table 3. Estimated relative total daily caffeine intake (mg/day) and the proportion of products in the consumption of caffeine (in %)

Caffeine source	Mean ± SD	%	Median	Q25-Q75	p-value
Total caffeine intake	255.75 ± 233.10	100.0	199.72	78.42-370.47	
Coffee	154.32 ± 223.72	60.3	43.64 [a]	0-244.0	<0.0001
Tea	70.12 ± 86.32	27.4	37.60 [b]	13.43-92.90	
Cocoa/Chocolate	0.65 ± 1.23	0.3	0.30 [c]	0-0.76	
Energy drinks	14.31 ± 43.96	5.6	1.33 [c]	0-6.67	
Cola-type drinks	16.50 ± 32.26	6.4	2.78 [c]	0.69-16.79	

p-value - was calculated by analysis of variance *Kruskal-Wallis* ANOVA for p<0.05;
a, b, c – statistically significant differences

Table 4. Estimated relative total daily caffeine intake (mg/kg b.w.)

Variables	Mean ± SD	Median	Q25-Q75	p-value
total subject	3.78 ± 3.50	2.88	1.21-5.10	
Gender females	4.27 ± 4.02	3.35 [a]	1.36-5.56	0.023
males	3.29 ± 2.80	2.61 [b]	1.06-4.87	
Age (years) ≤18	2.56± 2.38	1.61 [a]	0.65-3.42	0.0001
19 - 30	3.74 ± 3.33	2.85	1.24-4.98	
31 - 50	5.13 ± 4.43	4.62 [b]	2.01-6.65	
≥51	3.68 ± 2.47	3.22	1.39-5.19	
Education primary	2.56 ± 2.25	1.49 [a]	0.67-3.11	0.0002
vocational	2.74 ± 2.65	1.12	0.29-4.71	
secondary	3.96 ± 3.57	2.99 [b]	1.46-5.25	
higher	4.23 ± 3.61	3.70 [b]	1.35-5.66	
Place of residence rural areas	4.27 ±3.56	3.61	1.33-5.65	0.137
urban areas	3.66 ±3.48	2.78	1.19-4.95	
Physical activity unsystematic	3.55 ± 3.16	2.91	1.22-4.95	0.299
systematic	3.76 ± 3.66	2.69	1.06-5.54	
lack	4.39 ± 3.84	3.15	1.38-5.89	
Smoking smoker	5.36 ± 4.00	4.59 [a]	2.90-6.68	<0.0001
non-smoker	3.32 ± 3.20	2.32 [b]	1.00-4.71	

p-value - was calculated by analysis of variance *Kruskal-Wallis* ANOVA for p<0.05;
a, b – statistically significant differences

daily caffeine intake among respondents with higher (mean: 4.23 mg/kg b.w.; median: 3.70 mg/kg b.w.) and secondary education (mean: 3.96 mg/kg b.w.; median: 2.99 mg/kg b.w.) was significantly higher compared to respondents with primary education (mean: 2.56 mg/kg b.w.; median: 1.49 mg/kg b.w.) (p = 0.0002). The total caffeine intake among smokers (mean: 5.36 mg/kg b.w.; median: 4.59 mg/kg b.w.) was significantly higher than non-smokers (mean: 3.32 mg/kg b.w.; median: 2.32 mg/kg b.w.) (p <0.0001).

Assessment of intake above (standard/agency) safe criteria

Percentage of respondents exceeding daily caffeine intake is shown in Table 5. Approximately 20% of respondents exceed the daily limit values of caffeine intake. Acceptable daily intake (habitual) of substances set at 5.7 mg/kg b.w., i.e. 400 mg/day, was exceeded in 17.7% of the surveyed males and 22.5% of females. Caffeine consumers below 18 year were assumed by lowest level of caffeine intake according to EFSA opinion (3 mg/kg b.w).

Table 5. Percentage of people exceeding daily caffeine intake (%)

Variables	n	%	p-value
total subject	87	20.1	
Sex			
females	49	22.5 [a]	a vs. b 0.259
males	38	17.7 [b]	
Age (years)			a vs. b 0.074
≤18	5	8,6 [a]	a vs. c 0.001
19-30	57	19.5 [b]	b vs. c 0.008
31-50	23	35.4 [c]	b vs. d 0.640; a vs. d 0.934
≥51	2	11.8 [d]	c vs. d 0.112
Education			a vs. b 0.038
primary	6	9.2 [a]	b vs. c 0.751
vocational	3	15.8 [b]	b vs. d 0.666
secondary	44	21.8 [c]	c vs. d 0.866
higher	34	23.1 [d]	a vs. d 0.028
Place of residence			
rural areas	22	24.4 [a]	a vs. b 0.337
urban areas	65	18.95 [b]	
Physical activity			
unsystematic	28	16.0 [a]	a vs. b 0.201
systematic	40	21.9 [b]	b vs. c 0.659
lack	19	25.3 [c]	a vs. c <0.0001
Smoking			
smoker	34	34.3 [a]	a vs. b 0.0001
non-smoker	53	15.9 [b]	

p-value - comparisons with $\chi 2$, $p<0.05$;
a, b, c, d - compare of averages

The respondents between 31 and 50 years old constituted the highest percentage of people who exceeded the dose considered as safe for healthy people. Considering respondents under 18 years old, for whom EFSA proposes a level of normal caffeine intake up to 3 mg/kg/day, the percentage of people who exceed daily intake is 8,6%. The least respondents with primary education exceeded the dose of daily caffeine intake. Significantly more often respondents with lack of physical activity exceeded the daily dose of caffeine (25.3%) than respondents with unsystematic physical activity (16.0%) (p <0.0001). Also, significantly more often smokers (34.3%) exceed the dose of this substance than non-smokers (15.9%) (p = 0.0001).

DISCUSSION

The median daily intake of caffeine among the respondents was estimated at 2.88 mg/kg b.w. (199.72 mg/day) and was confirmed by the literature data that the daily caffeine intake in Central Europe was in the range from 3 up to 7 mg/kg b.w. [4, 5]. A similar level of caffeine intake was determined by other authors [31, 32]. In American studies conducted on a representative sample of the population, the average caffeine intake was similar and amounted about 3.01 mg/kg b.w., i.e. 211 mg/day [8]. Similarly, in British studies conducted among women of childbearing age, the caffeine consumption was 173.9 mg/day, i.e. approx. 3.0 mg/kg b.w. [3]. Whereas studies conducted in Austria [22] among adolescents and adults up to 40 years old, showed that the average caffeine intake was at a much higher level, i.e. 5.33 mg/kg b.w. Many studies it was support a hypothesis proved that caffeine intake by women per kilogram body weight was higher than for men. In Japanese studies [31] caffeine intake was 4.9 mg/kg in women, and 4.1 mg/kg b.w. in men. Whereas, in Austrian studies [22], the average caffeine intake in a woman was 5.4 mg/kg b.w./day, and in men 4.8 mg/kg b.w. Similar results were obtained in our these studies. Women consumed on 3.35 mg/kg b.w., and men 2.61 mg/kg b.w., and these differences were statistically significant. Analysing the caffeine intake in terms of age, there a statistically significant relationship was found between the amount of caffeine and age. The highest caffeine intake was consumed by respondents between 31 and 50 years old (4.62 mg/kg b.w.), and the lowest by respondents under 18 years old (1.61 mg/kg b.w.). *Fulgoni et al.* [8] found that 31-50- and 51-70-year-old people consumed approx. 3.05 mg/kg b.w./day, and respondents below 19-year-olds 2,66 mg/kg b.w./day. *Rudolph et al.* [22] recorded higher caffeine consumption with increasing age, where up to 25 years old the daily caffeine intake was 4.7 mg/kg b.w., and above 25 years old was 5.8 mg/kg b.w. A study presented by *Yamada et al.* [31] conducted among the adults of Japanese community and the study of *Tran et al.* [25] conducted among American youth and young adults, as well as American and British studies conducted among young women aged 14-40 and 16-40 respectively 45 years also confirmed the observed trend of increasing the consumption of caffeine with age [3, 28]. Also, in our own studies, it was recorded that after the age of 50, caffeine intake decreased and amounted 3.22 mg/kg b.w. A gradual decrease in caffeine consumption after the age of 50 was also noted by *Knight et al.* [14] (from 2.3 mg to 1.92 mg/kg b.w./day). The lower level of caffeine intake among respondents over 50 years old may result from the decreasing amount of sleep needed with age, and thus the lack of need to regulate the daily rhythm with psychostimulants – the caffeine. Drinking coffee and smoking puts caffeine and nicotine at the top of the list of legally available psychoactive substances. Our research support a significant relationship between smoking and the amount of caffeine consumed. The total caffeine intake among smokers (4.59 mg/kg b.w.) was significantly higher than among non-smokers (2.32 mg/kg b.w.) (p <0.0001). Other researchers also indicated a similar relationship [3, 28]. Smokers consumed three times more caffeine than nonsmokers (approx. 5.40 mg/kg b.w./day vs. 1.79 mg/kg b.w./day) [3]. In addition, along with increasing the dose of caffeine, the proportion of smokers increased, and decreased non-smokers consuming higher amounts of this substance (more than 200 mg/day, i.e. approx. 2.86 mg/kg b.w./day) [28]. Every fifth of respondents, exceeded the level of acceptable daily caffeine intake set at 5.7 mg/kg b.w./day (i.e. 400 mg/day). More often, this problem affected to females than males (22.5% vs. 17.7%) and respondents between 31 and 50 years old. In turn, lower than in the author's research, exceeding the acceptable daily amount of caffeine intake by adult respondents was noted in the studies presented by *Yamada et al.* [31] in which this dose was exceeded by 15.4% of men and 10.8% of women. However, in the study of *Wetmore et al.* with the level of 200 mg/day, the percentage of people with excessively high intake of this substance was higher (28%) [28]. In contrast, 18% of women of childbearing age living in the United Kingdom exceeded the dose set at 300 mg/day [3]. Knowing that respondents under 18 years old should not consume more than 3 mg/kg b.w./day of caffeine, the percentage of respondents who exceed the safe dose was noted at 32.8%. In the studies of *Santangelo et al.* [23] even more teenagers, almost half (46%) exceeded the upper limits of caffeine intake. Coffee was the richest source of caffeine in the diet of the respondents, and coffee contribution in caffeine intake was approximately 60%. The same percentage of coffee in caffeine intake (60.8%) was obtained by *Rudolph et al.* [22], who examined the adolescents and adults up to 40 years old. In turn, in the studies presented by *Yamada et al.* [31] showed the percentage of caffeine supplied with this product accounted only 47%. Tea was also an important source of caffeine, the contribution was 27.4% of the total daily intake. In the studies of *Yamada et al.* [31] in groups of Japanese and Chinese that tea provided as much as 47% of caffeine. However, the highest share of tea in the collection of caffeine was recorded among the British 53% [9].

CONCLUSIONS

Considering the average caffeine intake along with the diet, as well as the results of the health risk assessment resulting from exceeding the safe dose of caffeine intake among the studied population of Polish people, it is advisable to undertake all activities promoting health-oriented lifestyle and increasing consumer awareness in the field of nutritional knowledge. One of this maybe proper and healthy intake of caffeine as an chemo protective factor of nutrition. This fact was confirmed by the introduction of coffee as a drink that improves the health of the population in the Pyramid of Healthy Eating and Physical Activity by Institute of Food and Nutrition (IŻŻ) in 2016. In turn, among people who exceeded the safe dose of caffeine intake, the consumption of products that are its main source should be limited. It is also important to constantly monitor danger and conduct long-term research, which will significantly extend the knowledge of future generations. In addition, measures should be taken to regulate the descriptions provided by manufacturers on the packaging of products, including those food products in which caffeine is present. Thanks to this knowledge, consumers will be aware of their dietary choices.

Conflict of interest

The authors declare no conflict of interest.

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Received: 02.06.2021
Accepted:19.07.2021
Published online first: 23.07.2021