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DIETARY EXPOSURE OF ADOLESCENTS TO CAFFEINE FROM SOFT DRINKS IN NIŠ (SERBIA)

UNOS KOFEINA PREKO OSVEŽAVAJUĆIH BEZALKOHOLNIH PIĆA KOD ADOLESCENTA U NIŠU (SRBIJA)

Konstansa Lazarević [1,2], Nina Jančić[3]

[1]Department for biomedical science, State University of Novi Pazar, Serbia
[2] Public Health Institute Niš, Serbia
[3] School of Medicine, University of Niš, Serbia

Correspondence to:

Doc. dr Konstansa Lazarević
Državni Univerzitet u Novom Pazaru
Vuka Karadžića bb
36300 Novi Pazar
E-mail: koni33@hotmail.com

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Ključne reči
cola bezalkoholna pića, kofein, adolescenti

Abstract

Literature data indicates negative health consequence of high caffeine intake, and that intake of soft drinks presents the main source of caffeine among adolescents. The aim of this study was to estimate dietary intake of caffeine via soft drinks among adolescents in Nis (Serbia).

Data on consumption of soft drinks among 368 adolescents (14-18 age) were collected by means of a modified Food frequency questionnaire (FFQ) by Willet, and 103 cola and 5 energy drinks were analyzed by spectrophotometric method in an accredited laboratory (ISO 17025) in Public Health Institute Nis.

The values of caffeine in all of analyzed samples of cola soft drinks (mean: 95.1± 31.1 mg/l) and energy drinks (236 ± 11.6mg/l) did not exceed the maximum permitted level. The mean daily intake of caffeine via soft drinks was higher among boys - (62.25 ± 85.71 mg vs. 47.67 ± 78.59 mg for girls) ($z = 1.98$; $p < 0.05$). Nevertheless, there is not any statistically significant difference in the daily intake of caffeine per body weight among boys (0.81±1.14 mg/kg/bw) and girls (0.71±1.22 mg/kg/bw) ($z = 1.136$; $p > 0.05$). The results of the values of caffeine in cola soft drinks and dietary intake of caffeine among adolescents in our study are similar as in other studies around the world.

Acceptable daily intake of caffeine that can be ingested over a lifetime without an appreciable health risk must be established. Until then, moderate intake of soft drinks with caffeine among adolescents is recommended as public health policy.

INTRODUCTION

Results of studies in Europe, America [1,2] and National Public Health Institute (Serbia) [3] indicated that consumption of soft drinks has increased, especially among adolescents [4,5]. This is period of intensive growth and development when proper nutrition as well proper sleep has an important role.

Non alcoholic cola drinks are not the part of a healthy diet. Excess intake of energy from soft drinks increased the risk for being overweight and obesity in adulthood [6], and excess caffeine intake may also affect calcium metabolism [7,8] and bone mineral density [9]. The consumption of cola soft drinks predicted high fracture risk in teenage girls [10,11].

Adolescents with high daily caffeine intake from cola drinks may suffer from caffeine-induced daily headache [12], difficulty with sleeping and they feeling tired in the morning [13].

The purpose of this study was to estimate daily intake of caffeine via soft drinks in adolescents of Niš Serbia.

MATERIALS AND METHODS

Present study was implemented during the period from 2008 to 2011, among a random sample of 328 adolescents aged from 15 to 18. Adolescents were informed about the aims of the study and they agreed with the involvement in the study.

Collected data included information about socio-demographic characteristics, dietary habits, body weight and food

intake by modified Willet,s self administered food frequency questionnaires (FFQ) (14). After excluding those who do not drink cola soft drinks (n-34 or 10.3% of study participants), a total of 294 adolescents were used as participants in the present study.

The accredited laboratory of the Public Health Institute Nis (ISO 17025), determined the content of caffeine in 103 cola beverages and 5 energy drinks collected from markets in Nis (Serbia). Spectrophotometric method for determining caffeine (AOAC 962.13) [15] in soft drinks has been used.

Results were interpreted according to the maximum allowed concentrations of caffeine in soft drinks (maximum permitted level (mg/l) - MPL) [16] stipulated by Serbian Book of Regulations.

For each person the estimate of daily caffeine intake (Yi) was conducted according to the EC recommendations (Tier 3) stated in the report from 2001 [17].

$$Yi = \Sigma (Xvi * Cv)$$

where Xv, *i* is the average daily amount of soft drink with caffeine consumed by subjects *i* [l] and Cv is concentration of caffeine in that soft drink (mg/l).

Joint FAO/WHO Expert Committee on Food Additives (JECFA) don't stipulate [18] acceptable daily intakes (ADI) for caffeine. For health risk assessment, the ADI is usually expressed in mg per kg body weight.

STATISTICAL METHODS

Descriptive statistics (mean, standard deviation, median, rang) were processed by Microsoft Excel software. Comparisons in daily intake of caffeine via soft drinks between groups (boys and girls) were performed with the Mann–Whitney U test in SPSS 10.0. A p-value < 0.0.5 was considered to be statistically significant.

RESULTS

Table 1 shows concentration (mean, standard deviation) of caffeine in the analyzed cola soft drink.

Table 1. *Mean content of caffeine (mg/l) in beverages*

	Caffeine			
	N	Mean (SD)	Min-max	MPL*
Cola soft drink	103	95.1±31.1	27-150	250
Energy drink	5	236±11.6	220-247	320

*maximum permitted level

The Book of the Regulations [16] stipulates maximum permitted levels (MPL) of caffeine in cola soft drinks (250 mg/kg) and energy drinks (320 mg/kg). In the present study the contents of caffeine were in accordance with legal limits (table 1).

In our study participants don't consume or consume energy drinks very rarely. For this reason table 2 shows data on the daily intake (mean, standard deviation) of cola soft drink.

Table 2. *Mean daily intake of beverages (ml/day) in consumers (n=294) of cola soft drinks only*

Beverages group	(ml/day)	
	Mean± SD	Min-max
Cola soft drink	57.3 ±86.4	5-500

The mean daily intake of caffeine were higher among boys (z =1.98; p <0.05). There is not statistically significant difference in the daily intake of caffeine per body weight among boys and girls (z =1.136; p>0.05) (table 3).

Table 3. *The daily intake of caffeine and daily intake of caffeine per body weight by cola soft drink among adolescents in Niš (Serbia) by gender**

	Daily intake of caffeine	
	(mg; mean±SD)	per body weight (mg/kg bw)
Boys	62.25±85.71	0.81±1.14
Girls	47.67±78.59	0.71±1.22
z	1.98*	1.136

*(p<0.05- significant difference between boys and girls for daily caffeine intake)

DISCUSSION AND CONCLUSION

There is not a significant difference in the concentration of caffeine in cola soft drink determined in studies around the world. The range of caffeine content determined in cola soft drinks in our study (2-149 mg/l) was similar to those determined in two studies in the USA [19,20], two studies from Portugal [21,22], and studies in Brazil [23], Spain [24], Argentina [25] and Croatia [26].

In most of the studies involving youths: adolescents in USA [27], students in Portugal [22] and Croatia [26], Canadian and American children [28], adolescents in Italy [29] the major source of caffeine are soft drinks. Only among adolescents in Argentina [25] the main source of caffeine is mate.

The mean caffeine daily intake of caffeine via cola soft drinks among students in a study from Portugal was 65.8 and 42.3 mg/day for males and females, respectively [22]. There results have similar values as those in our study.

Temple and al. [30] found gender differences in cardiovascular response to caffeine emerge after puberty.

The mean daily intake of caffeine in high school students in Croatia was between 2-570 mg - in average 64.6mg in boys and 59.8mg in girls [26], and there is not a statistically significant difference in the daily intake of caffeine and the daily intake among boys and girls. In our study, he mean daily intake of caffeine was higher among boys.

Energy drinks contain a significant amount of caffeine, often in combination with ingredients with unknown safety profiles [31]. In our study participants don't consume or consume energy drinks very rarely, and they are therefore not important source of caffeine. Similar results were observed among students in Portugal [22].

American Academy of Pediatrics [32] from the Committee on Nutrition and the Council on Sports Medicine and

Fitness sustains that energy drinks and sport drinks are dangerous for children and that should not be admitted in children, adolescents and young adults.

Adolescents who drink soft drink have much lower milk thought diet [2,33], and milk and dairy products are the best source of calcium for adolescents.

Heaney and Rafferty determined that drinks containing caffeine, regardless of their phosphoric acid content, were associated with increases in urinary calcium loss [34].

Total dietary intake of caffeine in our study population is much higher. We did not include caffeine intake from coffee, tea, chocolate and other foods containing caffeine. Unfortunately, ADI for caffeine have not been established. ADI is a measure of the amount of food additive that can be ingested on a daily basis over a lifetime without an appreciable health risk. For these reasons we did not estimate the health risks of consumption of caffeine.

Results of studies around the world determined increased intakes of soft drinks among adolescents. High intake of drinks with caffeine: cola soft drink, energy drink and sport drinks may have negative health consequences.

For these reasons it is appropriate to recommend reduced intake of soft drinks with caffeine, and also sports and energy drinks among children and adolescents.

Cola soft drinks and energy drinks must have caffeine content stated in the declaration, and ADI for caffeine needs to be established.

Sažetak

Podaci iz literature ukazuju da visok unos kofeina ima negativne zdravstvene posledice, a da unos bezalkoholnih osvežavajućih pića predstavlja glavni izvor kofeina kod adolescenata. Cilj ove studije je bio da proceni unos kofeina putem bezalkoholnih pića kod adolescenata u Nišu (Srbija).

Podaci o unosu bezalkoholnih pića kod 368 adolescenata, uzrasta od 14-18. godina prikupljani su pomoću modifikovanog semikvantitavnog upitnika o unosu namirnica (FFQ po Villet-u), a 103 uzoraka cola osvežavajućih pića i 5 energetskih pića analizirano je na sadržaj kofeina spektrofotometrijskom metodom u akreditovanoj laboratoriji (ISO 17025) Instituta za javno zdravlje Niš. Vrednosti kofeina u svim analiziranim uzorcima kola bezalkoholnih pića (Sv : 95,1 ± 31,1 mg/l) i energetskim napicima (236 ± 11,6mg/l) nisu prelazile maksimalni dozvoljenu koncentraciju, propisanu Pravilnikom. Srednji dnevni unos kofeina putem bezalkoholnih pića bio je viši kod adolescenta - (62,25±85,71mg prema 47,67±78,59mg za adolescentkinje) ($z = 1,98$; $p < 0,05$). Nije dokazana statistički značajna razlika u dnevnom unosu kofeina po kg telesne težine između adolescenta (0,81 ± 1,14mg/kg/ TT) i adolescentkinja (0,71 ± 1,22 mg / kg / TT) ($z = 1,136$; $p > 0,05$). Rezultati vrednosti kofeina u cola bezalkoholnim pićima i unos kofeina kod adolescenata u našoj studiji su slični kao i u drugim studijama širom sveta.

Neophodno je da se utvrdi prihvatljiv dnevni unos kofeina tokom života, koji neće imati negativne posledice po zdravlje. Do tada, preporučuje se umeren unos bezalkoholnih pića sa kofeinom kod adolescentima, a kao deo javno zdravstvene politike.

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