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Correlation between caffeinated soft drinks consumption and overweight/hypertension in Romanian children and adolescents: results of a cross-sectional survey

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Abstract

Knowledge of the existence of a prolonged action of cardiovascular risk factors since childhood is extremely important in a country with one of the highest cardiovascular mortality in Europe. We aimed to identify a possible correlation between caffeinated soft drinks consumption (CSDC) and overweight/hypertension in Romanian children and adolescents. Children and adolescents (2407 males, 2459 females), aged 3 to 17 years from Bucharest and Ilfov County were admitted in a cross–sectional survey. Body weight, height, and blood pressure (BP) were measured and the percentiles for height, BP and body mass index were established. An interviewer-administered questionnaire about CSDC and other presumed risk factors was used. The prevalence of AH in our population was 7.4%. AH prevalence was higher both in overweight (12.4%) and obese (24.4%) groups comparing with normal weight (5.8%), (P<0.0001). Daily CSDC was present in 10.4% of all children and adolescents. 10.2% of the obese children and adolescents (n=82) were daily CSDC. Regarding correlations with AH, 12.5% of the daily CSDC were hypertensives (n=45) and 9.7% of the hypertensive children and adolescents are daily CSDC. We found no significant correlation between AH in children and adolescents, overweight/obesity and consumption of caffeinated beverages, family history of cardiovascular disease, smoking, low birth weight, sleep disorders and abnormal sleep duration, absence of extra-school sport activity. The high AH prevalence together with overweight or obesity represent cardiovascular risk factors, identified within our population but we could not establish a statistically significant correlation with CSDC.

Keywords: caffeinated soft drinks, hypertension, children, high normal blood pressure, overweight, cardiovascular risk factors.

Introduction

Romania has one of the highest national prevalence rates of arterial hypertension (AH) in the European Union [1]. Early-onset AH in children and adolescents was demonstrated in many reports, but what

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is worrying is the increasing prevalence in children, often associated with overweight and obesity [2], responsible for an early progression to end-organ damage (left ventricular hypertrophy, increased arterial intima-media thickness, chronic kidney disease) [3, 4].

Changes in the 2017 Hypertension Guidelines by the American Academy of Pediatrics (AAP) have resulted in increased prevalence of elevated BP and hypertension, and there is no international consensus on these changes. Despite the rise in overweight and obese children, hypertension prevalence is stable, suggesting multifactorial effects on childhood BP [5]. Although obesity and overweight represent important risk factors for hypertension, other factors should be identified and evaluated.

This paper aims to analyze the correlation between caffeinated soft drinks consumption and overweight and hypertension based on the data collected during the survey interview performed for the original research conducted between 2006 and 2008 and published in 2013 by authors Cinteza and Balgradean entitled "Hypertension in Romanian children and adolescents: a cross-sectional survey" [6].

Material and methods

Study Population

Initially, 5290 children and adolescents were recruited between 2006 and 2008. Of these, 424 were excluded for either of the following reasons: they were absent at the second or third measurement, they were older than 18, they or their parents did not give their consent. We selected 3 kindergartens, 5 schools and 1 high school in Bucharest and 8 kindergartens, 6 schools and 1 high school in Ilfov County. There were 2187 participants from Bucharest (urban area) and 2679 from Ilfov County (rural area) who made up the entire population attending school or kindergarten at the moment of the study. In the end, we analyzed data from 4866 subjects. Of these, 2459 were females (50.5%) and 2407 males (49.5%).

Data Collection

Weight, height, blood pressure (BP) measurements were taken. BP was measured at different hours, never the same for the same subject. Consent was obtained before measurements. We calculated the body mass index (BMI). We compared the values obtained for height, BMI, BP to those from the tables recommended by the American Academy of Pediatrics (AAP) [5] and the Centers for Disease Control and Prevention (CDC) (http://www.cdc.gov/growthcharts). An interviewer-administered questionnaire about family history of heart disease, consumption of caffeinated soft drinks, smoking, absence of extra-curricular physical activity, sleeping hours and disorders was used for both parents and children.

A mobile digital scale (SECA, Hamburg, Germany; accuracy 100 g) was used to measure weight, with children dressed in light clothing. Height accuracy was 5 mm. BP measurements were made using a validated oscillometric BP monitor for the first measurement (Omron 705IT) and a mercury BP monitor (Riester) for the second and the third measurement, both with adapted cuffs, taken at a one-week interval, a method accepted by the AAP. We strictly followed the recommendations of the Fourth Report on the Diagnosis, Evaluation and Treatment of High Blood Pressure in Children and Adolescents of the National High Blood Pressure Education Program (NHBPEP) on blood pressure measurement [7].

A questionnaire-based interview regarding caffeinated soft drinks consumption was applied to all children, and the answers were subsequently confirmed by their parents. The study was approved by the Ethics Committee of the Carol Davila University of Medicine and Pharmacy.

Definitions

Arterial hypertension in children is defined as systolic and/or diastolic blood pressure exceeding the 95th percentile for age, gender, and height after at least three measurements [7]. High normal BP represents the average systolic blood pressure (SBP) or diastolic blood pressure (DBP) levels that are ≥90th percentile and <95th percentile [7]. BP measurements were included in a computerized database, and values of BP over the 9^{5th} percentile were identified based on the US normative blood pressure tables [7]. The second and third measurements followed at a one-week interval between themselves. If all three measurements exceeded the 95th percentile of BP for age, gender and height, the subjects were considered hypertensive.

BMI percentiles pointed to being underweight, overweight and obese. BMI below the 5th percentile identified the patient as underweight; between 85th and 95th percentiles, BMI was an indicator of overweight, while obesity was defined as BMI over 95th percentile according to the CDC normative tables [8, 9].

Statistical Analysis

Mean and standard deviation were calculated for height, BMI, SBP, and DBP according to gender. We described types of hypertension (systolic, diastolic, and systo-diastolic) for each weight class. The proportions of hypertensive children were compared

Table 1. Description of the cohort according to height, BMI, SBP and DBP in females.

Age (years)		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
Subjects (n)		35	85	95	150	179	201	190	202	152	175	154	182	209	229	221	2459
%		1.4	3.5	3.9	6.1	7.3	8.2	7.7	8.2	6.2	7.1	6.3	7.4	8.5	9.3	9.0	100.0
Height (cm)	Mean	99.7	106.0	115.7	120.5	126.1	131.9	137.7	142.7	148.3	153.7	157.9	161.8	163.5	164.3	164.5	145.2
	SD	5.9	6.4	5.6	5.3	6.5	6.7	7.2	8.0	7.9	8.0	7.3	6.5	6.3	6.2	6.4	19.4
BMI	Mean	14.4	14.3	14.4	114.8	15.5	15.9	16.8	17.3	18.3	19.2	20.1	20.4	19.9	20.0	20.0	17.9
	SD	1.8	2.7	1.9	2.5	2.4	2.9	3.3	3.4	3.6	3.4	3.1	3.6	2.8	2.6	3.0	3.7
SPB (mmHg)	Mean	92.1	94.7	101.1	102.7	102.1	104.3	106.1	107.8	111.9	116.4	118.3	116.3	114.1	113.0	113.0	109.3
	SD	11.1	10.0	11.6	11.6	13.0	12.4	14.5	15.3	13.1	13.3	14.2	13.3	12.0	12.2	14.2	14.4
DPB (mmHg)	Mean	60.6	60.6	63.4	62.8	63.9	64.5	65.4	65.7	69.0	70.5	72.1	70.5	69.6	67.9	67.4	67.0
	SD	9.1	9.5	8.3	9.8	10.9	11.1	11.9	11.5	10.7	10.2	10.2	10.2	10.0	9.8	11.1	10.9

Table 2. Description of the cohort according to height, BMI, SBP and DBP in males.

Age (years)		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
Subjects (n)		31	63	116	150	207	194	203	216	188	180	176	189	186	163	145	2407
%		1.3	2.6	4.8	6.2	8.6	8.1	8.4	9.0	7.8	7.5	7.3	7.9	7.7	6.8	6.0	100.0
Height (cm)	Mean	101.6	108.3	116.0	121.6	127.3	132.9	138.2	142.8	146.3	153.0	159.7	166.9	173.5	176.5	177.2	147.1
	SD	5.9	5.8	5.7	5.9	6.5	7.8	7.5	6.7	7.0	8.2	8.9	9.6	8.5	7.1	7.1	21.9
BMI	Mean	15.2	15.0	15.0	15.1	15.6	16.4	16.7	17.2	18.0	19.2	19.1	19.8	20.0	20.7	20.9	17.9
	SD	1.6	2.0	2.4	2.3	2.6	2.9	3.2	3.4	3.3	3.8	3.2	3.4	3.1	3.2	3.4	3.7
SPB (mmHg)	Mean	95.7	95.9	100.5	101.6	104.8	105.0	107.2	108.4	109.8	113.7	118.2	121.3	120.7	123.5	122.5	111.5
	SD	13.2	10.2	11.1	11.5	2.6	11.8	12.1	12.1	12.9	12.5	14.4	12.9	13.5	14.1	14.4	15.1
DPB (mmHg)	Mean	59.6	58.6	62.2	61.3	64.9	63.0	64.2	66.5	68.8	69.5	70.6	69.8	68.5	67.7	67.5	66.3
	SD	7.3	8.5	10.9	9.1	11.4	10.9	10.3	11.1	10.7	10.1	11.5	10.4	11.2	10.9	9.8	11.0

between sexes and weight classes using the chi-squared test. P-values were calculated for each type of AH in various weight classes. We also used linear regression of age-related height, BMI, BP. All-data analysis was performed using R V1.21.1 (R Foundation for Statistical Computing, 2010) on an Ubuntu V11.04 personal computer. P<0.05 was considered statistically significant.

Results

Characteristics of the study population regarding height, BMI, SBP, and DBP for the 3 to 17 age group are presented in Table 1 for females and Table 2 for males.

The presence of different presumed risk factors and AH prevalence in these sub-groups are shown in Table 3. Daily caffeinated soft drinks consumption was present in 507/4866 children, 10.4% of all children and adolescents. This percent increased to 12.5% for hypertensive children and adolescents (n=45). 10.2% of the obese children and adolescents (n=82) were daily consumers of caffeinated soft drinks. AH was present among 9.7% of the caffeinated soft drinks consumers.

Although some reports connected soft drinks consumption with a high risk of developing AH [10], we found no significant relation between caffeinated soft drinks consumption and arterial hypertension (P=0.96). Table 4 shows the presence of AH in the sub-groups with daily consumption of soft drinks.

Daily consumption of sugar-sweetened and artificially sweetened beverages is incriminated in many published reports as an important risk factor for metabolic syndrome onset, overweight and cardiovascular disease [11]. Our survey results could not establish a statistical correlation between caffeinated sweet beverages and overweight or obesity (p=0.36).

Discussion

The 2017 American Academy of Pediatrics Clinical Practice Guidelines (AAP CPG) resulted in an overall increase in the prevalence of HTN, particularly in youth who are obese or who have other cardiovascular risk factors. The change in prevalence likely differs based on sex, age, and height [12]. The research found an AH prevalence of 7.4%, higher than previously reported. Hypertension was more prevalent in

Table 3. Prevalence of presumed risk factors.

Presumed risk factor	Total number of children (n)	AH children (n)	%
Overweight	490	61	12.4
Obesity	311	26	3.8
Underweight	691	26	3.8
Family history of heart disease	484	46	9.5
Smoking	164	12	7.3
Low birth weight	20	2	0.1
Caffeinated soft drinks	507	49	9.7
Sleep disorders	131	8	6.1
Abnormal sleep duration	163	11	6.7
Physical inactivity	431	48	11.1

Table 4. Prevalence of AH versus soft drinks daily consumption.

Soft drinks daily consumption (l)	0.2	0.3	0.3	0.3	0.5	0.6	0.8	1	1.3	1.3	1.5	2	2.3	2.3	2.5	4
AH absent (n)	2.4	45	9	2	136	1	16	159	2	1	21	57	4	1	3	2
AH present (n)	0	6	1	0	14	0	3	13	0	0	0	7	0	0	0	0

males and associated with obesity and overweight. High-normal BP prevalence was 16.9%. Overweight and obesity prevalence in children and adolescents was 10.1% and 6.4%, respectively, which are around the median of reported values from other countries [13]. These results agree with recent data about AH prevalence in Romanian adults [1] and show the importance of AH screening in children. We found a strong correlation of AH with obesity and overweight, which confirms the importance of the weight issue in AH management.

This research is one of few studies examining the relationship between hypertension and caffeinated soft drinks consumption. However, our study does not carry enough statistical strength, given that only about 20% of respondents provided an answer to the caffeinated soft drinks consumption question. This is probably one of the main reasons for the lack of statistically proven correlation. However, there is growing evidence that the consumption of energy drinks is associated with a range of adverse outcomes and risk behaviors in terms of children's health and well-being. More research is needed to explore the short-term and long-term impacts in all spheres, including health, behavior, and education [14].

Data in the literature claim a relationship between increased soft drinks intake and overweight/obesity [9, 10, 15, 16]. The daily consumption of caffeinated soft drinks in our group was 11.7%, in the same range as in other European countries (Latvia, 10-16%), but less than in the US (56%) or Canada (36%) [9, 17]. As a result of changing consumer behavior observed after the transition period of an ex-communist country, we should probably pay more attention as long as the young population is more exposed to its side effects [18]. The relation was not confirmed by the statistical work on the figures obtained during this survey partially for the reasons already stated above.

As for obesity, environmental and metabolic health risk factors for obesity, a cross-sectional study conducted in Brazil and revealed 84.0% of participants consumed snacks and soft drinks at home. This cohort reported having engaged in physical activity for less than 3 hours per week at school (93.0%) and home (85.0%) [19].

Our study also had some limitations regarding the geographical extent. It is a monocentric study (Bucharest area), and biases could interfere if we extrapolate results to the Romanian pediatric population. A continuation of this research would be very welcome, preferably on a multicentric basis. We should find ways to increase the respondent's adherence during the interviews in order to refine the results and bring more up-to-date information regarding AH prevalence and relation with risk factors as a part of a prevention program of the most invalidating pathology and the main mortality cause in our country: the cardiovascular disease.

Conflict of interest

The authors confirm that there are no conflicts of interest.

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