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ORIGINAL ARTICLE

Association of junk food consumption with high blood pressure and obesity in Iranian children and adolescents: the CASPIAN-IV Study☆

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KEYWORDS
Junk food;
High blood pressure;
Obesity;
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Abstract
Objective: This study aimed to evaluate the association of junk food consumption with hypertension and obesity in a national sample of Iranian children and adolescents.
Methods: This nationwide study was conducted in 2011-2012 among 14,880 students, aged 6-18 years, selected by cluster sampling from 30 provinces. Weight, height, waist circumference (WC), hip circumference (HC), waist-to-hip ratio (WHR), waist-to-height ratio (WHtR), as well

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as systolic and diastolic blood pressure (BP) were measured. Junk food was divided into four categories, including salty snacks, sweets, sweetened beverages, and fast food. Subjects reported how many times they had consumed each item (daily, weekly, and seldom).
Results: The intake of sweets was significantly associated with anthropometric indices and BP levels. Moreover, a significant association was found between fast food consumption, BP levels, and anthropometric indices (except for WHtR and WHR). Sweet beverages consumption was significantly associated with anthropometric indices; however, the consumption of salty snacks was only significantly associated with height, HC, and WHR. The risk of general obesity (OR: 0.75, 95% CI: 0.65-0.87) and abdominal obesity (OR: 0.81, 95% CI: 0.72-0.92) among participants who seldom consumed sweets was less than those who consumed daily. Also, the risk of general obesity (OR: 0.85, 95% CI: 0.74-0.97) among students that seldom consumed sweetened beverages was less than subjects who consumed them on a daily basis.
Conclusion: It was found that junk food consumption increased the risk of both general and abdominal obesity; therefore, consumption of junk food should be reduced via restricting TV advertisements and increasing taxes on junk foods.

PALAVRAS CHAVE
Junk Food;
Hipertensão Arterial;
Obesidade;
Medidas antropométricas

Associação entre o consumo de *junk food* e a pressão arterial alta e obesidade em crianças e adolescentes iranianos: o Estudo CASPIAN-IV

Resumo
Objetivo: Este estudo pretende avaliar a associação entre o consumo de *junk food* e a hipertensão e obesidade em uma amostra nacional de crianças e adolescentes iranianos.
Métodos: Este estudo nacional foi realizado entre 2011 e 2012 com 14.880 estudantes com 6-18 anos de idade, selecionados por amostra em bloco em 30 províncias. Foram medidos o peso, a estatura, a circunferência da cintura (CC), circunferência do quadril (CQ), razão cintura/quadril (RCQ), razão cintura/estatura (RCE) e a pressão arterial sistólica e diastólica (PAS e PAD). A *junk food* foi dividida em quatro categorias, incluindo lanches salgados, doces, bebidas açucaradas e *fast food*. Os indivíduos relataram quantas vezes consumiam cada um dos itens (diariamente, semanalmente, raramente).
Resultados: O consumo de doces foi associado significativamente aos índices antropométricos e níveis de PA. Além disso, havia uma associação significativa entre o consumo de *fast food* e os níveis de PA e índices antropométricos (exceto RCE e RCQ). O consumo de bebidas açucaradas foi associado significativamente aos índices antropométricos, porém o consumo de lanches salgados foi associado significativamente apenas à estatura, CQ e RCQ. O risco de obesidade geral (RC: 0,75, IC de 95%: 0,65-0,87) e obesidade abdominal (RC: 0,81, IC de 95%: 0,72-0,92) entre participantes que raramente consumiam doces era menor que naqueles que os consumiam diariamente. Além disso, o risco de obesidade geral (RC: 0,85; IC de 95%: 0,74-0,97) entre estudantes que raramente consumiam bebidas açucaradas era menor que entre indivíduos que os consumiam diariamente.
Conclusão: Constatamos que o consumo de *junk food* aumentou o risco de obesidade geral e abdominal; portanto, o consumo de *junk food* deve ser reduzido por meio da restrição de comerciais de TV e do aumento de impostos sobre esse tipo de alimento.

Introduction

In recent decades, childhood obesity has become a worldwide concern. In the United States, nearly one-third of children and adolescents are overweight or obese.[1] In addition, the prevalence of obesity in children in developing countries, including Iran, is increasing rapidly.[2] In the third nationwide survey of the CASPIAN study, 17.7% of the students were overweight or obese (19.9% of boys and 15.5% of girls). Abdominal obesity also has been reported (16.3%).[3] In addition, in childhood, obesity is a known risk factor for cardiovascular disease (including hypertension and coronary disease), type-2 diabetes, and certain types of cancer. Obese children are at increased risk of mortality and morbidity resulting from cardiovascular disease in adulthood.[4] Increased sedentary activity, lack of regular physical activity, and poor eating habits, e.g., high intake of sweetened beverages, fast foods, and sweets, may lead to obesity.[5]

Only 25% of hypertensive cases are diagnosed and treated. Many studies have shown that hypertension may

begin in adolescence or even in childhood.[6] In children, the prevalence of hypertension is lower than adults. The prevalence of hypertension in the adult population of the United States and Europe has been estimated at 15-30%, while the prevalence in children is 3-5%.[7] Physical inactivity, smoking, consumption of fast food, and sugar-sweetened beverages are associated with increased blood pressure.[8]

Low intake of nutrients and increased consumption of high-energy foods is known as junk food. It represents a significant proportion (15-40%) of total daily caloric intake of children and has been shown to be associated with overweight and obesity.[9,10] These eating habits of children and adolescents are a concern of many researchers. A study has shown that increased consumption of snacks is associated with obesity and other chronic diseases among children and adolescents.[11] The consumption of junk food as snacks is increasing among children. The prevalence of obesity has increased with a greater intake of processed carbohydrates (e.g. sugar, white flour, and saturated fats) in Western societies during past century.[12] Majane et al. have demonstrated that consumption of a diet high in sugar and saturated fat compared to sugar-free and low-fat diet resulted in left ventricular dysfunction and hypertension.[13] Experimental studies have shown that chronic hypertension and systolic and diastolic dysfunction can lead to heart failure.[14]

As a result of changing dietary patterns in recent decades, nutritious snacks are substituted by junk food. Television advertising, attractive packaging, and lack of parental awareness are the major cause of junk food consumption. These snacks contain high amounts of fat, salt, and sugar. Excess salt intake in childhood is associated with hypertension in adulthood.[15] Since life style changes, weight disorders, and hypertension prevalence have increased rapidly due to epidemiological and nutritional transition in recent years in Iran, and because the effect of junk food consumption on these disorders in children and adolescents is not well documented, this study was designed to evaluate association between hypertension and obesity with junk food consumption in a representative national sample of Iranian children and adolescents.

Materials and Methods

Study population

This study was as fourth survey of Childhood and Adolescence Surveillance and Prevention of Adult Noncommunicable Diseases, entitled CASPIAN-IV (2011-2012). This study was conducted on 13,486 children and adolescents 6-18 years who were selected through a multi-stage cluster sampling from 30 provinces of Iran (480 samples in each province). Methods are described in detail in previous study.[16] After a full explanation of the study objectives and protocols, written informed consent and verbal consent was obtained from parents and students.

Measurements

Demographic data

Trained health care providers collected the demographic characteristics, such as age, family size, socio-economic status, sedentary lifestyle, physical activity, as well as parent's occupation and education level.

Measurements

Weight, height, waist circumference (WC), hip circumference (HC), waist-to-hip ratio (WHR), waist-to-height ratio (WHtR), and systolic and diastolic blood pressure (SBP and DBP) were measured by a trained researcher. Weight was measured with minimal clothing, with 0.1 kg accuracy and standing height was recorded without shoes, with 0.1 cm accuracy. WC was measured using a non-elastic tape on the distance around the smallest area below the rib cage and above the iliac crest at the end of normal expiration, to the nearest 0.1 cm. The widest part of the buttocks was measured to obtain the hip circumference to the nearest 0.1 cm. WHtR was calculated by dividing WC (in cm) by height (in cm). In this study, abdominal obesity was defined as WHtR more than 0.5.[17] Body mass index (BMI) $\geq$ 95th percentile was considered as obesity.

BP was measured using a mercury sphygmomanometer on the right arm in a sitting position. It was measured twice at five-minute intervals, and the average was reported. BP was categorized into two groups: normal pressure (< 95th percentile) and hypertension ($\geq$ 95th percentile).

Foods with a high content of sugar, salt, saturated fats and trans fats, and low content of nutrients were placed in the junk food group. Accordingly, junk food was categorized into four groups, including salty snacks (chips, cheese curls, popcorn, and pretzels), sweets (biscuits, cookies, cakes, chocolate, and candies), sweetened beverages (soda, soft drinks), and fast foods (hot dogs, hamburgers, cheeseburgers, fried chicken, and pizza). Junk food consumption was categorized into four groups: daily, weekly, seldom, and never. Subsequently, the groups of ''seldom'' and ''never'' were merged, and were considered as the seldom group. Subjects reported how many times they had consumed each item (daily, weekly, and seldom).

The physical activity (PA) of the participants was collected one week prior to the study, benefiting a valid questionnaire.[18] Weekly frequency of PA outside the school of at least 30 minutes per day was reported by children as the number of days which had caused heavy sweating or large increases in breathing or heart rate. For the sake of statistical analysis, each weekly frequency received a classification (0-2 days per week [mild], 3-5 days per week [moderate], 6-7 days [severe]).

Statistical analysis

Qualitative variables were reported as numbers and percentages, and quantitative variables were reported as mean $\pm$ SD (standard deviation). The chi-squared test was used to analyze qualitative variables, and comparison of means of quantitative variables was investigated by Student's *t*-test and analysis of variance (ANOVA). To adjust the relationships for possible confounders, logistic regression analysis was conducted to evaluate the association of junk food with hypertension and anthropometric indices in four models, consisting of: Model I: crude model (without adjustment); Model II: adjusted for age and sex, and

Table 1 Demographic characteristics of participants according to sex: the CASPIAN-IV Study.

	Boys	Girls	Total	p-value
Age (years)	12.36 ± 3.4	12.58 ± 3.32	12.47 ± 3.36	0.2
Family size				
Less than four persons	3,366 (50%)	3,125 (48%)	6,491 (49%)	0.06
More than four persons	3,343 (50%)	3,435 (52%)	6,778 (51%)	
Father's occupation				
Unemployed	312 (5%)	345 (5%)	657 (5%)	0.07
Employee	3,166 (48%)	2,908 (45%)	6,074 (47%)	
Farmer	654 (9%)	581 (10%)	1,235 (9%)	
Self-employed	2,491 (38%)	2,571 (40%)	5,062 (39%)	
Mother's occupation				
Housekeeper	6,025 (89%)	5,858 (89%)	11,883 (89%)	0.04[a]
Employee	561 (8%)	499 (7%)	1,060 (8%)	
Other	178 (3%)	231 (4%)	409 (3%)	
Father's education (%)				
Illiterate/elementary school	775 (12%)	696 (11%)	1,471 (11%)	0.6
Secondary school/high school	4,943 (74%)	4,845 (75%)	9,788 (75%)	
University	927 (14%)	904 (14%)	1,831 (14%)	
Mother's education (%)				
Illiterate/elementary school	1,191 (17%)	1,079 (16%)	2,270 (17%)	0.46
Secondary school/high school	4,982 (74%)	4,943 (75%)	9,925 (74%)	
University	596 (9%)	571 (9%)	1,167 (9%)	
Sedentary lifestyle				
Watching TV (%)				
≤ 2 h/day	3,300 (49%)	3,285 (50%)	6,585 (49%)	0.36
> 2 h/day	3,460 (51%)	3,300 (50%)	6,760 (51%)	
Working with computer (%)				
≤ 2 h/day	5,799 (88%)	6,021 (93%)	11,820 (90%)	< 0.001[a]
> 2 h/day	811 (12%)	449 (7%)	1,260 (10%)	
Screen Time				
≤ 2 h/day	5,301 (78%)	5,598 (85%)	10,899 (81%)	< 0.001[a]
> 2 h/day	1,489 (22%)	1,005 (15%)	2,494 (19%)	
Family history				
HTN	3,542 (52%)	3,622 (55%)	7,164 (54%)	0.02[a]
Dyslipidemia	2,942 (43%)	2,946 (44%)	5,888 (44%)	0.2
DM	2,931 (43%)	3,148 (48%)	6,079 (45%)	0.001[a]
Obesity	2,395 (36%)	2,462 (38%)	4,857 (37%)	0.16
Physical activity				
< 2 times/week	1,945 (28%)	2,608 (40%)	4,553 (34%)	< 0.001[a]
2-4 times/week	2,410 (36%)	2,500 (38%)	4,910 (37%)	
> 4 times/week	2,410 (36%)	1,476 (22%)	3,886 (29%)	
Social Economic Status				
Low	2,082 (33%)	2,065 (34%)	4,147 (34%)	0.57
Medium	2,050 (33%)	2,050 (33%)	4,100 (33%)	
High	2,143 (34%)	2,000 (33%)	4,143 (33%)	

HTN, hypertension; DM, diabetes mellitus.
[a] $p \leq 0.05$ is considered significant.

living area; Model III: additionally adjusted for family history of chronic disease, physical activity, screen time, and socioeconomic status; Model IV: additionally adjusted for BMI only for hypertension. In all models, the daily group was considered as the reference group. p-value of less than 0.05 was considered as statistically significant. All statistical analyses were conducted in Stata 2011, release 12 (Stata Corp - College Station, TX, USA), by using survey (cluster) analysis design.

Ethical considerations

After a complete explanation of the objectives and methods of the study, an informed consent was obtained from

Table 2 Characteristics of participants according by sex and age groups: the CASPIAN-IV Study.

Sex	Boys				Girls			
Years	6-10	11-14	15-18	Total	6-10	11-14	15-18	Total
Height (cm)[a]	127.56 ± 0.36	148.48 ± 0.42	169.61 ± 0.37	148.17 ± 19.78	127.04 ± 0.39	149.39 ± 0.44	159.25 ± 0.22	145.78 ± 16.1
p-value					0.005[b]			
Weight (Kg)[a]	26.61 ± 0.25	41.92 ± 0.41	61.59 ± 0.48	43.07 ± 18.37	26.4 ± 0.26	42.8 ± 0.46	54.35 ± 0.3	41.71 ± 15.56
p-value					0.06			
BMI (kg/m²)[a]	16.18 ± 0.09	18.78 ± 0.11	21.31 ± 0.12	18.74 ± 4.42	16.2 ± 0.11	18.95 ± 0.13	21.4 ± 0.10	18.97 ± 4.39
p-value					0.1			
WC (cm)[a]	58.76 ± 0.3	68.89 ± 0.37	76.36 ± 0.42	67.83 ± 12.84	58.52 ± 0.29	67.15 ± 0.33	72.37 ± 0.31	66.19 ± 10.92
p-value					< 0.001[b]			
Hip (cm)[a]	68.61 ± 0.35	80.84 ± 0.35	91.4 ± 0.56	80.06 ± 16.51	68.96 ± 0.36	82.38 ± 0.41	92.2 ± 0.45	81.53 ± 16.59
p-value					0.01[b]			
WHtR (cm)[a]	0.461 ± 0.002	0.464 ± 0.002	0.44 ± 0.002	0.46 ± 0.06	0.461 ± 0.002	0.449 ± 0.001	0.454 ± 0.001	0.45 ± 0.06
p-value					0.03[b]			
WHR (cm)[a]	0.197 ± 0.001	0.188 ± 0.001	0.187 ± 0.001	0.19 ± 0.03	0.193 ± 0.001	0.182 ± 0.001	0.169 ± 0.001	0.181 ± 0.03
p-value					< 0.001[b]			
SBP (mmhg)[a]	95.46 ± 0.56	102.18 ± 0.45	111.15 ± 0.49	102.79 ± 14.17	95.59 ± 0.58	100.35 ± 0.45	104.25 ± 0.41	100.21 ± 12.54
p-value					< 0.001[b]			
DBP (mmhg)[a]	61.19 ± 0.47	65.19 ± 0.48	70.56 ± 0.52	65.58 ± 11.56	61.99 ± 0.57	63.80 ± 0.44	66.40 ± 0.40	64.12 ± 11.10
p-value					0.001[b]			
BMI categories								
Underweight	302 (13.5)	309 (13)	270 (12)	881 (13%)	240 (12)	331 (15)	169 (8)	740 (11)
Normal	1,519 (67)	1,394 (60)	1,420 (66)	4,333 (64%)	1,421 (70)	1,442 (63)	1,634 (72)	4,497 (68)
Overweight	162 (7)	237 (10)	228 (10)	627 (9%)	160 (8)	250 (11)	250 (11)	660 (10)
Obese	284 (12.5)	389 (17)	245 (12)	918 (14%)	211 (10)	248 (11)	207 (9)	666 (11)
p-value					< 0.001			
Abdominal obesity[c]								
Yes	394 (17)	570 (24)	420 (19)	1,385 (21)	364 (17.8)	384 (17)	423 (18.7)	1,171 (18)
No	1,882 (83)	1,769 (76)	1,747 (81)	5,401 (79)	1,674 (82.2)	1,895 (83)	1,838 (81.3)	5,411 (82)
p-value					0.006[b]			
DBP								
Normal	2,237 (98.5)	2,261 (96.9)	2,024 (93.6)	6,526 (96)	1,991 (97.8)	2,212 (97.1)	2,209 (97.6)	6,412 (97)
HTN	9 (1.5)	72 (3.1)	140 (6.4)	247 (4)	44 (2.2)	66 (2.9)	54 (2.4)	164 (3)
p-value					0.04[b]			
SBP								
Normal	2,270 (99.6)	2,325 (99.4)	2,105 (97)	6,704 (99)	2,026 (99.5)	2,270 (99.6)	2,244 (99.1)	6,540 (99)
HTN	9 (0.4)	14 (0.6)	62 (3)	85 (1)	9 (0.5)	9 (0.4)	20 (0.9)	38 (1)
p- value					0.003[b]			
HTN[c]								
Normal	2,234 (98.3)	2,249 (96.4)	1,980 (91.5)	6,462 (95)	1,986 (97.6)	2,206 (96.8)	2,191 (96.8)	6,383 (97)
HTN	39 (1.7)	84 (3.6)	184 (8.5)	307 (5)	49 (2.4)	72 (3.2)	72 (3.2)	193 (3)
p-value					0.007[b]			

BMI, body mass index; WC, waist circumference; WHtR, waist-to-height ratio; WHR, waist-to-hip ratio; SBP, systolic blood pressure; DBP, diastolic blood pressure; HTN, hypertension.

[a] Data are presented as mean (SD).

[b] $p \leq 0.05$ is considered as significant (for both boys and girls).

[c] Data are presented as n (%).

Table 3 Association between blood pressure and junk foods: the CASPIAN-IV Study.

	Sweets			Fast foods			Sweetened beverages			Salty Snacks		
	Daily	Weekly	Seldom	Daily	Weekly	Seldom	Daily	Weekly	Seldom	Daily	Weekly	Seldom
BMI												
Underweight	344 (11)	678 (12)	589 (13)	1,184 (12)	379 (12)	47 (12)	481 (11)	783 (12)	347 (13)	804 (12)	589 (12)	216 (13)
Normal	1,977 (63)	3,722 (67)	3,093 (68)	6,432 (66)	2,115 (66)	243 (64)	2,749 (65)	4,276 (67)	1,772 (66)	4,441 (66)	3,181 (67)	1,162 (68)
Overweight	347 (11)	524 (9)	404 (9)	940 (10)	294 (10)	41 (11)	448 (11)	571 (9)	257 (10)	663 (10)	458 (10)	152 (9)
Obese	477 (15)	649 (12)	446 (10)	1,121 (12)	407 (12)	46 (13)	559 (13)	725 (11)	290 (11)	854 (12)	537 (11)	181 (10)
p-value		< 0.001[a]			0.61			0.001[a]			0.13	
Abdominal obesity												
No	2,432 (77)	4,556 (81)	3,780 (83)	7,908 (81)	2,544 (79)	307 (81)	3,416 (80)	5,188 (81)	2,164 (81)	5,473 (81)	3,885 (81)	1,393 (81)
Yes	725 (23)	1,043 (19)	764 (17)	1,805 (19)	658 (21)	72 (19)	841 (20)	1,187 (19)	507 (19)	1,320 (19)	891 (19)	320 (19)
p-value		< 0.001[a]			0.06			0.37			0.56	
DBP												
Normal	3,044 (96.5)	5,404 (96.8)	4,419 (97.4)	9,410 (97)	3,093 (96.8)	364 (96.3)	4,124 (97)	6,170 (96.9)	2,582 (96.8)	6,583 (97.1)	4,616 (96.7)	1,658 (96.7)
HTN	109 (3.5)	179 (3.2)	120 (2.6)	291 (3)	103 (3.2)	14 (3.7)	126 (3)	198 (3.1)	84 (3.2)	194 (2.9)	156 (3.3)	57 (3.3)
p-value		0.19			0.64			0.88			0.5	
SBP												
Normal	3,122 (98.8)	5,544 (99.1)	4,503 (99.2)	9,628 (99.1)	3,168 (99)	374 (98.9)	4,211 (98.9)	6,331 (99.3)	2,636 (98.8)	6,716 (98.9)	4,743 (99.3)	1,699 (98.9)
HTN	37 (1.2)	49 (0.9)	37 (0.8)	86 (0.9)	33 (1)	4 (1.1)	47 (1.1)	43 (0.7)	33 (1.2)	73 (1.1)	32 (0.7)	18 (1.1)
p-value		0.22			0.73			0.01[a]			0.08	
HTN												
Normal	3,016 (95.6)	5,372 (96.2)	439 (96.7)	9,345 (96.3)	3,072 (96.1)	362 (95.8)	4,090 (96.2)	6,137 (96.4)	2,561 (96)	6,536 (96.4)	4,589 (96.2)	1,644 (95.9)
HTN	137 (4.4)	212 (3.8)	148 (3.3)	357 (3.7)	124 (3.9)	16 (4.2)	161 (3.8)	231 (3.6)	105 (4)	242 (3.6)	183 (3.8)	71 (4.1)
p-value		0.1			0.77			0.77			0.61	

Data are presented as n (%).
BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; HTN, hypertension.
[a] $p \leq 0.05$ is considered as significant.

Table 4 Odds ratios (CI 95%) for anthropometric indices and BP across junk food consumption: the CASPIAN-IV Study.

	Overweight OR (95% CI)	Obesity OR (95% CI)	Abdominal obesity OR (95% CI)	HTN OR (95% CI)
Sweets				
Model I[a]				
Seldom	0.83 (0.72-0.97)[e]	0.74 (0.65-0.84)[e]	0.76 (0.68-0.86)[e]	0.86 (0.66-1.13)
Weekly	0.78 (0.67-0.92)[e]	0.61 (0.53-0.71)[e]	0.67 (0.6-0.76)[e]	0.74 (0.56-0.97)[e]
Daily	1	1	1	1
Model II[b]				
Seldom	0.86 (0.74-1.00)	0.72 (0.63-0.82)[e]	0.77 (069-0.86)[e]	0.96 (0.73-1.25)
Weekly	0.81 (0.69-0.94)[e]	0.60 (0.52-0.70)[e]	0.68 (0.6-0.77)[e]	0.82 (0.62-1.08)
Daily	1	1	1	1
Model III[c]				
Seldom	0.90 (0.77-1.06)	0.75 (0.65-0.87)[e]	0.81 (0.72-0.92)[e]	0.93 (0.69-1.24)
Weekly	0.82 (0.69-0.98)[e]	0.60 (0.51-0.70)[e]	0.70 (0.61-0.80)[e]	0.78 (0.58-1.05)
Daily	1	1	1	1
Model IV[d]				
Seldom				0.96 (0.71-1.13)
Weekly				0.83 (0.61-1.14)
Daily				1
Sweetened beverages				
Model I				
Seldom	0.83 (0.72-0.95)[e]	0.84 (0.74-0.95)[e]	0.92 (0.83-1.03)	0.95 (0.77-1.17)
Weekly	0.90 (0.76-1.06)	0.80 (0.68-0.94)[e]	0.95 (0.83-1.08)	1.04 (0.79-1.35)
Daily	1	1	1	1
Model II				
Seldom	0.83 (0.73-0.95)[e]	0.82 (0.72-0.93)[e]	0.91 (0.82-1.01)	0.89 (0.72-1.11)
Weekly	0.89 (0.75-1.05)	0.77 (0.65-0.90)[e]	0.92 (0.81-1.05)	0.91 (0.69-1.19)
Daily	1	1	1	1
Model III				
Seldom	0.84 (0.72-0.97)[e]	0.85 (0.74-0.97)[e]	0.95 (0.85-1.07)	0.87 (0.69-1.09)
Weekly	0.88 (0.73-1.05)	0.79 (0.66-0.95)[e]	0.96 (0.83-1.12)	0.84 (0.62-1.13)
Daily	1	1	1	1
Model IV				
Seldom				0.9 (0.72-1.14)
Weekly				0.87 (0.65-1.18)
Daily				1
Fast foods				
Model I				
Seldom	0.94 (0.82-1.07)	1.11 (0.98-1.26)	1.13 (1.01-1.26)	1.05 (0.85-1.30)
Weekly	1.13 (0.80-1.59)	1.06 (0.77-1.45)	1.02 (0.78-1.34)	1.15 (0.68-1.95)
Daily	1	1	1	1
Model II				
Seldom	0.91 (0.79-1.04)	1.10 (0.97-1.25)	1.11 (1-1.24)[e]	0.92 (0.75-1.13)
Weekly	1.06 (0.75-1.49)	1.04 (0.75-1.43)	0.98 (0.75-1.29)	0.86 (0.51-1.46)
Daily	1	1	1	
Model III				
Seldom	0.82 (0.70-0.95)[e]	1.04 (0.90-1.19)	1.05 (0.93-1.18)	0.86 (0.68-1.09)
Weekly	1.02 (0.70-1.48)	1.02 (0.71-1.44)	1.03 (0.77-1.37)	0.90 (0.51-1.59)
Daily	1	1		1
Model IV				
Seldom				0.86 (0.68-1.09)
Weekly				0.91 (0.51-1.61)
Daily				1
Salty snacks				
Model I				
Seldom	0.97 (0.86-1.11)	0.87 (0.78-0.98)[e]	0.95 (0.85-1.05)	1.07 (0.84-1.37)
Weekly	0.89 (0.74-1.07)	0.81 (0.67-0.98)[e]	0.95 (0.82-1.09)	1.16 (0.85-1.59)
Daily	1	1	1	1

Table 4 (*Continued*)

	Overweight OR (95% CI)	Obesity OR (95% CI)	Abdominal obesity OR (95% CI)	HTN OR (95% CI)
Model II				
Seldom	0.96 (0.84-1.09)	0.88 (0.78-0.99)[e]	0.94 (0.85-1.05)	1.05 (0.83-1.34)
Weekly	0.87 (0.72-1.04)	0.83 (0.69-1.00)	0.95 (0.82-1.09)	1.13 (0.83-1.55)
Daily	1	1	1	1
Model III				
Seldom	0.99 (0.86-1.14)	0.93 (0.82-1.06)	0.99 (0.89-1.11)	1.02 (0.78-1.33)
Weekly	0.87 (0.71-1.07)	0.90 (0.74-1.11)	1.01 (0.86-1.18)	1.14 (0.82-1.59)
Daily	1	1	1	1
Model IV				
Seldom				1.03 (0.79-1.35)
Weekly				1.16 (0.83-1.63)
Daily				1

OR, odds ratio; CI, confidence interval.
[a] Without adjusted (crude models).
[b] Adjusted for age, sex, and area of residence.
[c] Additionally adjusted for family history of chronic disease, physical activity, screen time, and socioeconomic status.
[d] Additionally adjusted for BMI only for hypertension.
[e] Statistically significant.

parents and students. The study protocol was reviewed and approved by the ethical committees and other relevant national regulatory organizations.

Results

A total of 13,486 children and adolescents out of 14,880 invited subjects (participation rate of 90.6%) were evaluated in the current study. The average age of girls and boys was 12.58 (SD: 3.32) and 12.36 (SD: 3.39) years, respectively. Demographic characteristics of participants are shown in Table 1. As shown, physical activity levels were significantly higher in boys than girls (p-value < 0.001). Screen time activity more than two hours per day in boys and girls was 22% and 15%, respectively, a significant difference between sexes.

Mean and prevalence of various anthropometric and blood pressure measures are shown in Table 2. The average of height, WC, WHtR, WHR, SBP, and DBP were significantly higher in boys compared with girls. The percentage of overweight and obesity in girls were 11% and 10%, while in boys they were 14% and 9%, respectively. Also, the percentage of abdominal obesity among girls was larger than boys (p-value = 0.006). Hypertension was reported in 5% of boys and in 3% of girls, which was a statistically significant difference (p-value = 0.006).

The association of junk food consumption with prevalence of general and abdominal obesity and hypertension is presented in Table 3. According to this table, there was no association between junk food consumption and hypertension. However, sweets consumption showed a significant association with obesity and abdominal obesity.

The odd ratios for blood pressure and general and abdominal obesity across junk food intake categories are presented in Table 4. In the multivariate model (model III), the risk of general obesity and abdominal obesity among subjects who seldom consumed sweets was approximately 25% (OR: 0.75, 95% CI: 0.65-0.87) and 19% (OR: 0.81, 95% CI: 0.72-0.92) less than subjects who consumed daily, respectively. Also, the risk of general obesity among students that seldom consumed sweetened beverages was approximately 15% (OR: 0.85, 95% CI: 0.74-0.97) less than subjects who consumed daily.

Discussion

This study showed significant association between consumption of sweets and both general and abdominal obesity. Moreover, daily consumption of sweets increased the risk of general and abdominal obesity. However, there was no significant association between sweets consumption and elevated BP. These findings are consistent with a longitudinal study with two years of follow-up, which showed a parallel finding with the result of the current study; a significant association was found between the intake of sweets and weight gain during two years of follow-up.[19]

In addition, there was a significant association between sweetened beverages consumption and general obesity. However, there was no significant association between the intake of sweetened beverages and hypertension. As reported by Zheng et al., there was a significant association between sweetened beverages and obesity.[20] These results are similar to the findings of the present study. Also, Chen et al. concluded that decreased intake of sweetened beverages was significantly associated with reduced blood pressure.[21]

There was no significant association among junk foods (fast foods and salty snacks), obesity, and hypertension; despite the fact that many studies have shown that there is a significant association among general, abdominal obesity, and junk foods.[20,22] Esmaillzadeh & Azadbakht showed that among of general, central obesity is inversely associated with healthy dietary pattern, while the Western dietary pattern (include refined grains, processed meats, sweets, desserts, pizza, fries potatoes, and soft drinks) was directly related to obesity.[22] According to a study conducted on children, a significant association was not observed between

consumption of junk foods and weight.[15] In that study, the consumption of junk food in children with weight over the 95th percentile and below the 5th percentile was higher.[15]

As reported by Stanley et al., long-term consumption of junk foods accelerates the onset of heart failure.[23] The high consumption of junk foods also can cause obesity.[23] A community-based study showed that obesity is an independent risk factor for heart disease.[24] There is also a strong relationship between obesity and hypertension.[25] High consumption of junk foods may also cause the hypertension. However, the present study did not observe significant association between consumption of junk foods and hypertension. Khan et al. also did not observe a significant association between blood pressure and junk food.[26]

A study revealed that children who spent more time on watching TV usually consumed more calories (their diet contained more fat and soda and fewer fruits and/or vegetables).[27] Some researchers believe that inclination toward unhealthy food increases during watching TV.

TV advertisements also have a significant effect on the consumption of foods containing fat, salt, and sugar. More than 80% of food advertisements during children's TV programs include junk foods.[28] Restricting TV advertisements is a major way to reduce the choice of junk foods.

Another policy to reduce the consumption of junk food is to place taxes on unhealthy foods.[29] Decreasing junk food consumption leads to a reduction in energy intake, which ultimately results in reduced weight changes.[30]

One of the main strengths of present study is a large national sample size. The other strength of this study is its consideration of socioeconomic status and physical activity, in order to reduce the effects of confounders.

The limitations of this study included its cross sectional design, and the possible recall bias in reporting dietary intakes.

In conclusion, consumption of sweets was associated with general obesity and central obesity in children and adolescents. Moreover, significant association existed between consumption of sweetened beverages and general obesity. However, the association of fast food and salty snack consumption with obesity and hypertension was not significant. It is suggested that the consumption of junk foods should be reduced by several methods, including restriction of TV advertisements and increased taxation of junk foods.

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Conflicts of interest

The authors declare no conflicts of interest.

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