

Is snack consumption associated with meal skipping in children and adolescents? The CASPIAN-IV study

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Abstract

Purpose The present inquiry set to assess the relationship between snack consumption and meal skipping in Iranian children and adolescents.

Methods Overall, 14,880 students, aged 6–18 years, were selected via multistage cluster sampling method from rural and urban areas of 30 provinces of Iran. A validated questionnaire of food behaviors including questions on snacks consumption and taking/skipping meals was completed. Consuming and skipping meals and their related factors were reported in both crude and adjusted models.

Results Overall, 13,486 students with a mean age of 12.47 ± 3.36 years completed the study (90.6% participation

rate). Among them, 32.08, 8.89, and 10.90% skipped breakfast, lunch, and dinner, respectively. Compared to their counterpart groups, the frequency of meal skipping was higher in girls, urban inhabitants, and students in higher school grades ($P < 0.05$). Snack consumption was associated with an increased odds ratio of meal skipping in many types of snack groups.

Conclusions Meal skipping and snack consumption were frequent among Iranian children and adolescents. Evidence based interventions are proposed to improve the students' eating habits.

Keywords Snack consumption · Meal skipping · Children · Adolescents

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Introduction

A growing body of evidence reveals the worldwide increasing trends in mean body mass index [1] and the prevalence of obesity and overweight [2]. Excess weight as one of the most common risk factors of non-communicable diseases (NCDs) has become an emerging health problem in the pediatric age group, even in developing countries [3–5]. Childhood overweight increases the risk of overweight in later years of life [6, 7]. In these regards, adverse consequences of morbidities and mortality [8] lead to increased concern about the diets of adolescents and children [9, 10].

Although major shifts in physical activity patterns are associated with the increase in obesity, shifts in dietary pattern might also influence this outcome [11, 12]. During the same time period in which the prevalence of overweight increase, the average of consumed calories per day from snack foods also increases [13]. Snack foods tend to be energy dense and of little nutritional value. Despite their

lack of nutritional value, snack foods are readily available to children and adolescents in a variety of settings, including school [14]. In addition to providing energy, snacks are necessary for children to meet their nutritional requirements [15, 16]. The time between lunch at school and dinner at home is a critical period in a child's daily nutrient intake (American Academy of Pediatrics, American Public Health Assn. & Natl. Resource Center for Health and Safety in Child Care and Early Education, 2010; Preventing childhood obesity in early care and education programs: selected standards from caring for our children: Natl. health and safety performance standards; Guidelines for early care and education programs. 3rd ed. Aurora, Colo.: Natl. Resource Center for Health and Safety in Child Care and Early Education). The majority of snacks served in after-school environments are high in energy and low in nutrient quality, with considerable added sugar (such as cookies) or salty snacks (such as potato chips) [17].

There has been a sharp increase in the availability and consumption of junk food in recent years, and this may have contributed to rising rates of obesity. Junk foods are defined as items that are high in energy content, fat, and/or sugar and low in nutrients. Consumption of junk food is of concern among young adults because they are demographically identified as high consumers of junk food [18–20].

The concern is that younger people would eat less at regular meal time if they frequently consume large amount of snacks with low nutrient quality prior to their meals [21, 22]. The increasing prevalence of snacking has also recently been suggested as a potentially important influence on energy regulation in adolescents [23] and adults [24, 25]. The prevalence of snacking (defined as the consumption of foods and drinks between meals including milk drinks, regular soft drinks, sports drinks, and energy drinks) among adolescents and children varies widely across the world [13, 26].

Although evidence is limited, snacking may also be associated with less frequent consumption of meals or skipping meals, which may be detrimental to health since regular meal patterns are associated with greater dietary diversity [27], healthier food choices [28] and better nutrient intakes [29–31]. In contrast, few studies that have examined whether snacking varies with age, region of residence, and socioeconomic status have yielded more consistent results. In some research, snacking among children, adolescents, and young adults occurs more often in younger than older subjects [13, 26, 32], more often in urban than rural residents [33], and more often in subjects from families with higher incomes [13, 18] and education levels [34].

To prevent childhood obesity, greater understandings of dietary environmental factors that influence energy intake are needed. Dietary habits of children that play an important role in determining their health consequences

do not only vary from population to population, but also change due to cultural and socioeconomic factors. In developed countries, the dietary pattern of children have altered rapidly [35] although such information is very limited for children in developing countries, undergoing rapid socioeconomic changes. Moreover, dietary patterns influenced by cultural and religious norms and cultural opinions about body shape and acceptable weight gain may explain the increase in overweight and obesity in certain populations [36–38].

Due to the trend of excess weight among young children in Iran [39], it was aimed to find out: (1) What is the frequency of eating food and snack in Iranian school children? (2) Does snack consumption by school children cause skipping meals by theme?

Methods

The current national schoolbased study was performed in the framework of the national survey of school students' high-risk behaviors, conducted as the 4th survey of the schoolbased surveillance system. It was conducted among 14,800 students, aged 6–18 years, living in 30 provinces in Iran.

In order to achieve maximum representativeness, the study populations were students from rural and urban areas of Iran selected through multistage cluster sampling method from 30 provinces (48 clusters of 10 people in each province). Stratification was performed in each province according to location of residence (urban/rural) and school grade elementary/intermediate/high school, proportional to size and equal sex ratio, i.e., in each province, the number of boys and girls was the same, and the ratios in urban and rural areas were proportionate to the population of urban and rural students.

The questionnaire was prepared in Persian based on the World Health Organization (WHO) global school-based student health survey, and some questions were added [40]. The questionnaire's validity and reliability were confirmed [41].

Demographic characteristics of the students were collected including the students' educational level and the type and frequency of daily food and snack consumption. Also, they were asked how many days in a week do you eat each of main meals (breakfast, dinner, and lunch)?

In this study convenience definition of under study terms were as follow:

- Skippers: eating meal 0–2 days/week
- Non-skippers: eating meal 3–7 days/week

- Snacks: the consumption of foods and drinks between meals including milk drinks, regular soft drinks, sports drinks, and energy drinks
- Junk foods: fast food, salty snacks, and sweetened beverages
- Healthy foods: milk, dried fruits, fresh fruits, and fresh vegetables

Statistical analysis

Categorical variables are reported as percentage (95% confidence interval [CI]). Logistic regression analyses were performed to predict the odds of adolescents skipping meals when snacking in crude and adjusted model. In the adjusted model, the association was adjusted for age, sex, region, socioeconomic status, screen time, and physical activity. Data were analyzed using Stata software version 11.1 (Stata Corporation, College Station, TX, USA).

Ethical considerations

The study procedures were reviewed and approved by Ethics Committees of Tehran and Isfahan University of Medical Sciences. After explaining the study aims

and protocols, written consent and verbal assent were obtained from the participants.

Results

The population of this survey consisted of 13,486 children and adolescents (participation rate of 90.6%) including 49.2% girls and 75.6% urban inhabitants. The mean age of participants was 12.5 years (95% CI 12.3–12.6). The socio-demographic characteristics of the subjects are presented in Table 1.

The frequency of snacking among adolescents is shown in Table 2. The answers were classified in four categories of daily, weekly, seldom, and never. Daily consumption of puffs, chips, and salty snacks and carbonated drinks were reported 12.9 and 7.64%, respectively. More than 20% never drank milk or consumed milk rarely, and about 25% used sausage and other processed meats on a daily or weekly basis.

Frequency of meal skipping among adolescents according to school grade, sex, and region is shown in Table 3. High school students' significantly had lower frequency of skipping habits of all meals compared with other school grades. Girls had significant lower frequency of skipping breakfast and dinner.

Logistic regression analyses were performed to predict the odds of adolescents skipping meals when snacking in different contexts (Table 4). In the adjusted model, students who never consumed milk (OR 3.02, 95% CI 2.59–3.53), dried fruits (OR 1.58, 95% CI 1.33–1.86), fresh fruits (OR 1.95, 95% CI 1.41–2.20), and fresh vegetables (OR 1.79, 95% CI 1.45–2.71) (compare to daily consumption) had higher odds of breakfast skipping, and also students who never consumed fast food, salty snacks, and sweetened beverages had lower odds of breakfast skipping compared to students who consumed daily.

Table 1 Demographic characteristics of students: the CASPIAN IV study

Variable	N (%)
Sex	
Male	6846 (50.7%)
Female	6640 (49.2%)
School grade	
Elementary	6198 (45.9%)
Intermediate	3492 (25.8%)
High school	3796 (28.1%)
Region	
Urban	10,191 (75.5%)
Rural	3295 (24.4%)

Table 2 Frequency of food and snack eating among Iranian student

Food items	Daily N (%)	Weekly N (%)	Rarely N (%)	Never N (%)
Cakes, cookies, sweets, biscuits, chocolate	4578 (34.15)	5649 (42.14)	2803 (20.91)	375 (2.8)
Puffs, chips, salty snacks	1728 (12.9)	4831 (36.07)	5006 (37.37)	1829 (13.66)
Carbonated drinks	1022 (7.64)	4204 (31.43)	5749 (42.98)	2402 (17.96)
Fresh fruit or fruit juice	7351 (55.74)	4483 (33.99)	1195 (9.06)	159 (1.21)
Dried fruit (dried peaches, dried figs, raisins)	2660 (21.88)	4532 (37.27)	3873 (31.85)	1095 (9)
Packed fruit juices	2016 (15.12)	5375 (40.3)	4588 (34.4)	1357 (10.18)
Fresh vegetables (tomatoes, carrot, salads), or cooked	4791 (35.84)	6182 (46.24)	1901 (14.22)	495 (3.7)
Milk	6155 (46)	4435 (33.14)	1826 (13.65)	965 (7.21)
Sausage, pizza, burgers	382 (2.85)	3235 (24.13)	6600 (49.23)	3190 (23.79)

Table 3 Frequency of meal skipping among adolescents according to school grade, sex and region

Meal	Total	School grade			Sex		Region	
		Elementary	Intermediate	High School	Male	Female	Urban	Rural
<i>N</i> =								
Breakfast								
Skippers	% 32.08	26.02	36.29	38.11*	28.39	35.89*	32.93	29.47*
Non-skippers	%67.92	73.98	63.71	61.89*	71.61	64.11*	67.07	70.53*
Lunch								
Skippers	% 8.89	6.03	11.94	10.77*	8.57	9.22	9.33	7.54*
Non-skippers	% 91.1	93.97	88.06	89.23*	91.42	90.77	90.66	92.45*
Dinner								
Skippers	% 10.9	6.53	13.02	16.03*	8.75	13.1*	11.74	8.28
Non-skippers	% 89.1	93.46	86.98	83.97*	91.25	86.9*	88.26	91.72

Skippers: eating meal 0–2 days/week; Non-skippers: eating meal 3–7 days/week

Values are presented as %

*Pearson's chi square test of significance

Discussion

In the present study, daily consumption of junk foods, never, and rarely consumption of healthy foods were associated with increased odds of meal skipping. Similar results were observed in a previous study [42]. Susan et al. assessed skipping breakfast and lunch meal in 540 elementary students, showing that about 20% skipped breakfast and/or lunch at least three times per week. In addition, urban students skipped meals more than rural students [43].

In present investigation, by increase of the students' age and educational grade, most of them skipped main meals like breakfast, lunch, or dinner. For example, elementary students skipped main meals less compared with middle-school students, and middle-school students compared with high-school ones. In addition, breakfast is the most skipped meal among students.

Girls skipped meals more significantly than boys. Girls in growing age should be more careful about their nutritional habits because of the risks of puberty, childbearing, and reproduction [44]. Thus, meal skip may lead to serious problems in adolescence and adulthood [44].

The present study also showed that urban students skipped meals more than rural students. Since meal skipping was less in lower education grades and younger students, it is suggested to consider supervision and parental impact as influencing factors which is studied in a previous investigation [45].

The increasing rate of snack consumption in various communities is a nutritional problem [13]. One study among US children showed that as a result of increasing snack consumption, calcium and fat intake were decreased and increased, respectively [13].

A relatively large percentage of students in different age groups did not eat breakfast. Given the importance of breakfast and its negative relationship with eating snacks,

it is expected that students who do not eat breakfast are likely to consume snacks during the day. In National Longitudinal Study of Adolescent Health in US, fast food consumption and the possibility of eating breakfast was assessed in a sample of 9919 adolescents. Based on the findings, fast food consumption and breakfast skipping increased during the transition to adulthood, and both dietary behaviors were associated with increased weight gain from adolescence to adulthood [46].

It is proved that adolescents who are obese are more likely to remain obese in adulthood [47], so the problem of skipping meals, including breakfast, could be a life-time effect. The third School Nutrition Dietary Assessment Study assessed the consumption of foods with low nutritional value in about 2314 U.S. students; they found that breakfast was the most frequently skipped meal [48], which was similar to the present study.

Through a similar study, 3250 students in Australia were studied in terms of eating behaviors and meal skipping [42]. It was revealed that students eat snacks mostly after school, while watching TV and when they were with friends. Similarly, urban students skipped meals more than rural students, and breakfast was the most skipped meal among students. It was also found that eating snacks was associated with sex, education grade, and location of living. Meal skipping was also associated with sex and location of living, but not with education grade [42]. In the present study, meal skipping was associated with all these three factors.

Our experience also showed that eating different kinds of snacks was associated with increased odds of meal skipping.

Skipping breakfast, compared to those who eat breakfast, increases the incidence of cardiovascular disease risk factors [49].

Table 4 Association of snacking and meals skipping in logistic regression analysis

Snacks		Skipping breakfast		Skipping lunch		Skipping dinner	
		Crude OR (95% CI)	Adjusted OR (95% CI) ¹	Crude OR (95% CI)	Adjusted OR (95% CI) ¹	Crude OR (95% CI)	Adjusted OR (95% CI) ¹
Cakes, cookies, sweets, biscuits, chocolate	Daily	1	1	1	1	1	1
	Weekly	0.82 (0.74,0.89)*	0.84 (0.77,0.93)*	0.84 (0.72,0.99)*	0.89 (0.75,1.06)	0.92 (0.80,1.06)	0.99 (0.85,1.15)
	Rarely	0.97 (0.87,1.08)	0.94 (0.84,1.05)	1.41 (1.18,1.67)*	1.41 (1.18,1.70)*	1.51 (1.30,1.76)*	1.47 (1.25,1.73)*
	Never	1.30 (1.04,1.64)*	1.34 (1.06,1.70)*	2.25 (1.66,3.05)*	2.38 (1.72,3.29)*	2.07 (1.56,2.75)*	2.29 (1.73,3.05)*
Puffs, chips, salty snacks	Daily	1	1	1	1	1	1
	Weekly	0.66 (0.59,0.75)*	0.71 (0.62,0.80)*	0.63 (0.52,0.76)*	0.68 (0.55,0.83)*	0.70 (0.59,0.83)*	0.73 (0.60,0.88)*
	Rarely	0.55 (0.49,0.62)*	0.59 (0.52,0.67)*	0.64 (0.53,0.78)*	0.71 (0.58,0.88)*	0.78 (0.66,0.93)*	0.85 (0.70,1.03)
	Never	0.51 (0.43,0.59)*	0.60 (0.51,0.71)*	0.68 (0.54,0.86)*	0.79 (0.62,1.02)	0.93 (0.75,1.14)	1.17 (0.93,1.48)
Carbonated drinks	Daily	1	1	1	1	1	1
	Weekly	0.78 (0.68,0.90)*	0.82 (0.70,0.96)*	0.67 (0.55,0.83)*	0.73 (0.58,0.92)*	0.70 (0.57,0.86)*	0.76 (0.60,0.94)*
	Rarely	0.68 (0.59,0.78)*	0.75 (0.64,0.87)*	0.54 (0.44,0.67)*	0.61 (0.49,0.77)*	0.68 (0.56,0.84)*	0.74 (0.60,0.93)*
	Never	0.62 (0.53,0.73)*	0.71 (0.60,0.84)*	0.64 (0.50,0.81)*	0.78 (0.60,1.00)	0.84 (0.67,1.06)	1.00 (0.78,1.28)
Fresh fruits	Daily	1	1	1	1	1	1
	Weekly	1.27 (1.16,1.39)*	1.27 (1.16,1.39)*	1.54 (1.33,1.80)*	1.51 (1.28,1.77)*	1.18 (1.03,1.34)*	1.22 (1.06,1.40)*
	Rarely	1.73 (1.51,1.98)*	1.62 (1.40,1.87)*	2.74 (2.23,3.35)*	2.45 (1.97,3.05)*	1.62 (1.34,1.97)*	1.56 (1.26,1.92)*
	Never	2.04 (1.49,2.79)*	1.95 (1.41,2.71)*	5.01 (3.40,7.38)*	5.06 (3.37,7.59)*	2.18 (1.43,3.33)*	2.29 (1.45,3.61)*
Dried fruits	Daily	1	1	1	1	1	1
	Weekly	1.02 (0.91,1.14)	1.01 (0.89,1.14)	1.00 (0.83,1.20)	1.00 (0.81,1.22)	0.94 (0.79,1.11)	0.92 (0.77, 1.01)
	Rarely	1.14 (1.02,1.29)*	1.10 (0.97,1.24)	1.05 (0.86,1.29)	1.03 (0.83,1.28)	1.13 (0.95,1.34)	1.09 (0.90,1.30)
	Never	1.59 (1.35,1.87)*	1.58 (1.33,1.86)*	1.26 (0.98,1.63)	1.31 (0.99,1.72)	1.37 (1.10,1.71)*	1.35 (1.07,1.70)*
Packed fruit juice	Daily	1	1	1	1	1	1
	Weekly	0.86 (0.77,0.97)*	0.86 (0.76,0.97)*	0.62 (0.51,0.75)*	0.65 (0.53,0.79)*	0.82 (0.70,0.98)*	0.82 (0.68,0.99)*
	Rarely	0.85 (0.76,0.96)*	0.83 (0.73,0.94)*	0.83 (0.69,1.00)	0.84 (0.68,1.03)	1.03 (0.87,1.22)	1.00 (0.83,1.21)
	Never	1.11 (0.95,1.30)	1.12 (0.95,1.31)	1.04 (0.82,1.32)	1.10 (0.85,1.42)	1.49 (1.21,1.84)*	1.49 (1.20,1.86)*
Fresh vegetables (tomatoes, carrot, salads), or cooked	Daily	1	1	1	1	1	1
	Weekly	1.11 (1.02,1.22)*	1.13 (1.03,1.25)*	0.95 (0.81,1.10)	0.93 (0.79,1.10)	0.80 (0.71,0.91)*	0.84 (0.74,0.96)*
	Rarely	1.49 (1.32,1.68)*	1.41 (1.24,1.60)*	1.58 (1.30,1.91)*	1.41 (1.15,1.74)*	1.08 (0.90,1.28)	1.05 (0.87,1.26)
	Never	1.79 (1.47,2.18)*	1.79 (1.45,2.20)*	2.13 (1.62,2.81)*	2.10 (1.58,2.80)*	1.10 (0.83,1.47)	1.17 (0.86,1.58)
Milk	Daily	1	1	1	1	1	1
	Weekly	1.52 (1.39,1.67)*	1.42 (1.28,1.56)*	1.27 (1.08,1.50)*	1.11 (0.93,1.33)	1.27 (1.10,1.47)*	1.04 (0.89,1.22)
	Rarely	2.54 (2.26,2.86)*	2.11 (1.86,2.39)*	2.11 (1.74,2.57)*	1.53 (1.23,1.91)*	2.14 (1.81,2.54)*	1.48 (1.23,1.78)*
	Never	3.82 (3.29,4.44)*	3.02 (2.59,3.53)*	2.70 (2.16,3.37)*	2.09 (1.65,2.64)*	2.67 (2.20,3.23)*	1.73 (1.41,2.12)*
Sausage, pizza, burgers	Daily	1	1	1	1	1	1
	Weekly	0.78 (0.62,0.98)*	0.84 (0.66,1.06)	0.54 (0.40,0.74)*	0.66 (0.47,0.93)*	0.61 (0.45,0.82)*	0.65 (0.47,0.89)*
	Rarely	0.55 (0.44,0.69)*	0.62 (0.49,0.78)*	0.42 (0.31,0.57)*	0.50 (0.35,0.71)*	0.55 (0.42,0.74)*	0.61 (0.44,0.84)*
	Never	0.55 (0.44,0.70)*	0.63 (0.49,0.81)*	0.51 (0.37,0.70)*	0.63 (0.44,0.90)*	0.61 (0.45,0.82)*	0.73 (0.53,1.01)

Skippers: eating meal 0–2 days/week; Non-skippers: eating meal 3–7 days/week

¹Adjusted for age, sex, region, SES, screen time and physical activity

**P* < 0.05

Studies on eating snacks and skipping meals are challenging and inconclusive. There are a lot of studies which show a relationship between consumption of snacks and an increase in obesity, overweight, waist circumference, greater plasma glucose, LDL cholesterol, and total

cholesterol. However, some studies have reported an inverse relationship between eating snacks and overweight and obesity [50–54].

Since studies in the field of nutrition as well as taking meals by children and adolescents are different in many

aspects, it is difficult to achieve a general and comprehensive conclusion. These differences are in terms of methodology, food questionnaires (recall or others), software to calculate calorie intake, methods of statistical analysis, foods considered as snacks and junk food, race and ethnicity, and classification into skip or non-skip groups (for example, in the present study, people who did not eat one of the meals more than three days a week were considered as skipped).

Since childhood and adolescence food behaviors are very important, attempts to reach a more comprehensive understanding of the factors associated with food behaviors as well as understanding the advantages and harms of snacks consumption by this age group are valuable.

To reach a conclusion, secondary studies such as systematic reviews or meta-analyses are necessary to centralize and reduce controversial study results.

Since many factors such as watching TV [55–58], being with friends [42], and food behaviors of family [59] affect eating behaviors, in addition to gathering main data of nutritional behaviors, information on variables that are likely to affect eating behaviors should also be collected and considered in adjusted analysis.

Considering above, meal skipping is prevalent among Iranian children and adolescents, and breakfast is the most frequent skipped meal. Skipping main meals is more common among students who consume snacks. Evidence based interventional programs should be considered to improve the eating habits of Iranian children and adolescents.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics approval The study was approved by ethical committees of all contributing organizations.

Informed consent Informed written consent was obtained from students' parents.

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