



# Fruit and vegetable intake and its correlates among high-school adolescents in Iran: a cross-sectional study

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## Abstract

**Background** Two important components of a healthy diet are fruits and vegetables (F&V), which are essential for maintaining physical health. The aim of the present study was to assess the prevalence and correlates of F&V intake among high school adolescents in the city of Tabriz.

**Methods** The Global School-based Student Health Survey self-administered questionnaire was used for data collection among 1517 adolescents.

**Results** The prevalence of fruit intake was 76.1% ( $\geq 2$  times/day) and vegetable intake 23% ( $\geq 3$  times/day). Being at the third level of high school and having sedentary behavior, low intake of vegetables, low or lack of parental support, lack of peer support and lack of enough food at home were significantly associated with low consumption of fruit among students. Also, being overweight or obese and having low intake of fruit, low or lack of peer support, and being physically inactive were significantly associated with low intake of vegetables.

**Conclusion** Results suggest that interventions targeting personal, interpersonal and environmental factors for increased F&V consumption should be given more priority by the public health authorities.

**Keywords** Fruit intake · Vegetable intake · Physical activity · Students · Global school-based student health survey · Iran

## Introduction

In 2005, according to the World Health Organization (WHO), 35 million deaths were due to non-communicable diseases (NCDs). Of these, 80% occurred in low- and middle-income countries (WHO 2018). For instance, in the Eastern Mediterranean Region (EMRO), NCDs are the leading cause of death, claiming 1.7 million lives annually (UN Secretary-General Report 2011). According to the World Health Organization (WHO), NCDs including cardiovascular disease (CVD), diabetes, obesity, certain types of cancer and chronic respiratory diseases will be

responsible for the deaths of 52 million people globally by 2030 (UN Secretary-General Report 2011).

The two important risk factors for NCDs are unbalanced diet and physical inactivity, and many scientific studies have shown that sufficient physical activity and a healthy diet play an important role in the prevention of NCDs (WHO 2018).

Two important components of a healthy diet are fruit and vegetables (F&V), which are essential for maintaining physical health. Adequate daily intake of F&V can promote health and prevent chronic conditions such as cardiovascular disease (CVD) (Key et al. 2002).

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WHO and the Food and Agriculture Organization (FAO) recommend a daily intake of a minimum 400 g of fruit and vegetables (excluding potatoes and other starchy tubers), an equivalent of  $\geq 2$  servings of fruit and  $\geq 3$  servings of vegetables, to prevent chronic diseases (WHO 2003). According to the Center for Disease Control and Prevention (CDC) and WHO, insufficient fruit consumption is defined as eating fruit less than twice a day and inadequate vegetable consumption as less than three times a day (State Indicator Report on Fruits and Vegetables 2013; Agudo 2004; Adults Meeting Fruit and Vegetable Intake Recommendations 2013). Maintaining the recommended daily consumption of F&V can reduce daily calorie intake for maintaining healthy body weight and managing related problems such as obesity and weight loss for adolescents (Nystrom et al. 2005).

Adolescence is a critical period in life and has an important role in the formation of behavioral and nutritional habits. Some studies have shown that behavioral risk factors associated with chronic disease, such as lack of exercise and unhealthy dietary habits, persist from adolescence into adulthood and tend to remain throughout life (Veltsista et al. 2010), while adolescence is the best time to adopt healthy lifestyle habits (Paudel et al. 2014).

In the majority of western countries, despite the importance of adequate intake of F&V, most adolescents consume far less than the recommended daily levels of F&V (Vereecken et al. 2004; Yngve et al. 2005). In the USA, the data have shown that, among adolescents, the daily intake of F&V has decreased (Larson et al. 2007), and a recent study showed that fewer than one in ten Americans meet the fruit and vegetable recommendations (Kimmons et al. 2009). Among Chinese students, only 14% of adolescents reached the daily recommended intake of F&V (Zhang et al. 2012). In Ghana, 56% of adolescents rarely ate fruit and 48% rarely ate vegetables (Doku et al. 2013). The data from the Global School-based Student Health Survey (GSHS), carried out among school adolescents in seven African countries, showed that 77.5% of adolescents did not meet the WHO daily recommended intake of F&V (Peltzer and Pengpid 2010). The data from the Pro-Green survey project among ten European countries revealed that the mean intake of F&V among adolescents did not reach the WHO recommendation of 400 g/day (Lynch et al. 2014).

In Iran, according to a national survey (Caspian study) on adolescents' dietary behaviors, the intake of unhealthy food choices, such as salty, fatty and junk food snacks, was high. In contrast, the intake of F&V was lower than the amount recommended (Kelishadi et al. 2007) by the United States Department of Agriculture (USDA) (Health Gov 2018) and WHO (WHO 2003). A recent study that evaluated F&V intake among adolescents in Iran found that only 30.3% and 34.6%

had the optimal consumption of fruit and vegetables, respectively (Shokrvash et al. 2013).

In designing effective interventions to increase F&V intake among adolescents, it is necessary to identify the correlates of F&V consumption. Some factors that were found significant in previous studies in relation to F&V intake among adolescents were socioeconomic status, age, gender, F&V availability and accessibility at home, family and peer support, family encouragement and physical inactivity (Rasmussen et al. 2006; Pearson et al. 2009). In some other studies, inadequate F&V intake was considered a behavior influenced by other risk behaviors, such as tobacco smoking (Neumark-Sztainer et al. 2002).

To the best of the authors' knowledge, there are some studies on the prevalence of F&V consumption among adolescents in Iran, but they have used different methodologies, questionnaires, cutoff points and objectives than F&V consumption. Therefore, there is a lack of studies that use a reliable and valid WHO questionnaire about dietary habits among a representative sample of adolescents.

The aim of the present study was to assess the prevalence and correlates of F&V intake among a representative sample of high school students in the city of Tabriz by using the reliable and valid Persian version of the Global School-based Student Health Survey (GSHS) questionnaire (Ziaei et al. 2014).

## Methods

### Study site and sampling

Iran is a country in the Middle East and, from the WHO perspective, situated in the Eastern Mediterranean Region (EMRO). It has a population of approximately 80 million. The present cross-sectional study was carried out in north-west Iran, in the city of Tabriz, with approximately 2 million inhabitants. Tabriz City, during the 2013–2014 academic years, had 62,714 students at the high school stage (9 to 11th grades) (Scholaro 2018), of which 29,935 were female and 32,779 male.

The sampling method used in this study was two-stage cluster sampling according to the international common protocol of GSHS methodology. At the first stage, high schools were selected with probability proportional to the enrollment size, and at the second stage classes were randomly selected. All students in the selected classes were then eligible to participate in the study. Overall, 30 high schools, including 16 girls' and 14 boys' high schools, and 90 classes (grades 9 to 11) were chosen to participate in the study. The full details of the methodology and Iranian education system have been reported previously (Scholaro 2018; Ziaei et al. 2016; Ziaei et al. 2017).

## Participants

The whole study population comprised 1517 students, of which 727 were (47.9%) male and 790 (52.1%) female. Students' ages ranged from 15 to 17 with a mean of  $16.1 \pm 0.76$  years. From grade 9, 435 (28.7%) students, from grade 10, 539 (35.5%) students, and from grade 11, 543 (35.8%) students participated in the study.

## Description of the survey and data collection

The Global School-based Student Health Survey (GSHS) is a global youth health monitoring surveillance system, providing accurate data on health behaviors among 13–17-year-old students. It is a self-administered, school-based questionnaire in the ten key areas of morbidity and mortality among school adolescents, designed by WHO in collaboration with UNICEF and UNESCO and with technical support from the US Centers for Disease Control and Prevention (CDC) (Global School-based Student Health Survey 2018).

Data for the present study were collected by the reliable, valid and anonymous self-administered “Persian Version of the GSHS” (Ziaei et al. 2014) “Dietary behavior” module (Global School-based Student Health Survey Core Expanded Questionnaire 2009). According to the WHO's GSHS item rationales, the questions in this module measure self-reported height and weight, frequency of hunger, fruit and vegetable consumption, carbonated soft drink consumption and frequency of eating at fast food restaurants (Global School-based Student Health Survey Item Rationale 2009).

Data collection took place from December 2013 to February 2014. Questionnaires were administered to students during an ordinary school day in selected schools and classes by the Province Health Center staff who had attended a workshop on GSHS methodology 1 week prior to the survey date.

## Data processing and analysis

### Measures

There were two dependent outcome variables: fruit intake and vegetable consumption; these were assessed by asking students about the frequency of F&V intake.

Fruit intake was assessed by the question, “During the past 30 days, how many times per day did you usually eat fruit?” and vegetable intake by the question “During the past 30 days, how many times per day did you eat vegetables?” Both questions had the same response options: I did not eat fruit/vegetables during the past 30 days; I ate them less than one time per day; one time per day; two times per day; three times per day; four times per day; five or more times per day. Students that reported fruit intake less than two times per

day and vegetable consumption less than three times per day were coded as having inadequate consumption.

Hunger was assessed by the question, “During the past 30 days, how often did you go hungry because there was not enough food in your home?” The answers were: never, rarely, sometimes, most of the time and always, with “never,” “rarely” and “sometimes” coded “0” and “most of the time” and “always” coded as “1” in the analysis.

### Analysis

Data analysis was carried out using SPSS software version 24.0. Descriptive statistics were used to report the frequency, percentages, mean and standard deviations. The two main outcome variables were self-reported consumption of fruits and of vegetables. A multivariate logistic regression was used to assess the association between relevant independent variables, such as age, gender, grade and being bullied and the dependent outcome variables (F&V consumption, yes/no). Reporting of adjusted odds ratios (AORs) and unadjusted odds ratios (UAORs) was done after controlling for factors identified as significant in the bivariate analysis. AORs and UAORs with 95% confidence intervals (CI) were reported.  $p < 0.05$  was considered statistically significant for other statistical tests.

## Results

### Prevalence

Among the studied sample, the prevalence of fruit intake was 76.1% ( $\geq 2$  times/day) and vegetable intake 23% ( $\geq 3$  times/day). Table 1 shows the detailed prevalence of all factors.

### Association with fruit intake

Multivariate regression analysis showed that being at the third level of high school (11th grade) [AOR = 1.90; 95% CI (1.21–2.99)], sedentary behavior (sitting  $\geq 3$  h/day) [AOR = 1.93; 95% CI (1.43–2.61)], low intake of vegetables (intake  $< 3$  daily) [AOR = 3.40; 95% CI (2.33–4.97)], low or lack of parental support [AOR = 1.52; 95% CI (1.17–1.98)], low or lack of peer support [AOR = 1.33; 95% CI (1.03–1.73)] and the lack of enough food (hunger) in the home [AOR = 1.47; 95% CI (1.03–2.11)] were significantly associated with low consumption of fruit among students (Table 2).

### Association with vegetable intake

Regression analysis showed that being overweight or obese [AOR = 1.89; 95% CI (1.21–2.95)], low intake of fruit (intake  $< 2$  daily) [AOR = 4.95; 95% CI (3.12–7.85)], little or lack of peer support [AOR = 1.36; 95% CI (1.03–1.78)] and being

**Table 1** Characteristics of the study participants ( $n = 1517$ )

Item	Males no. (%)	Females no. (%)	Total no. (%)
During the past 30 days, how often did you go hungry because there was not enough food in your home?			
Never	432 (59.4)	570 (72.2)	1002(66.1)
Rarely	199 (27.4)	136 (17.2)	335(22.1)
Sometimes	84(11.6)	73 (9.2)	157(10.3)
Most of the time	9 (1.2)	9 (1.1)	18 (1.2)
Always	3 (0.4)	2(0.3)	5 (0.3)
During the past 30 days, how many times per day did you eat fruit?			
I did not eat fruit during the past 30 days	0 (0.0)	4(0.5)	4 (0.3)
Less than one time per day	76(10.5)	54(6.8)	130 (8.6)
1 time per day	129 (17.7)	100(12.7)	229 (15.1)
2 times per day	164 (22.6)	167 (21.1)	331 (21.8)
3 times per day	190 (26.1)	232 (29.4)	422 (27.8)
4 times per day	85 (11.7)	118(14.9)	203 (13.4)
5 or more times per day	83 (11.4)	115 (14.6)	198 (13.1)
During the past 30 days, how many times per day did you eat vegetables?			
I did not eat vegetables during the past 30 days	71 (9.8)	44 (5.6)	115 (7.6)
Less than one time per day	178(24.5)	238 (30.1)	416 (27.4)
1 time per day	176 (24.2)	183 (23.2)	359 (23.7)
2 times per day	138 (19.0)	140 (17.7)	278 (18.3)
3 times per day	84 (11.6)	118 (14.9)	202 (13.3)
4 times per day	26 (3.6)	36 (4.6)	62 (4.1)
5 or more times per day	54(7.4)	31 (3.9)	85 (5.6)
During the past 30 days, how many times per day did you drink carbonated soft drinks?			
I did not drink carbonated soft drinks during the past 30 days	154 (21.2)	135(17.1)	289 (19.1)
Less than 1 time per day	288 (39.6)	278 (35.2)	566 (37.3)
1 time per day	106 (14.6)	148(18.7)	254 (16.7)
2 times per day	71 (9.8)	106 (13.4)	177 (11.7)
3 times per day	30 (4.1)	65 (8.2)	95 (6.3)
4 times per day	32 (4.4)	21 (2.7)	53 (3.5)
5 or more times per day	46 (6.3)	37 (4.7)	83 (5.5)
During the past 7 days, on how many days did you eat food from a fast food restaurant?			
0 days	275(37.8)	187 (23.7)	462 (30.5)
1 day	184 (25.3)	251 (31.8)	435 (28.7)
2 days	133 (18.3)	156 (19.7)	289 (19.1)
3 days	78 (10.7)	111 (14.1)	189 (12.5)
4 days	16 (2.2)	45 (5.7)	61 (4.0)
5 days	16 (2.2)	16 (2.0)	32 (2.1)
6 days	19 (2.6)	17 (2.2)	36 (2.4)
7 days	6 (0.8)	7 (0.9)	13 (0.9)

physically inactive ( $< 5$  day/week) [AOR = 1.45; 95% CI (1.08–1.95)] were significantly associated with low intake of vegetables (Table 3).

## Discussion

The present study examined the prevalence and correlates of adequate F&V intake among high school students in the city of Tabriz by using the GSHS questionnaire based on the frequency of intake per day and not the portion sizes. According to the self-reported fruit intake, 76.1% of students consumed  $\geq 2$  time/day and 23.9% consumed  $< 2$  times per day, which, according to the US Department of Health and Human Services (Healthypeople 2018) cutoff points, meant that most of the students (76.1%) met the recommended fruit intake. In contrast, for vegetable intake, only 23% of the students reported an adequate level and 77% consumed less than the daily recommended intake ( $\geq 3$  times/day). In some research, the cutoff points for

adequate fruit intake are defined as  $\geq 5$  or  $\geq 7$  times/day, which compared with our results show a huge difference. According to the literature (State Indicator Report on Fruits and Vegetables 2013; Agudo 2004; Adults Meeting Fruit and Vegetable Intake Recommendations 2013), most countries have their own definitions of the adequate cutoff points, but by providing the information in Table 1, our results can be easily compared with other studies and different cutoff points. In a GSHS study in seven African countries (Peltzer and Pengpid 2010) among high school students, the adequate cutoff point was  $\geq 5$  times/daily, where 77.5% consumed  $< 5$  times/day and 36% of the boys and 32.6% of the girls had inadequate fruit and vegetable consumption (less than once per day), respectively. In another GSHS study in 11 EMRO countries (Al Ani et al. 2016), among high school students, overall 19.4% of the students consumed F&V  $\geq 5$  times/day. In the US, just 22.3% of adolescents had adequate intake of F&V per day (Eaton et al. 2010). Variations in assessment approaches and cutoff points should be accounted for when comparing results.

**Table 2** Associations between fruit intake and independent variables among students (*n* = 1517)

Independent variables	UAOR	CI 95%	AOR	CI 95%
Age <sup>a</sup> in years				
15	1.00			
16	1.68	1.18–2.41**	1.20	0.80–1.79
17	1.89	1.30–2.74**	0.95	0.55–1.63
Gender <sup>a</sup>				
Girl	0.63	0.50–0.80****	0.84	0.63–1.11
Boy <sup>b</sup>	1.00			
Grade <sup>a</sup>				
First <sup>eb</sup>	1.00			
Second <sup>c</sup>	1.59	1.16–2.19 **	1.32	0.91–1.90
Third <sup>d</sup>	1.96	1.44–2.68 ****	1.90	1.21–2.99**
Sedentary behavior (≥ 3 h/days)				
Yes	1.97	1.47–2.63****	1.93	1.43–2.61****
No	1.00			
Vegetables intake (≥ 3 daily)				
Yes	1.00			
No	3.50	2.41–5.08****	3.40	2.33–4.97****
Parental support				
Yes	1.00			
No	1.71	1.34–2.18****	1.52	1.17–1.98**
Parental connectivity				
Yes	1.00			
No	1.32	1.08–1.68*	1.08	0.83–1.41
Peer support				
Yes	1.00			
No	1.59	1.24–2.03****	1.33	1.03–1.73*
Fizzy drinks				
Yes	0.91	0.56–1.01		
No	1.00			
Fast foods				
Yes	0.92	0.72–1.17		
No	1.00			
Hunger				
Yes	1.47	1.04–2.06*	1.47	1.03–2.11*
No	1.00			

CI confidence interval, UAOR unadjusted odds ratio, AOR adjusted odds ratio,

\**p* < 0.05; \*\**p* < 0.01; \*\*\**p* < 0.001; \*\*\*\**p* < 0.0001

<sup>a</sup> Categorical variable

<sup>b</sup> Reference group

<sup>c</sup> Second level of high school

<sup>d</sup> Third and final level of high school

<sup>e</sup> First level of high school

According to our results, the students in the final year of high school (11th grade) had 90% higher odds of consuming less fruit than in the second grade of high school. This means

that, with increasing high school grade and age, the tendency for fruit intake decreases. Studies in 11 EMRO countries (Al Ani et al. 2016) and the USA (Larson et al. 2007) and Australia (Mikkila et al. 2005) also reported the same results. This negative association may persist from adolescence into adulthood (Mikkila et al. 2005; Neumark-Sztainer et al. 2002). Students with sedentary behavior (sitting ≥ 3 h/day) had 93% higher odds of eating less fruit than students sitting < 3 h per day. According to an Iranian study (Caspian III), screen-time activities, such as watching TV, playing games, mobile surfing or working with a computer, comprises > 4 h per day among Iranian adolescents, of which at least 3 h is watching TV (Baygi et al. 2015). Therefore, sedentary behavior leads to the intake of unhealthy food choices such as salty, fatty and junk foods and, in contrast, less F&V intake (Kelishadi et al. 2007). The students that reported not having adequate vegetable intake (≥ 3 times/day) had 3.40 times higher odds of inadequate fruit intake; students not having adequate fruit intake (≥ 2 times/daily) also had 4.95 times higher odds of inadequate vegetable intake. The students that were overweight or obese had 89% higher odds of eating fewer vegetables. According to the study, boys and girls who were significantly overweight consumed less F&V than those of normal weight (Nystrom et al. 2005). In the present study, higher BMI was not associated with fruit intake. In some studies (Hart et al. 2010), higher intake of F&V was supposed to decrease BMI and help weight management among adolescents, but the study of an association between F&V intake and BMI change did not show a positive effect (Field et al. 2003).

Parental and peer supports are two important factors that affect adolescents' F&V intake and healthy eating habits. According to the systematic review (Pearson et al. 2009), parental intake, education and support were positively associated with children's F&V intake. Our study showed the same results; students without parental support had 52% higher odds of consuming less fruit than students that reported parental support: peer support also plays an important role, and students without peer support had 33% higher odds of consuming less fruit. Students without peer support also had 36% higher odds of eating fewer vegetables.

Students that reported hunger had 47% higher odds of consuming less fruit than the students that did not report hunger. Food security, as well as availability of food or F&V, is another issue that needs more research and attention.

Furthermore, we found that physically inactive students had 45% higher odds of consuming fewer vegetables than active students. A recent study from Brazil has also shown that adolescents who were insufficiently active had a 50% higher chance of consuming fewer vegetables than those who were active (Silva and Silva 2015). This suggests that inactive students have other unhealthy eating behaviors that can increase their risk for NCDs.

**Table 3** Associations between vegetable intake and independent variables among students ( $n = 1517$ )

Independent variables	UAOR	CI 95%	AOR	CI 95%
Age <sup>a</sup> in years				
15	1.00			
16	1.18	0.93–1.75	1.10	0.76–1.61
17	1.47	1.05–2.07*	1.03	0.60–1.77
Gender <sup>a</sup>				
Girl	0.95	0.75–1.21		
Boy <sup>b</sup>	1.00			
Grade <sup>a</sup>				
First <sup>eb</sup>	1.00			
Second <sup>c</sup>	1.09	0.81–1.46	0.86	0.61–1.22
Third <sup>d</sup>	1.46	1.08–1.98 *	1.31	0.79–2.15
Sedentary behavior ( $\geq 3$ h/days)				
Yes	1.05	0.81–1.37		
No	1.00			
BMI <sup>a</sup>				
Normal/underweight <sup>b</sup>	1.00			
Overweight/obese	1.76	1.14–2.71*	1.89	1.21–2.95**
Fruit intake ( $\geq 2$ daily)				
Yes	1.00			
No	3.50	2.41–5.08****	4.95	3.12–7.85****
Parental support				
Yes	1.00			
No	1.20	0.93–1.55		
Parental connectivity				
Yes	1.00			
No	1.15	0.90–1.46		
Peer support				
Yes	1.00			
No	1.31	1.03–1.66*	1.36	1.03–1.78*
Fizzy drinks				
Yes	1.01	0.74–1.37		
No	1.00			
Fast foods				
Yes	0.93	0.73–1.19		
No	1.00			
Hunger				
Yes	0.85	0.59–1.22		
No	1.00			
Physical activity ( $\geq 5$ days/week)				
Yes	1.00	1.00		
No	1.56	1.20–2.01**	1.45	1.08–1.95*

CI confidence interval, UAOR unadjusted odds ratio, AOR adjusted odds ratio

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ ; \*\*\*\* $p < 0.0001$

<sup>a</sup> Categorical variable

<sup>b</sup> Reference group

<sup>c</sup> Second level of high school

<sup>d</sup> Third and final level of high school

<sup>e</sup> First level of high school

## Study limitations

This study used the WHO GSHS self-reported questionnaire for data collection, so results are valid only for adolescents who are attending school and may not be representative of those not at school. Despite the anonymous nature of the survey, missed, over- or underreporting may have taken place. The correlates of F&V intake were limited to the questionnaire. Many other important factors, such as family intake, education, income, home availability and accessibility of fruit, school nutrition education, social situation, etc., should be included in future and

more comprehensive studies. The present study was a cross-sectional study and did not allow establishing causality to any of the associated factors in the study.

## Conclusion

The level of fruit intake was high according to our cutoff points among students, but not vegetable intake. Interventions targeting sedentary behavior, low intake of vegetables and fruit, lack of parental support, lack of peer support and hunger can be given more priority by concerned authorities.

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## Compliance with ethical standards

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

**Informed consent** Informed consent was obtained from all individual participants included in the study.

**Ethical considerations** The Ethics Committee of Tabriz University of Medical Sciences granted approval for the study [5/4/7180, 1391/08/10]. One week prior to the survey, consent forms were distributed to all parents of students in the participating classes through the school authorities and these were collected from students on the day of administration. All students were informed about the voluntary and anonymous nature of the study and were told that they could terminate their participation at any time during the survey.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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