

# Normative and Subjective Oral Health Evaluation among Smoker and non-Smoker Adolescents of Qazvin, Iran, in 2015

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## Abstract

**Background:** Smoking among adolescents is a universal matter. Several findings suggest that smoking can lead to impaired oral health.

**Objectives:** The current study was undertaken to evaluate the normative and subjective oral health status of 13-year-old smokers and nonsmokers in Qazvin, Iran.

**Methods:** This cross-sectional study was carried out on a multistage cluster sample of 519 adolescents in Qazvin, Iran, in 2015. A self-administered questionnaire comprising three parts pertaining to oral health behavior (frequency of tooth brushing and dental visits, snacking, and the use of fluoride toothpaste) was administered. The socio-demographic and subjective characteristics of the study participants, including self-reported smoking, gum bleeding, and halitosis, were determined. The simplified oral hygiene index (OHI-S) was used to evaluate their clinical condition. Binary logistic regression analysis was performed separately for the smokers and nonsmokers. Correlation, kappa agreement, sensitivity, and specificity between the subjective and normative measurements were calculated.

**Results:** 26% of the male adolescents and 15% of the female adolescents claimed that they smoked cigarettes or used water pipe. Infrequent dental visits ( $\geq 2$  years) [odds ratio (OR) = 3.0, 95% confidence interval (CI): 1.1-7.8,  $P = 0.030$ ], frequent snacking ( $\geq 3$  times between meals) (OR = 3.5, 95% CI: 1.5 - 8.4,  $P = 0.001$ ), and halitosis were significantly associated with poor self-perceived oral health. Poor oral hygiene index, which represents normative measurement, was similar among smokers and nonsmokers in this age group. Sensitivity and specificity were reported to be 81% and 85% for smokers and 30% and 21% for nonsmokers, respectively.

**Conclusions:** Normative and subjective oral health evaluations were not in the same line among smoking and nonsmoking adolescents. Professional screening is necessary to evaluate oral health in this age group, especially in countries with developing oral health care systems.

**Keywords:** Adolescent, Smoking, Oral Health

## 1. Background

Despite considerable effort and improvements, oral health remains a major public health problem in developing and developed countries (1). Indeed the magnitude of the problem is highlighted when evaluating oral health disparities among children and adolescents, who constitute approximately 20% of the world's population (2, 3). Adolescence is referred to the period in which the acquisition and consolidation of health behaviors occur. Consequently, establishment of negative health behaviors, such as smoking, is often reported in this age period, especially because of the influence of peers and even parents (4, 5). Smoking among adolescents is a universal matter, with the prevalence of up to 30% being claimed in various reports (6, 7). The prevalence of smoking among this age group ranges 2% -17% in Iran. This trend is also increasing in many countries (8, 9). Conversely, the trend of smoking has been

reversed in some developed countries due to effective preventive measures (4, 10).

Empirical findings suggest that smoking can lead to some oral clinical conditions, ranging from mild discoloration of the teeth to oral cancer. It can also cause impaired periodontal health, for example, gingival bleeding, higher amount of calculus, and increased caries increment, during adolescence (11-13). Importantly, the use of water pipe can cause the same degree of periodontal tissue damage as cigarettes (14).

Self-perceived oral health and degree of dental attendance in smokers have been demonstrated to vary from those of nonsmokers. Smokers were found to visit the dentist less routinely than nonsmokers were, and they held poor perceptions about their oral health. In addition, they were more likely to present at the dentist when they had symptoms (15, 16). Oral hygiene habits also differ between smokers and nonsmokers. Tobacco users were found to

brush their teeth less often than nontobacco users were and they also used less dental floss (17, 18). Oral malodor, as a poor outcome of smoking, is frequently reported in many articles (13, 19, 20).

The focus of most previous studies has been on the evaluation of smoking among adult participants and the subsequent impact on normative oral health indices. In the previous studies, poor oral health was observed and reported among Iranian adolescents, regardless of their smoking status (21, 22). Smoking is a complex behavior with social and cultural background; thus, socio-dental approach should not be neglected in the oral health need assessment (23, 24).

2. Objectives

The aim of the current study was to describe the prevalence of tobacco use among 13-year-old adolescents and assess the normative and subjective oral health status in smoking and nonsmoking adolescents.

3. Methods

3.1. Design and Sampling

This cross-sectional study was conducted on 13-year-old adolescents studying at the public schools in Qazvin in 2015. The city is located 150 km away from Tehran (the capital of the country) with a population of 380,000 people. The climate is cold and dry. About 17,500 adolescents were studying in both private and public schools. Due to high costs of private schools and with the aim of reaching analogous sample with socio-economic background, the participants were all selected from public schools.

The sample size was calculated using data from a previous similar study in Iran reporting the prevalence of smoking among adolescents as 13%, at a 5% level of significance, and precision of 3%. The minimum sample size of 482 was calculated for the study (25) using the following formula:

$$n = \frac{z^2 P (1 - P)}{d^2} \tag{1}$$

Multistage random cluster sampling was performed proportionally to the size of the population of the students from two educational areas of the city. This stage represented the first stratum. Gender was the second stratum due to the single education system of Iran. Accordingly, 24 schools (clusters) were included in the study. 22 randomly chosen students were selected from each school. Adolescents with chronic systemic diseases and those wearing orthodontic appliances in the past 6 months were excluded.

These conditions could affect normal oral health. The selected adolescents (528 individuals) completed the questionnaires although nine of them declined to participate in the study. Thus, the overall participation rate was 98%. The final sample comprised 260 male and 259 female adolescents (n = 519).

3.2. Data Collection and Questionnaire

Data collection was achieved via a self-administered questionnaire and clinical examination. The questionnaire had been validated and utilized in a previous study in Tehran (26). Initially, it was completed twice by a small number of students (n = 25), with a two-week interval between sessions, to determine its reliability (Cronbach's alpha = 0.929). In addition, information on the socioeconomic and demographic characteristics of the study participants, associated oral health behaviors, subjective measures of oral health conditions (self-reported gum bleeding and halitosis), and the use of tobacco (cigarettes or water pipe) was obtained.

3.3. Clinical Measurements

The clinical examination was performed by two dentists qualified in calibration (one male and one female dentist) (kappa = 0.87). The simplified oral hygiene index (OHI-S) was used to assess the participants' oral health (27). The OHI-S involves the examination of six tooth surfaces (four permanent first molars, the upper right and the lower left central incisors) representing the anterior and posterior segments of the mouth. A score was only given to tooth surfaces covered with plaque and/or calculus. The scoring system was applied to index teeth covered with plaque and calculus as follows:

- Score of 0: The absence of any plaque or calculus on the tooth
- Score of 1: Plaque or calculus on some, but not all, of the interproximal and gingival surfaces
- Score of 2: Plaque or calculus covering more than one-third, but not more than two-third, of the entire clinical crown
- Score of 3: Plaque or calculus covering more than two-third of the entire clinical crown

To compute the relevant plaque/calculus index scores, the sum of all the scores was divided by the number of examined teeth (six in total). The final OHI-S score for each participant was determined by calculating the sum of the plaque and calculus index scores. Subsequently, the OHI-S score was categorized as good (a score of 0.0 - 1.2), fair (a score of 1.3 - 3.0), or poor (a score of 3.1 - 6.0). The "poor" and "fair" score categories were subsequently merged and renamed as the "poor" category to account for wide differences in the distribution of the data.

All of the oral examinations were performed using appropriate lighting headlamp, disposable dental mirrors, and a standard World Health Organization-approved ball-ended probe.

3.4. Statistical Analysis

Descriptive statistics, binary, and multiple logistic regressions (entry method) were performed for the statistical analysis. We used two multiple logistic regression models to estimate the factors relating to the outcome variables “poor self-perceived oral health” and “poor OHI” with odds ratios. The “good” category comprised the reference group for the dependent variables in all the regression models. Chi-square automatic interaction detection analysis was carried out. Correlation, kappa agreement, sensitivity, and specificity between the subjective and normative measurements were calculated. Significance level was set at  $< 0.05$ . SPSS version 22, for Windows (SPSS Inc., Chicago, IL, USA) was used for all analyses.

3.5. Ethics

The study participants were informed that they could withdraw from the study at any time and they were asked to provide informed written consent. The study was approved by the Ethics Committee of Tehran University of Medical Sciences, Tehran, Iran (Number IR.tums.REC.1394.988). The authors declare that they have no conflict of interest.

4. Results

Smoking was self-reported in 20% of the participating adolescents. 26% of the male adolescents and 15% of the female adolescents claimed to smoke cigarettes or use water pipe. Only 16% of the smokers believed that smoking is harmful to their oral health and only 18% admitted that it damages their general health. The categorical variables among the smokers and nonsmokers are presented in Table 1.

A low education level for both parents was observed in the group of smokers (with the highest possible level of attained education being primary school; 43% for the fathers and 49% for the mothers). More than half of the participants in both groups reported that their last visit to the dentist had taken place  $\leq 2$  years ago. 30% of the smokers reported oral malodor most or all of the time, compared to 21% of the nonsmokers. The majority of adolescents in both groups held good perceptions about their oral health.

An interaction was observed between smoking and certain oral health behavior variables. Hence, analysis of the

smokers and nonsmokers was performed separately to ensure the accuracy of the results.

The levels of correlation, Kappa agreement, sensitivity, and specificity between self-perceived oral health and the dichotomized (categorical) OHI-S for the smokers and nonsmokers are shown in Table 2. Sensitivity and specificity were reported to be 81% and 85% for smokers and 30% and 21% for nonsmokers, respectively.

The unadjusted and adjusted regression models for poor OHI-S and explanatory variables are shown in Table 3.

There was a marginally statistically significant association between adolescents who smoked and sometimes used fluoride toothpaste and a poor oral hygiene index (OR = 1.8, 95% CI: 1.0 - 3.1,  $P = 0.050$ ). However, any significance was lost with the adjusted model.

When the adjusted model was applied to the nonsmoking group, no significant association was found between poor OHI-S and any of the independent variables. By contrast, the unadjusted model showed associations between poor OHI-S and self-reported gum bleeding (OR = 1.6, 95% CI: 1.04 - 2.4,  $P = 0.03$ ) and persistent oral malodor (OR = 2.2, 95% CI: 1.0 - 4.8,  $P = 0.05$ ).

The unadjusted and adjusted regression models for poor self-perceived oral health and explanatory variables are shown in Table 4.

The frequency of dental visits  $\geq 2$  years was strongly associated with poor self-perceived oral health. The chance of smokers having a poor perception of their oral health was three times greater in those who presented at the dentist  $\geq 2$  years ago (adjusted OR = 3.0, 95% CI: 1.1 - 7.8,  $P = 0.030$ ).

Poor self-perceptions about oral health were also significantly associated with less frequent tooth brushing using bivariate analysis (OR = 3.7, 95% CI: 1.0 - 8.8,  $P = 0.04$ ), even though no statistically significant association was found in the adjusted model. Adolescents who rarely used fluoride toothpaste were found to have unfavorable self-perceptions of their oral health, compared to those who used it often (adjusted OR = 2.8, 95% CI: 1.0 - 7.8,  $P = 0.04$ ).

Similarly, perceptions of poor oral health increased with higher snacking frequency among the adolescents who smoked, with both regression models. Those who reported eating snacks  $\geq 3$  times a day were 3.5 times more likely to report poor self-perceived oral health than smoking adolescents who never have eaten snacks between meals (adjusted OR = 3.5, 95% CI: 1.5 - 8.4  $P = 0.006$ ). Similarly, adolescents who smoked and who reported having oral malodor always or most of the time had poor self-perceptions about their oral health.

Poor literacy levels in relation to the participants' mothers led to poor self-perceptions of oral health in the nonsmoking adolescents (adjusted OR = 1.9, 95% CI: 1.1 - 3.4,

**Table 1.** Distribution of Socio-Demographic Factors, Oral Health Behaviors, and Subjective Norms, among 13-Year-Old Smoking and Nonsmoking Adolescents of Qazvin in 2015<sup>a</sup>

Explanatory Variables	Smoker N (105)	Nonsmoker N (414)
<b>Gender</b>		
Boy	68 (64.8)	196 (47.2)
Girl	37 (35.2)	218 (52.8)
<b>Father occupation</b>		
With Job	91 (86.7)	379 (92.0)
Without Job	14 (13.3)	35 (8.0)
<b>Mother occupation</b>		
With Job	27 (26.0)	98 (23.7)
Without Job	78 (74.0)	316 (76.4)
<b>Father education</b>		
Illiterate or primary school	46 (43.8)	163 (39.0)
Diploma	18 (17.2)	93 (22.6)
University	40 (39.0)	158 (38.4)
<b>Mother education</b>		
Illiterate or primary school	51 (49.0)	156 (37.0)
Diploma	25 (24.0)	96 (23.2)
University	28 (27.0)	162 (39.8)
<b>House ownership</b>		
Free house	11 (10.6)	31 (7.7)
Tenant	26 (25)	95 (22.9)
Own house	68 (64.4)	288 (69.4)
<b>Dental visit</b>		
Under 2 years	59 (56.2)	245 (59.2)
Above 2 years	46 (43.8)	169 (40.8)
<b>Tooth brushing frequency</b>		
Never or sometimes	37 (35.2)	157 (37.8)
everyday	34 (32.4)	173 (41.7)
More than once a day	34 (32.4)	85 (20.5)
<b>Use of fluoride toothpaste</b>		
Never or sometimes	35 (33.3)	144 (35.0)
Most of the times	32 (30.5)	137 (33.2)
always	38 (36.2)	130 (31.8)
<b>Frequency of Snacking</b>		
3 times or more in a day	22 (21.2)	44 (10.6)
once or twice a day	26 (25.0)	128 (30.9)
never between meals	57 (53.8)	242 (58.5)
<b>Self-perceived oral health</b>		
Poor	28 (26.7)	81 (19.5)
Good	77 (73.3)	333 (80.5)
<b>Self-report of gum bleeding</b>		
Never had gum bleeding	43 (40.4)	184 (44.3)
Had bleeding while tooth brushing, eating, spontaneously	62 (59.6)	230 (55.7)
<b>Self-report of halitosis</b>		
Never, seldom	48 (45.7)	219 (52.5)
sometimes	25 (23.8)	107 (25.8)
Always, most of the time	32 (30.5)	90 (21.7)
<b>OHI</b>		
Good	73 (69.6)	281 (67.8)
Poor	32 (30.4)	133 (32.2)

<sup>a</sup> Variables are expressed as No. (%).

**Table 2.** The Degree of Correlation, Kappa, Sensitivity, and Specificity between Self-Reported Oral Health and Simplified Oral Health Index among Smoking and Nonsmoking Adolescents

OHI Versus Self-Perceived Oral Health	Sensitivity	Specificity	r	Kappa
Smokers	81	30	0.10	0.06
Nonsmokers	85	21	0.07	0.04
Total	57	46	0.07	0.04

**Table 3.** The Unadjusted and Adjusted Logistic Regression Models of Poor Oral Hygiene Index and Explanatory Variables Among Smoker and Nonsmoker Adolescents in Qazvin, Iran, in 2015

Explanatory Variable			Smoker				Nonsmoker			
			Unadjusted Model		Adjusted Model		Unadjusted Model		Adjusted Model	
			OR (CI95%)	P Value	OR (CI95%)	P Value	OR (CI95%)	P Value	OR (CI95%)	P Value
Socio-demographic	Gender	Boy	0.50 (0.2-1.4)	0.2	0.3 (0.1-1)	0.06	1.2 (0.7-2.0)	0.6	0.9 (0.5-1.5)	0.4
		Girl					1		1	
	Father occupation	With Job	1		1		1		1	
		Without Job	0.7 (0.2-2.1)	0.5	0.5 (0.1-2.1)	0.3	1.5 (0.7-3.6)	0.3	1.2 (0.5-2.8)	0.6
	Mother occupation	With Job	1		1		1		1	
		Without Job	1.0 (0.3-3.2)	0.9	1.1 (0.2-6.3)	0.9	1.0 (0.6-1.6)	0.9	0.8 (0.4-1.6)	0.5
	Father education	Illiterate/primary school	2.3 (1.2-4.4)	0.02	1.6 (0.6-3.9)	0.3	0.8 (0.5-1.5)	0.5	0.7 (0.3-1.4)	0.3
		Diploma	1.5 (0.6-3.9)	0.4	0.9 (0.3-2.8)	0.8	0.8 (0.5-1.3)	0.3	0.7 (0.4-1.1)	0.1
		University	1		1				1	
	Mother education	Illiterate/primary school	1.6 (0.6-4.7)	0.3	1.4 (0.3-5.8)	0.6	1.0 (0.5-2.0)	0.9	1.1 (0.5-2.4)	0.8
		Diploma	1.4 (0.4-4.6)	0.6	1.5 (0.2-8.4)	0.7	1.2 (0.8-1.8)	0.4	1.4 (0.7-2.6)	0.3
		University	1		1		1			
	House ownership	Free house	1.3 (0.5-3.5)	0.6	0.7 (0.1-3.3)	0.6	1.2 (0.4-3.3)	0.8	1.1 (0.4-3.1)	0.8
		Tenant	1.9 (0.6-5.6)	0.3	1.5 (0.4-6.6)	0.5	1.3 (0.6-2.9)	0.4	1.3 (0.6-2.8)	0.5
		Own house	1		1				1	
Oral health behaviors	Dental visit	Under 2 years	1		1		1		1	
		Above 2 years	1.9 (0.9-3.9)	0.1	2.2 (1.0-5.2)	0.06	1.3 (0.8-1.9)	0.3	1.3 (0.8-2.3)	0.3
	Tooth brushing frequency	Never or sometimes	1.7 (0.9-3.3)	0.1	1.8 (0.6-5.5)	0.3	1.6 (0.6-4.5)	0.3	1.5 (0.8-3.1)	0.2
		Everyday once	1.6 (0.8-3.1)	0.2	0.9 (0.3-2.6)	0.8	1.0 (0.4-2.6)	0.9	1.3 (0.6-3.1)	0.4
		More than once a day	1		1				1	
	Use of fluoride toothpaste	Never	1.3 (0.4-4.2)	0.6	1.9 (0.4-10)	0.9	1.0 (0.5-1.7)	0.9	0.8 (0.4-1.6)	0.5
		Sometimes	1.8 (1.0-3.1)	0.05	0.8 (0.3-2.2)	0.8	1.1 (0.6-1.9)	0.8	0.9 (0.5-1.9)	0.9
		Always	1		1		1		1	
	Frequency of Snacking	3 times or more a day	1.8 (0.4-8.8)	0.4	0.9 (0.4-2.1)	0.4	0.9 (0.4-1.9)	0.7	0.9 (0.4-2.0)	0.7
		Once or twice a day	0.9 (0.3-2.9)	0.9	1.5 (0.6-4.1)	0.6	1.0 (0.6-1.9)	0.9	1.0 (0.5-2)	0.9
		Never between meals	1		1		1		1	
Subjective measures	Self-report of gum bleeding	Never had gum bleeding	1				1		1	
		Had bleeding while tooth brushing, eating, spontaneously	1.5 (0.5-5)	0.5	0.8 (0.2-2.7)	0.7	1.6 (1.04-2.4)	0.03	1.3 (0.9-2)	0.2
	Self-report of halitosis	Never, seldom	1		1				1	
		Sometimes	1.0 (0.4-2.6)	0.2	0.9 (0.4-2.1)	0.4	1.5 (0.8-2.9)	0.3	1.7 (0.9-3.3)	0.1
		Always, most of the time	1.6 (0.7-3.6)	0.4	1.5 (0.6-4.1)	0.5	2.2 (1.0-4.8)	0.05	1.9 (0.8-4.3)	0.6

P = 0.03). A lengthy lapse in time between dental visits for both regression models were associated with poor self-perceptions of oral health in the nonsmoking group (adjusted OR = 1.7, 95% CI: 1.0 - 2.9, P = 0.04). The probability of nonsmoking adolescents having poor self-perceptions

**Table 4.** The Unadjusted and Adjusted Logistic Regression Model of Poor Self-Perceived Oral Health and Explanatory Variables Among Smoker and Nonsmoker Adolescents of Qazvin, Iran, in 2015

Explanatory Variable			Smoker				Nonsmoker			
			Unadjusted model		Adjusted Model		Unadjusted Model		Adjusted Model	
			OR (CI95%)	P Value	OR (CI95%)	P Value	OR (CI95%)	P Value	OR (CI95%)	P Value
Socio-demographic	Gender	Boy	1.8 (0.6 - 5.4)	0.25	1.0 (0.3 - 3.1)	0.9	1.5 (1.0 - 2.2)	0.03	1.1 (0.7 - 1.6)	0.7
		Girl	1		1		1		1	
	Father occupation	With Job	1		1		1		1	
		Without Job	1.7 (0.5 - 5.5)	0.4	0.9 (0.3 - 2.6)	0.8	1.4 (0.7 - 2.9)	0.3	1.1 (0.5 - 2.6)	0.8
	Mother occupation	With Job	1		1		1		1	
		Without Job	0.6 (0.2 - 1.6)	0.3	0.9 (0.2 - 3.8)	0.9	2.0 (0.9 - 4.4)	0.08	1.5 (0.7 - 3.3)	0.3
	Father education	Illiterate/primary school	0.7 (0.2 - 2.3)	0.5	0.7 (0.3 - 1.8)	0.5	1.9 (1.0 - 3.7)	0.04	0.9 (0.4 - 1.7)	0.7
		Diploma	1.0 (0.3 - 3.6)	0.9	1.2 (0.3 - 5.5)	0.8	1.3 (0.8 - 2.1)	0.3	0.8 (0.5 - 1.2)	0.3
		University	1		1		1		1	
	Mother education	Illiterate/primary school	0.4 (0.1 - 1.6)	0.2	0.5 (0.1 - 1.7)	0.3	2.9 (1.7 - 4.7)	0.003	1.9 (1.1 - 3.4)	0.03
		Diploma	0.4 (0.1 - 1.6)	0.2	0.5 (0.1 - 4.1)	0.5	1.6 (0.9 - 2.8)	0.1	1.3 (0.7 - 2.3)	0.3
		University	1		1		1		1	
	House ownership	Free house	0.4 (0.1 - 1.4)	0.1	0.5 (0.1 - 1.9)	0.3	1.5 (0.6 - 3.4)	0.3	1.3 (0.5 - 3.0)	0.6
		Tenant	0.9 (0.3 - 3.3)	0.9	1.0 (0.3 - 3.6)	0.9	1.1 (0.7 - 1.8)	0.7	0.8 (0.5 - 1.2)	0.2
		Own house	1		1		1		1	
Oral health behaviors	Dental visit	Under 2 years	1		1		1		1	
		Above 2 years	4.6 (1.9 - 10)	0.002	3.0 (1.1 - 7.8)	0.03	1.7 (1.0 - 2.6)	0.04	1.7 (1.0 - 2.9)	0.04
	Tooth brushing frequency	Never or sometimes	3.7 (1.0 - 8.8)	0.04	1.8 (0.5 - 6.5)	0.3	2.8 (1.3 - 6.0)	0.01	2.3 (1.0 - 5.3)	0.04
		Once a day	0.6 (0.2 - 2.2)	0.5	0.6 (0.1 - 2.6)	0.4	1.3 (0.6 - 2.9)	0.5	1.2 (0.5 - 2.7)	0.7
		More than once a day	1		1		1		1	
	Use of fluoride toothpaste	Never or sometimes	2.9 (1.0 - 8.4)	0.04	2.8 (0.9 - 8.1)	0.06	1.6 (0.8 - 3.5)	0.2	1.0 (0.5 - 2.2)	0.9
		Most of the times	3.0 (1.1 - 7.7)	0.03	2.8 (1.0 - 7.8)	0.04	1.2 (0.6 - 2.2)	0.6	0.9 (0.4 - 1.7)	0.7
		Always	1		1		1		1	
	Frequency of Snacking	3 times or more a day	5.9 (2.2 - 10.1)	0.001	3.5 (1.5 - 8.4)	0.006	0.8 (0.3 - 2.0)	0.6	0.7 (0.3 - 1.6)	0.4
		Once or twice a day	1.0 (0.3 - 3.6)	0.9	1.1 (0.2 - 5.7)	0.9	0.7 (0.4 - 1.3)	0.2	0.7 (0.4 - 1.3)	0.3
Subjective measures	Self-report of gum bleeding	Never between meals	1		1		1		1	
		Never had gum bleeding	1		1		1		1	
		Had bleeding while tooth brushing, eating, spontaneously	1.5 (0.6 - 4.0)	0.4	0.6 (0.2 - 2.0)	0.4	1.4 (0.8 - 2.2)	0.2	1.1 (0.7 - 1.8)	0.7
	Self-report of halitosis	Never, seldom	1		1		1		1	
		sometimes	1.9 (0.4 - 9.0)	0.3	0.9 (0.2 - 4.5)	0.08	2.5 (1.2 - 5.3)	0.003	2.1 (0.9 - 4.6)	0.2
		Always, most of the time	3.4 (1.5 - 8.0)	0.007	2.7 (1.0 - 7.2)	0.05	2.5 (1.4 - 4.4)	0.004	1.5 (0.8 - 2.7)	0.3

about their oral health was greater in those with frequent oral malodor (unadjusted OR = 2.5, 95% CI: 1.4 - 4.4, P = 0.004). No significant association was found between this variable and poor self-perceived oral health using the adjusted model.

5. Discussion

The prevalence of self-reported smoking among 13-year-old adolescents in Qazvin was high in comparison with the findings of previous reports from Iran (9, 28). To the best of our knowledge, studies on smoking among adolescents focusing on oral health determinants have rarely been reported in Iran. Checking the interaction between

smoking and variables and as a result, separate analysis of the data on smokers and nonsmokers empower us to detect the relation between dependent and independent variables more clearly. Moreover, using both subjective and normative (clinical) oral health measurements to evaluate oral health conditions among schoolchildren by considering their smoking status was the novelty of this study. The present study indicated that dental visits that occur ≥ 2 years, the infrequent use of fluoride toothpaste, frequent snacking, and persistent halitosis were associated with poor self-perceived oral health among smokers. Poor perceptions of oral health in the group of nonsmokers were associated with the low education level attained by their mothers, visiting the dentist ≥ 2 years, and infre-

quent tooth brushing. A poor OHI-S in the group of smokers was marginally associated with gender and less frequent visits to the dentist. Conversely, none of the tested variables was associated with a poor OHI-S score in nonsmokers in the adjusted model. This implies that subjective measure of oral health assessment was not similar to normative tools for smokers and nonsmokers.

Low specificity, and the phi coefficient and Kappa coefficients demonstrated that the normative and subjective measurements obtained for smokers and nonsmokers were in low agreement. In contrast to the findings of previous studies claiming that the determination of self-perceived oral health was a valid, cost-effective way to evaluate individual health and estimate clinical status, we found that self-perceived oral health and OHI-S clinical status were not in the same line among smokers and nonsmokers (28). Hence, professional dental care, such as undergoing a routine dental checkup and screening, is necessary to evaluate oral health in adolescents.

The relatively higher prevalence of self-reported smoking among study adolescents in our study compared to others might be because we did not determine when the smoking began. As a result, its prevalence rate might have been overestimated. In addition, the method of consuming tobacco was not determined in our study. As an illustration, water pipe smoking is a traditional form of tobacco consumption in the Middle East (29). Traditional families allow their children to smoke water pipe freely within the family setting. Our finding regarding an increasing smoking trend among adolescents was in line with those of studies conducted in Iran and in the region (9).

In contrast to some literature reports, very little differences were found regarding the normative indices between smokers and nonsmokers in our study. This may be because clinical changes are the consequence of oral health behavior over time. As previously suggested, most of the adolescents studied might have been in the initial smoking stages (11, 14, 30). The results of obvious clinical dental changes, such as gingival bleeding, attachment lost, and high plaque or calculus, are more easily observed in regular adult smokers (18, 31). However, it is unlikely that the same effects would be found in adolescents who are starting to experiment with smoking.

It was found in our study that a lengthy delay between dental visits was associated with poor perceptions of oral health in both groups, which is in agreement with previous findings (15, 16). However, in contrast to some literature reports on the negative impact of smoking on the frequency of snacking, we found that the adolescents who smoked in our study tended to consume more snacks than their nonsmoking counterparts did (32, 33).

Poorly perceived oral health was reported by smokers

who claimed to have halitosis always or most of the time, which is again in line with the findings of previous studies. Treating halitosis in adolescents should not be neglected. A weak correlation has been found between clinical halitosis and self-perceived halitosis, since self-reported halitosis is not a valid method of estimating such a condition (34, 35). In addition, the perception of halitosis, specifically in adolescents, is related to psychosocial factors, such as poor self-image and low self-esteem. An impaired self-image can lead to poor subjective perceptions about oral health and halitosis. According to previous findings, a significant relationship exists between adolescent's risk and benefit perceptions and oral health behavior and perception (36). In planning oral health promotion programs for adolescents, subjective perceptions should not be ignored, as there could be negative consequences. The authors of another study compared smokers and nonsmokers in terms of oral health and explained the consequences of smoking. However, it is worth noting that even poor oral health in nonsmoking adolescents can increase the likelihood that they would become smokers in adulthood (37).

### 5.1. Study Limitations

There were a number of limitations to our study, including the inclusion of a small smoking group sample. This can lead to wide CIs in the data and therefore, the findings should be interpreted with caution. The risk of social desirability bias was also high owing to the use of a self-administered questionnaire, possibly increased by the inherently rebellious nature of adolescents. In addition, establishing causality was difficult due to the cross-sectional design of the study. Ideally, we should have specified the type of tobacco, water pipe, and cigarettes used by the participants. Moreover, it would be necessary to distinguish between experimental and regular smokers in future studies.

### 5.2. Conclusions

The prevalence of smoking among 13-year-old adolescents was high in our study in comparison with that reported elsewhere. The OHI-S determinants were observed to be similar among smokers and nonsmokers in this age group. Poor self-perceived oral health in the group of smokers was associated with most of the oral health behavior determinants, while it was associated with the lower education status of the participants' mothers, infrequent tooth brushing, and delays between dental visits in the nonsmoking group.

Normative and subjective oral health evaluations were not in the same line for the smokers and nonsmokers. Professional screening is necessary to evaluate oral health

in this age group, especially in countries with developing oral healthcare systems. There is an urgent need for educational preventive programs that target adolescents in Qazvin, Iran.

Footnote

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