



PREVALENCE OF HALITOSIS AND EVALUATION OF ETIOLOGICAL FACTORS IN A TURKISH SUBPOPULATION

BİR GRUP TÜRK POPULASYONUNDA HALİTOZİSİN GÖRÜLME SIKLIĞI VE ETYOLOJİK FAKTÖRLERİN İNCELENMESİ

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ABSTRACT

Aim: The purpose of this study was to estimate the prevalence of halitosis in an adult Turkish subpopulation and to assess the relationship between halitosis and sociodemographics, self reported halitosis, etiological factors, by employing standardized procedures for measurement of halitosis.

Methods: The study included 459 subjects who referred to oral diagnosis clinic of Gazi University Faculty Of Dentistry. The questionnaire including the questions of sociodemographic data, halitosis complaints, oral hygiene practices, extrinsic causes and extra-oral causes. In the clinical examination, dentition and soft tissues were evaluated. Tongue coating status, periodontal index, gingival index and plaque index were recorded. Values for halitosis were assessed by measurement of volatile sulfur compounds (VSC) using portable sulphide monitor.

Results: The questionnaire revealed that 46.6% of the subjects suffered from halitosis and females suffered from halitosis more frequently than males. The prevalence of halitosis was 50.7% . A significant correlation was found between halitosis and tongue coating, periodontitis, gingivitis though PI did not affect halitosis. There were not significant correlations between halitosis and oral hygiene practices, extrinsic causes and extra-oral causes.

Conclusion: This study showed that there was a high prevalence of halitosis in the Turkish population and the most important factors that influence halitosis were intra-oral causes.

Keywords: Epidemiology, halitosis, VSCs

ÖZ

Amaç: Bu çalışmanın amacı erişkin bir grup Türk populasyonunda halitozisin görülme sıklığını, sosyo-kültürel faktörleri, halitozis şikayeti ve etiyolojik faktörlerin araştırılmasıdır.

Gereç ve yöntem: Çalışmaya, Gazi üniversitesi Oral Diagnoz Kliniğine başvuran 18 yaşından büyük 459 erişkin hasta dahil edildi. Hastaların sosyo-kültürel durumları, halitozis şikayeti, oral hijyen alışkanlıkları, ekstresek faktörleri ve ağız dışı nedenleri sorgulayan anemnez formları dolduruldu. Klinik muayenede dentisyon ve yumuşak dokular değerlendirildi ve dil yüzeyindeki birikintiler, periodontal durum indeksi, gingival indeks ve plak indeksleri kaydedildi. Halitozis portatif sülfür monitörü kullanılarak volatil sülfür bileşikleri (VSB) seviyesi ölçülerek değerlendirildi.

Bulgular: Ankete göre, hastaların %46.6' sını halitozisten şikayetçidir. Hastaların % 50.7'sinde halitozis vardır. Halitozis ile periodontal durum, dil yüzeyi birikinti miktarı, gingival durum arasında istatistiksel olarak anlamlı bir ilişki bulunmuştur. Plak indeks değerleri, oral hijyen alışkanlıkları, ekstresek faktörler ve ağız dışı nedenler ile halitozis arasında istatistiksel olarak anlamlı bir ilişki bulunmamıştır.

Sonuç: Çalışmamızın sonuçlarına göre halitozis Türk populasyonunda yaygındır ve halitozisi etkileyen en önemli nedenler ağız-içi faktörlerdir.

Anahtar kelimeler: Epidemiyoloji, halitozis, VSB

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INTRODUCTION

Halitosis or oral malodor is an unlikeable or bad odor arising from the oral cavity, which is a common problem that effects social relationships. Other terms include bad or foul breath, breath odor, foul smells, foetor ex ore, breath malodor, oral malodor, and offensive breath. The term of oral malodour is used to describe the halitosis caused by intra-oral factors¹.

The etiological factors of halitosis include extrinsic and intrinsic causes^{2,3}. The extrinsic causes are using tobacco, alcohol and some foods⁴⁻⁶. The intrinsic causes contain intra-oral and extra-oral causes⁷. Intra-oral causes are related with oral hygiene problems and oral diseases such as tongue coating, periodontal disease, extensive dental caries, pericoronitis, impacted food, unclean denture, stomatitis, xerostomia and habitual mouth breathing^{1,8-10}. Extra-oral causes are systemic diseases and some medications that effects the oral odor^{1,8,11}. Oral conditions are responsible for halitosis in nearly 90% of all cases^{2,12}.

The three main methods for measuring and assessing the halitosis are organoleptic measurement, gas chromatography (GC), and sulfide monitoring¹³. Methyl mercaptan, hydrogen sulfide, butyric acid, propionic acid and valeric acid are called as volatile sulphur components (VSCs) and these components are major cause of halitosis¹⁴. These components are formed as a result of the anaerobic bacteria in the mouth to degrade the sulfur-containing amino acids proteolytically^{14,15}. Portable sulphur monitors (Halimeters) measure the total concentration of sulphur compounds.

The prevalence of halitosis varies because different measurement methods were used. The prevalence of halitosis found to be 19-61% in studies that by using subjective criteria^{16,17} (patients with halitosis complaint) and found to be 28-42 % by using objective criteria^{18,19} (organoleptic method or the VSC-levels measuring).

The purpose of this study was to estimate the prevalence of halitosis in an adult Turkish subpopulation and to assess the relationship between halitosis and comprehensive survey of sociodemographics, self reported halitosis, etiological factors, by employing standardized procedures for measurement of halitosis.

MATERIAL METHOD

Ethical approval for this study was obtained from the Ethical Committee of the Faculty of Dentistry, University of Ankara. The study population was composed of 459 adult patients (222 M,237 F) between the ages 18-72 who referred to Oral Diagnosis and Radiology clinic of Gazi University, Faculty of Dentistry. All patients were informed and their consent was given prior to entering the study. The subjects were instructed to refrain from eating (especially garlic and onion), drinking coffee, eating mints, using minted chewing gum or scented oral hygiene products, and rinsing their mouths for 2 hours before the examination. All measurements were recorded between 8:30 and 11:30 hours (before lunch).

Questionnaire

The subjects were asked to fill in a questionnaire that included 32 questions. The first part of the questionnaire inquired about sociodemographic data, including age, gender, education level, etc. The subjects' oral hygiene practices were assessed through questions on the frequency of toothbrush, dental floss, miswak (chewing stick), mouthrinse use, tongue cleaning, frequency of dental visits. In the last part of the questionnaire, subjects were asked how often they have halitosis (never/rarely/sometimes/frequently)?

For evaluation of extrinsic causes, patients were also asked about their habits (smoking, drinking and diet).

The medical conditions were recorded for each patient carefully that including diabetes mellitus, renal disease, gastrointestinal tract disorders, respiratory disease, chronic sinusitis, neglected foreign bodies in the nose, pregnancy and medication use. A single positive statement to any of these questions classified a subject as having extra-oral causes.

Clinical examination (intra-oral causes)

Oral examinations were carried out by 2 experienced dentists from the department of Oral Diagnosis And Radiology Clinic (E.YK. and K.G.) . Oral health status was examined using a dental mirror and explorer under artificial light. Any of oral health problem that affecting the halitosis, such as extensive dental caries, pericoronitis, impacted food, unclean removable and fixed dentures, incompatible proximal

surface of the dental restorations, oral mucosal lesions and xerostomia were recorded. A single positive statement to any of these data was recorded as other intra-oral causes except oral hygiene indices during statistical analysis.

Clinically to assess oral hygiene and periodontal status, the tongue coating index²⁰ (TCI), periodontal screening index^{21,22} (PSI), plaque index²³ (PI) and gingival index²³ (GI) records were obtained. All measurements were recorded at 6 aspects on each of the 6 Ramfjord teeth (mesiobuccal, mid-buccal, distobuccal, mesiolingual, mid-lingual, and distolingual) by using a standard periodontal probe (PCP 15; Hu-Friedy, Chicago, IL).

Halitosis measurements

For determining halitosis and the level of detection, measurements were done according to organoleptic assessment and using portable sulphur monitor (Halimeters, Interscan corporation, Chatsworth, CA, USA).

VSC concentrations were measured using a Halimeter (Model No. RH17R; Chatsworth, CA). The subject was asked to close his or her mouth and to breathe through the nose for 3 minutes before the Halimeter reading was taken. It was used according to the manufacturer's instructions with a newly calibrated detector. The subject was asked not to exhale or inhale while the Halimeter reading was collected. The highest score was recorded, and the procedure was repeated twice at 3-minute intervals, resulting in 3 Halimeter readings, from which a mean odor score was calculated. The mean value was calculated in parts per billion (ppb) for each patient. According to the manufacturer, halitosis is present at a VSC value >110 ppb.

Statistical Analysis

The data obtained in this study was evaluated with the help of SPSS 12 software version (SPSS Inc., Chicago, IL, USA). First, all data were analyzed using descriptive methods. Dependence between the variables, the chi-square test and Fisher's exact, test for comparison of group comparisons, Mann-Whitney U test for two groups, Kruskal-Wallis test for 3 groups and more were used for comparisons. P value was set at 0.05.

RESULTS

The study participants were composed of 459 adult patients (222 M, 237 F) between the ages 18-72.

Questionnaire

The results according to questionnaire are provided in Tables 1 through 2.

Table 1. Distribution of sociodemographic data, oral hygiene practices, suffering from halitosis according to questionnaire.

	n	%	
Gender	Male	222	48.4
	Female	237	51.6
	Toplam	459	100.0
Education level	Primary School	110	24.8
	Junior high school	42	9.5
	High School	103	23.3
	University	181	40.9
	Master degree	7	1.6
	Total	443	100.0
Frequency of dental visit per year	Never	217	47.3
	1	109	23.7
	2	75	16.3
	3	24	5.2
	>3	34	7.4
	Total	459	100.0
Frequency of toothbrush per day	Never	67	14.6
	1	166	36.2
	2	196	42.7
	3	27	5.9
	>3	3	0.7
Total	459	100.0	
Flossing	No	341	74.3
	Yes	118	25.7
	Total	459	100.0
Mouthrinse use	No	308	67.1
	Yes	151	32.9
	Total	459	100.0
Tongue cleaning	No	303	66.0
	Yes	156	34.0
	Total	459	100.0
Suffering from halitosis	Never/rarely	245	53.4
	Sometimes	109	23.7
	Frequently	105	22.9
	Total	459	100.0

Distribution of sociodemographic data according to questionnaire was given in Table 1. Most of the subjects reported brushing their teeth twice a day (42.7%; 196 of 459). This was followed by 36.2% of the subjects (n = 166) brushing once per day, 14.6% (n = 67) brushing any time, 5.9% (n=27) brushing three times per day. A higher frequency of toothbrushing was reported by three participants. Most of our patients (85.4%) reported that brushing their teeth at least once a day. Flossing was performed by 45 subjects (9.8%), tongue cleaning was reported by 156 subjects (34%), and 151 subjects (32.9%) were



using a mouthrinse (table 1). Most of the study subjects reported that they suffered rarely/never from halitosis (53.4%; n = 245), 46.6% of the subjects suffered from bad breath. 109 subjects (23.7%) suffered sometimes from bad breath, and 105 subjects (22.9%) reported they experienced halitosis frequently (Table1).

Extrinsic and extra-oral causes were showed in table 2. Cigarette smoking was reported by 74 participants (16.1%). Almost 96.9% of the patients reported that they did not consume alcohol. Extra-oral causes were reported by 245 subjects (53.4% of the study population).

Table 2: Extrinsic and extra-oral causes according to questionnaire.

		n	%
Cigarette smoking	No	385	83.9
	Yes	74	16.1
	Total	459	100.0
Consuming alcohol	No	444	96.9
	Yes	14	3.1
	Total	458	100.0
How often do you consume sugar-containing food?	Rarely	130	28.3
	Once a week	87	19.0
	2-3 times per week	100	21.8
	Daily	142	30.9
	Total	459	100.0
How often do you eat meat?	Rarely	90	19.6
	Once a week	44	9.6
	2-3 times per week	282	61.4
	Daily	43	9.4
	Total	459	100.0
Extra-oral causes	No	214	46.6
	Yes	245	53.4
	Total	459	100.0

Clinical examination (intra-oral causes)

Clinical findings were given in table 3. Other intra-oral causes except oral hygiene indices were found 299 (65.4%) of the persons examined.

Tongue coating grade 1 was present mostly and found in 47.2% of the persons examined (n=458, missing data=1). Only 4.6% of the study subjects were recorded as grade 3. Majority of the patients (n=337, 73.6%) had tongue coating.

Grade 1 of PSI was found highest and was present in 40.7% of the patients (n=457, missing data=2). Over 50% of the study participants examined had a PSI of grade 1 or grade 0. Only two subjects (0.4%) exhibited severe periodontitis, with pocket probing depths of >5.5 mm. 43 of the patients were diagnosed as periodontitis.

Grade 1 of the plaque index was found mostly and present with 44.6 % of the patients (n=457, 2 missing data). Majority of the patients (73.5%) revealed plaque index scores of grade 0 and 1. According to GI, grade 2 and higher (gingivitis) was present in 100 of the subjects (n=456, 3 missing data), most of the patients (n=356, 78%) revealed scores of grade 0 and 1.

Table 3. Clinical findings

		n	%
Other intra-oral causes	Absent	158	34.6
	Present	299	65.4
	Total	457	100.0
TCI	Grade 0 = no tongue coating present.	121	26.4
	Grade 1 = light coating of the tongue present;/10% of the surface.	216	47.2
	Grade 2 = moderate coating of the tongue present/ 10% to 50% of the surface.	100	21.8
	Grade 3 = severe coating of the tongue present/ >50% of the surface.	21	4.6
	Total	458	100.0
PSI	Grade 0 = no bleeding on probing, no pathologic pocket, no calculus	186	40.7
	Grade 1 = bleeding on probing	57	12.5
	Grade 2 = calculus and no pathologic pocket	171	37.4
	Grade 3 = probing depth 3.5–5.5 mm	41	9.0
	Grade 4 = probing depth > 5.5 mm	2	0.4
Total	457	100.0	
PI	Grade 0 = No plaque	132	28.9
	Grade 1 = A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may be seen in situ only after application of disclosing solution or by using the probe on the tooth surface.	204	44.6
	Grade 2 = Moderate accumulation of soft deposits within the gingival pocket, or the tooth and gingival margin which can be seen with the naked eye.	97	21.2
	Grade 3 = Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin.	24	5.3
	Total	457	100.0
GI	Grade 0 = Normal gingiva	178	39.0
	Grade 1 = Mild inflammation – slight change in color and slight edema but no bleeding on probing	178	39.0
	Grade 2 = Moderate inflammation – redness, edema and glazing, bleeding on probing	86	18.9
	Grade 3 = Severe inflammation – marked redness and edema, ulceration with tendency to spontaneous bleeding.	14	3.1
	Total	456	100.0

Halitosis measurements

The mean value of the VSC measurements for the 458 (1 missing data) persons included in the study was 164.3 ppb (SD ±163.1). 232 (50.7%) subjects had a VSC value of >110 ppb and 226 (49.3%)



subjects had a VSC value of ≤ 110 ppb. The Halimeters values of > 110 ppb accepted as having halitosis.

Correlations

Correlations between suffering from halitosis and sociodemographic data, objective halitosis values:

A significant correlation was found between suffering from halitosis and gender and education levels ($p < 0.05$). Females suffered from halitosis more frequently than males. 48.7% of the subjects who were suffering from halitosis never/rarely were graduated from University. 34.7% of the subjects who were suffering from halitosis sometimes were graduated from high school. A significant correlation was found between suffering from halitosis and objective halitosis measurements ($p < 0.05$). 59.3% of the patients who had a VSC value of ≤ 110 ppb were reported that they never/rarely suffered from halitosis. The correlations were showed in table 4, we can say that there were compatible correlations between degree of suffering from halitosis and objective presence of halitosis. In addition, 9.3% (43 of 459) of the patients who had not halitosis according to halimeter measurements were suffered from halitosis frequently (halitophobia) (table 4).

Table 4: Correlations between suffering from halitosis and sociodemographic data, objective halitosis values:

		Suffering from halitosis						Chi-square Test	
		Never/Rarely		Sometimes		Frequently		chi-square	p
		n	%	n	%	n	%		
Gender	Male	127	51.8	40	36.7	55	52.4	7.802	0.020
	Female	118	48.2	69	63.3	50	47.6		
	Total	245	100.0	109	100.0	105	100.0		
Education level	Primary school	51	21.4	29	27.9	30	29.7	22.375	0.004
	Junior high school	23	9.7	13	12.5	6	5.9		
	High school	43	18.1	25	24.0	35	34.7		
	University	116	48.7	36	34.6	29	28.7		
	Total	238	100.0	104	100.0	101	100.0		
Halitosis	Absent	134	59.3	49	21.7	43	19.0	6.446	0.040
	Present	111	48.7	59	25.4	62	26.7	tablodada sadece biri verilmeli	0.040

Correlation among questionnaire data and halitosis measurements:

There were not significant correlations between halitosis and oral hygiene practices, extrinsic causes

and extra-oral causes ($p > 0.05$)

Correlations between halitosis and intra-oral causes:

A positive significant correlation was found between halitosis and tongue coating, periodontitis, gingivitis ($p < 0.05$). There was no significant correlation found between halitosis and PI ($p > 0.05$). Number of patients with objective presence of halitosis had significantly higher levels of tongue coating and periodontal scores than patients with objective absence of halitosis. Number of patients with objective absence of halitosis had significantly higher level of healthy gingiva than patients with objective presence of halitosis.

DISCUSSION

There are limited epidemiological studies of halitosis about Turkish population and comparison of the result is rather difficult as the researchers use different criteria. Our 459 patients represent the general population because all patients came spontaneously, had been having several dental complaints. Among the patients, there were slightly more women than men in this present study. It had already been observed that women seek treatment more often than men do²⁰. In addition, according to our results, females suffered from halitosis more frequently than males. It has been reported that women seem to be more willing to consult dentists about their halitosis problems²⁴. Most of the study subjects (53.4%) reported that they suffered rarely/never from halitosis, 46.6% of the subjects suffered from bad breath. Rosenberg et al²⁵ reported that in the USA about 50% of the population suffers from halitosis. A previous study²⁰ in Japan, among 232 respondents about 47% were sure they had oral malodour. The results of these previous studies were slightly higher than our results. It may be related to the different statistical analysis. We did not divided the answer of rarely and never suffering from halitosis because halitosis complaints would be related to the temporary conditions such as respiratory disease, sinusitis, pregnancy, habits, oral hygiene.

Our findings revealed that there were compatible significant correlations between degree of suffering from halitosis and objective presence of halitosis. The results of this present study are



incompatible with the previous studies that suggest that there was no relationship between the degree of self-reported halitosis and the objective presence of halitosis. In a study carried out in Berlin, Germany, almost 30% of patients complaining that they suffered from halitosis showed no objective detectable signs of oral malodor²⁶. On the other hand, the data of the study by Bornstein et al¹⁸ revealed a negligible degree of correlation between self-reported halitosis and organoleptic measurements and no correlation between self-reported halitosis and halimeter measurements. These different results may be related to characteristics of the study population and statistical analyses.

The term pseudo-halitosis is used when no breath malodour can be perceived, and yet the patient is convinced that he suffers from it. If after a diagnosis of pseudo-halitosis the patient still believes that there is bad breath, one can speak about halitophobia³. We found that 9.3% (43 of 459) of the subjects were designated as revealing pseudo halitosis/halitophobia. Similarly, Vandekerckhove et al²⁷ stated that the pseudo halitosis/halitophobia rate was 7.6% and Quirynen et al²⁸ defined in their study that pseudo-halitosis rate was 15.7% for the 2000-patient series.

It was declared that inadequate oral hygiene habits were the most important factors associated with self-reported halitosis and interdental cleaning methods, including dental floss, have been shown important in the treatment of oral malodor²⁹. In this study there were not significant correlations between halitosis and oral hygiene practices, though most of our patients (85.4%) reported that brushing their teeth at least once a day but flossing rate (9.8%) was low. Subjects with lower education levels reported a significantly higher prevalence of self-perceived halitosis because subjects with a university education may have better oral health and be more concerned about professional oral health care and oral hygiene practice²⁹. Oral hygiene education should be improved in populations.

Smoking has been defined as an extrinsic cause of halitosis³⁰. Cigarette smoke contains a volatile sulfur compound that can be detected using a halimeter^{31,32}. Myazaki and coworkers²⁰ demonstrated a statistically significant correlation between smoking and higher VSC values. However, the concentration of

detectable VSC strongly depends on the amount of time since the last cigarette²⁰. In the present study, however, according to our results, there were not significant correlations between halitosis and extrinsic causes ($p>0.05$) and the prevalence of smokers was clearly lower (16.1%) a than in previous study mentioned. Although study participants were advised not to smoke for at least 1 h before their examination, smoking could represent an important confounding factor¹⁹. Alcoholic beverages are also known to produce volatile compounds, acetaldehyde and other odorous byproducts by oxidation of alcohol in the mouth and liver^{11,33}. In contrast to the previous studies^{4,17,25}, we did not find any significant correlation between presence of objective halitosis and alcohol consumption. The difference in results may be a consequence of culture.

Extra-oral causes were reported 53.4% of this study population however there were not significant correlations between objective presence of halitosis and extra-oral causes. Even though multidisciplinary approach plays an important role for halitosis treatment, the results of this study noticed the main role of dentists in both diagnosis and treatment of halitosis.

Many studies have shown that periodontal disease and tongue coating are the major source of VSCs and oral malodor^{5,7,14,34,35}. In the present study, a significant correlation was found between halitosis and tongue coating, periodontitis and gingivitis ($p<0.05$). Number of patients with objective presence of halitosis had significantly higher levels of tongue coating and periodontal scores than patients with objective absence of halitosis. This is attributed to the large surface area of the tongue which allows the accumulation of food debris, the presence of dead leukocytes and desquamated epithelial cells and the presence of many organisms, which provide an ideal environment for the production of offensive odor^{7,33,36}. The level of VSC has been reported to increase with tongue coating and to reduce after the removal of the coating^{18,20,35}. As most of the oral bacteria that produce malodorous compounds (e.g. Porphyromonas gingivalis, Prevotella intermedia, Tannerella forsyntensis, etc) are periodontal pathogens, it was logical to assume a positive correlation between VSC levels in the mouth air and the extent of periodontal pocket depths and the gingival bleeding tendency³⁷.

PI as an indicator of objective oral hygiene was chosen as a potential influencing factor for oral malodor. Grade 1 of the plaque index was found mostly and present with 44.6 % of the patients (n=457, 2 missing data). Majority of the patients (73.5%) revealed plaque index scores of grade 0 and 1 although there was no significant correlation found between halitosis and PI (($p>0.05$)). It has been reported in the literature that the biofilm present at the time of examination seems not to significantly influence VSC values and organoleptic scores^{34,38}. With regard to the findings in our study, there is a need for further research to more clearly understand the roles of dental plaque and their relationship to oral malodor¹⁸.

The amount of VSCs (ppb) in the breath for the diagnosis of halitosis was measured by the Halimeter. The Halimeter is preferred because it provides an objective measurement, is portable, does not require experienced personnel, has low probability of crossinfection, and has 1- to 2-minute intervals between measurements³⁹. Organoleptic measurements were not preferred due to being subjective and having crossinfection risks⁴⁰. The gas chromatography device was also not preferred because it is expensive and complex and requires an experienced physician⁴¹. However, it has been reported that measuring only the VSCs would not be sufficient in determining halitosis and that the organoleptic method related to other gases would give more definitive data⁴⁰. However, recent studies have shown that data obtained with the Halimeter are consistent with data found with organoleptic measurements³⁹⁻⁴¹.

Of the 459 subjects included in the present study, 232 (50.7%) subjects revealed objective presence of halitosis and 226 (49.3%) subjects had not halitosis related to the VSC values. In the present study, the prevalence of halitosis was higher than that reported by previous epidemiological studies in China⁴², with VSC values >110 ppb for 20.3% of the subjects. A study from Japan²⁰ found that only 23% of the population had scores >75 ppb; however, the distribution of VSC values >75 ppb was not specified by the investigators. Other threshold measurements for manifest halitosis reported in the literature vary. Reported values include 125⁴³, ≥ 150 ⁴⁴, ≥ 170 ⁴⁵, and ≥ 200 ⁴⁶ ppb. The manufacturer of Halimeters had not stated a definite value of ppb for normal reading for

many years. Yaegaki et al⁴⁷ recommended 75 ppb as a perceived level of malodor in mouth air. Miyazaki et al²⁰ also utilized the same standard in their survey of the general population for halitosis in Japanese. Recently, the manufacturer suggested 110 ppb or below as a normal reading in their instructions (<http://www.halimeter.com/halcal.htm>) and we accepted the manufacturer's levels. This wide variation and optional fixing of threshold values makes comparisons of studies difficult. Furthermore, the lack of a universally accepted VSC level for detection of halitosis could change the results with regard to self-reported oral malodor and VSC measurements¹⁹.

Conclusions

This study showed that there was a high prevalence of halitosis in the Turkish population. Females suffered from halitosis more frequently than males. Subjects with lower education levels reported a significantly higher prevalence of self-perceived halitosis. We found that there were not significant correlations between halitosis and oral hygiene practices, extrinsic causes and extra-oral causes. The most important factors that influence VSCs levels were intra-oral causes. A significant correlation was found between halitosis and tongue coating, periodontitis, gingivitis though PI did not affect halitosis.

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