Prevalence of Self-Perceived Halitosis in Saudi Arabia

Waad Saleh Alharbi¹, Osama Mahmood Felemban², Soulafa Adnan Almazrooa³,
Lena Saadbaher Elbadawi⁴, Siraj Ahmed Dakhil⁵, Hani Haytham Mawardi⁶

¹Department of Dentistry, Ministry of Health, Taif, Saudi Arabia. ²Department of Paediatric Dentistry, King Abdul Aziz University, Jeddah, Saudi Arabia. ³Department of Oral Diagnostic Sciences, King Abdul Aziz University, Jeddah, Saudi Arabia. ⁴Department of Periodontics, King Abdul Aziz University, Jeddah, Saudi Arabia. ⁵Department Endodontics, King Abdul Aziz University, Jeddah, Saudi Arabia. ⁶Department of Oral Diagnostic Sciences, King Abdul Aziz University, Jeddah, Saudi Arabia.

ABSTRACT

BACKGROUND

Halitosis is the malodour with an intensity beyond a socially accepted level. It has a major negative effect on individual's social and professional lives. The study aimed to estimate the prevalence of self-reported halitosis among general population in Saudi Arabia (SA), and investigate the related factors.

METHODS

This was a cross-sectional, national study on adult population of SA. A validated, self-reported digital questionnaire was distributed which included questions on demographics, general and oral health, and self-perception of halitosis. Data was collected and analysed for significant correlations.

RESULTS

A total of 2673 participants from all 13 provinces of SA completed the survey. The prevalence of self-reported halitosis was 33.4 %, and 59.9 % have been complaining of halitosis for a long time. Overall, 76.3 % had concerns to communicate and be around people due to halitosis. Periodontal diseases, tongue coating, sinus problems and diabetes were strongly associated with halitosis. In terms of oral hygiene compliance, 43.7 % of participants were likely to brush their teeth twice daily and 55 % would use floss on regular basis.

CONCLUSIONS

Based on the current data, the prevalence of self-reported halitosis in SA falls within the worldwide average. Factors such as active periodontal disease, mouth dryness and tongue coating were highly association with halitosis. National educational programs for health care providers as well as the public may help in early diagnosis and management.

KEY WORDS

Halitosis, Genuine Halitosis, Self-Reported, Prevalence, Saudi Arabia

Corresponding Author:

*Dr. Hani Haytham Mawardi,
Faculty of Dentistry, Al - Ihtifalat
Street, Jaddah, Saudi Arabia.
E-mail: hmawardi@kau.edu.sa*

DOI: 10.14260/jemds/2020/740

How to Cite This Article:

*Alharbi WS, Felemban OM, Almazrooa SA,
et al. Prevalence of self-perceived halitosis
in Saudi Arabia. J Evolution Med Dent Sci
2020;9(45):3367-3372, DOI:
10.14260/jemds/2020/740*

Submission 06-08-2020,

Peer Review 30-09-2020,

Acceptance 06-10-2020,

Published 09-11-2020.

*Copyright © 2020 Waad Saleh Alharbi et al.
This is an open access article distributed
under Creative Commons Attribution
License [Attribution 4.0 International (CC
BY 4.0)]*

BACKGROUND

Halitosis is defined as oral malodour with an intensity beyond a socially acceptable level.¹ The current literature reports that more than 50 % of the general population, including both genders, experiences halitosis at some point.^{1,2} The common causes of halitosis are volatile sulphide compounds (VSCs) such as hydrogen sulphide (H₂S), methyl mercaptan (CH₃SH), and dimethylsulfide [(CH₃)₂S], which are produced by gram negative anaerobic bacteria residing in the oral cavity.³ Oftentimes, non-oral sources have to be ruled out prior to making a final diagnosis.² Several risk factors have been linked to halitosis including periodontal diseases, dental caries, respiratory infection, and uncontrolled diabetes.² Hyposalivation has also been considered a contributing factor due to the problem of compromised self-cleansing ability, creating an optimum environment for plaque and food debris accumulation and bacterial growth. Due to the significant impact on professional and social life, there is ongoing research into the best management options for halitosis.⁴

In order to better understand the condition, the national prevalence of halitosis has to be determined, which may vary between different communities. In general, a halitosis diagnosis requires several measures, including a clinical examination, radiographic and salivary assessments, and a measurement of sulphide compounds using halimeters.⁵ For the purpose of surveying a larger population, self-reported questionnaires are an easy and effective tool, backed by a reasonable time frame and useful data sets. Few studies have examined the prevalence of halitosis in Saudi Arabia, and they have mostly been limited to specific provinces / cities. In these studies, the overall prevalence of halitosis ranged between 21 % and 51 %.⁵⁻⁹ However, no study has assessed the prevalence of halitosis in Saudi Arabia as a whole.

This study aims to estimate the prevalence of halitosis among the adult population in the various Saudi Arabian provinces. The generated data will help in assessing some of the factors associated with halitosis including socio-economic factors, oral habits, and health practices in order to develop the best management approach.

METHODS

Ethical approval for human research was obtained from King Abdulaziz University, Faculty of Dentistry. This was a cross-sectional, self-reported survey, which included a convenient sample of Saudi Arabia's adult population. The study was conducted from March 2019 to March 2020. The questionnaire used in this study was written in Arabic and was previously validated by Bin Mubayrik et al.⁵ The questionnaire included questions on the participants' demographics and oral and general health, in addition to halitosis related questions such as duration, onset, severity, and previous treatment.

All the study participants consented electronically prior to accessing the survey. A digital questionnaire was distributed to a total of 3,182 people through different portals, including personal communications, emails, conversations (i.e., WhatsApp® and Telegram®), and social media applications (i.e., Facebook®, Instagram® and Twitter®). Participation in

the study was voluntary and anonymous. Only completed questionnaires were included in the analysis.

The collected data from the questionnaire were summarized as frequencies and percentages. Simple logistic regression was used to assess the effects of demographics, oral hygiene practices, oral disease status, and medical conditions as predictors of the likelihood of halitosis. Significant predictors at the 0.05 level were combined in a multiple logistic regression model to control possible confounding. The data was analysed using SPSS Statistics for Windows, Version 23.0 (Armonk, NY : IBM Corp).

RESULTS

A total of 2,673 subjects participated in the study and responded to all the questions. Overall, 59.3 % of the participants were in the age group of 18 – 35 years, and 74.2 % were female. In addition, 43.8 % were employed, and 54.5 % were married. Most of the responses were from residents from Makkah province (50.2 %), followed by Riyadh province (14.1 %). Complete details of the demographic distribution of the participants are listed in Table 1.

	Item	Frequency (%)
Age	18 - 25	854 (31.9)
	26 - 35	733 (27.4)
	36 - 45	514 (19.2)
	> 45	572 (21.1)
Gender	Male	689 (25.8)
	Female	1984 (74.2)
Employment status	Employed	1172 (43.8)
	Student	707 (26.4)
	Not employed	794 (29.7)
Marital Status	Married	1456 (54.5)
	Single	1079 (40.4)
	Divorced	101 (3.8)
	Widowed	37 (1.4)
Province in Saudi Arabia	Riyadh	378 (14.1)
	Makkah	1342 (50.2)
	Asir	91 (3.4)
	Eastern	224 (8.4)
	Hail	36 (1.3)
	Almadinah	126 (4.7)
	Albaha	85 (3.2)
	Tabuk	98 (3.7)
	Jazan	77 (2.9)
	Aljouf	103 (3.9)
	Alqassim	50 (1.9)
	North Borders	36 (1.3)
	Najran	27 (1.0)

Table 1. Demographics of Study Participants

Questions on oral hygiene practices were included in the questionnaire (Table 2). The vast majority of the participants reported brushing their teeth regularly (96.1 %), most commonly twice a day (43.7 %). However, only 55 % reported daily or occasional flossing. In total, 28.6 % of the participants reportedly used a non-prescription mouthwash once a day, and 63.1 % were not actively using any products.

Regarding the participants' oral health status, 56.2 % reported gingival bleeding during brushing, and 15.6 % had mobile or loose teeth. In addition, 17.4 % complained of mouth dryness, 25.8 % reported eye dryness, and 21.6 % had experienced oral ulcers before. The sensation of a bad taste was reported by 24.6 % of the participants, 32.8 % of whom experienced this once / week, 30.5 % for the whole day, and 63.4 % only when they woke up. Tongue coating was reported by 30.9 % of the participants, and this was ever-present.

Question	Response	Frequency (%)
Do you Brush your teeth every day?	Yes or Sometimes	2569 (96.1)
	No	104 (3.9)
	Three Times Daily	408 (15.3)
	Twice Daily	1167 (43.7)
If yes, how many times do you brush your teeth?	Once Daily	994 (37.2)
	Yes or Sometimes	1471 (55.0)
	No	1202 (45.0)
	Three Times Daily	67 (2.5)
Do you use the dental floss every day?	Twice Daily	189 (7.1)
	Once Daily	1215 (45.5)
	Three times Daily	39 (1.5)
	Twice Daily	183 (6.8)
Do you use a mouthwash?	Once Daily	765 (28.6)
	No	1686 (63.1)
	It was Prescribed	270 (10.1)
	I saw a Commercial	144 (5.4)
If yes, why did you choose this particular mouthwash?	I heard About it	214 (8.0)
	Others	359 (13.4)
	Yes or Sometimes	1501 (56.2)
	No	1172 (43.8)
Does your gums bleed when you clean your teeth?	Yes	416 (15.6)
	No	2257 (84.4)
	Yes	464 (17.4)
	No	2209 (82.6)
Do you have any mobile or loose teeth?	Yes	689 (25.8)
	No	1984 (74.2)
	Yes or Sometimes	577 (21.6)
	No	2096 (78.4)
Do you have dryness in the mouth?	Once a Week	56 (2.1)
	Once a Month	258 (9.7)
	Once every few Months	263 (9.8)
	Yes	658 (24.6)
Do you have dryness in the eyes?	No	2015 (75.4)
	Daily	201 (7.5)
	Once a Week	216 (8.1)
	Once a Month	116 (4.3)
Do you have oral ulcers?	Less than Once a Month	125 (4.7)
	Yes or Sometimes	1695 (63.4)
	No	978 (36.6)
	Yes	827 (30.9)
If yes, how frequent do you experience the bad taste?	No	1846 (69.1)
	Sinusitis or Nasal Problems	748 (28.0)
	Lungs or Bronchial Disease	120 (4.5)
	Stomach Symptoms or Disease	480 (18.0)
Do you have bad taste in your mouth when you wake up from sleep?	Diabetes	160 (6.0)
	Immune-Mediated Disease	25 (0.9)
	HIV / AIDS	2 (0.1)
	Cancer	2 (0.1)
Is your tongue usually covered with a white or yellow coating or patches? Or any other colour?	Emotional / Psychological Disturbances	333 (12.5)
	Others	1035 (38.7)
	Yes	893 (33.4)
	No	1780 (66.3)

Table 2. Oral Hygiene Practices and Oral Health Statuses among Study Participants

	OR	Unadjusted 95% CI	P	OR	Adjusted 95% CI	P
Age	0.86	0.80 - 0.92	<0.001*	0.80	0.70 - 0.92	0.001*
Gender (Male vs Female)	1.04	0.87 - 1.25	0.652			
Employment Status						
Employed	1.05	0.87 - 1.27	0.620	1.14	0.91 - 1.44	0.250
Student	1.30	1.05 - 1.62	0.015*	0.94	0.69 - 1.28	0.697
Marital Status						
Married	0.80	0.68 - 0.95	0.009*	1.10	0.83 - 1.45	0.503
Divorced / Widowed	0.71	0.48 - 1.05	0.083	0.79	0.47 - 1.32	0.363
Brushing Frequency	0.78	0.71 - 0.87	<0.001*	1.01	0.89 - 1.15	0.850
Flossing Frequency	0.67	0.59 - 0.76	<0.001*	0.82	0.71 - 0.95	0.009*
Mouthwash Use Frequency	0.79	0.70 - 0.90	<0.001*	0.82	0.71 - 0.98	0.010*
Gum Bleeding	2.23	1.88 - 2.64	<0.001*	1.35	1.10 - 1.65	0.003*
Tooth Mobility	2.30	1.86 - 2.84	<0.001*	1.46	1.13 - 1.89	0.004*
Mouth Dryness	2.88	2.35 - 3.53	<0.001*	1.54	1.20 - 2.0	0.001*
Eye Dryness	1.34	1.12 - 1.60	0.002*	0.96	0.77 - 1.20	0.699
Oral Ulcers Frequency	1.58	1.42 - 1.75	<0.001*	1.12	0.98 - 1.28	0.090
Bad Taste Frequency	2.05	1.91 - 2.20	<0.001*	1.72	1.59 - 1.86	<0.001*
Bad Taste when Wake Up	3.16	3.62 - 3.81	<0.001*	1.72	1.39 - 2.13	<0.001*
Tongue Coating	3.09	2.60 - 3.67	<0.001*	1.77	1.44 - 2.16	<0.001*
Sinusitis	1.63	1.37 - 1.94	<0.001*	1.52	1.23 - 1.88	<0.001*
Lungs or Bronchial Disease	1.40	0.96 - 2.03	0.079			
Stomach Disease	2.04	1.67 - 2.49	<0.001*	1.58	1.24 - 2.01	<0.001*
Diabetes	1.47	1.06 - 2.04	0.020*	2.11	1.42 - 3.15	<0.001*
Immune-Mediated Disease	1.57	0.71 - 3.48	0.263			
HIV / AIDS	1.99	0.13 - 31.92	0.626			
Cancer	1.99	0.13 - 31.92	0.626			
Emotional / Psychological Disturbances	2.40	1.90 - 3.03	<0.001*	1.55	1.17 - 2.04	0.002*
Other Diseases	1.07	0.91 - 1.26	0.437			

Table 3. Logistic Regression Model for Factors Associated with Halitosis.

*Statistically significant p < 0.05

Question	Item	Frequency (%)
Do you feel worried about others' behaviour around you due to your bad breath?	Yes	681 (76.3)
	No	212 (23.7)
	A week ago	70 (7.8)
	A month ago	79 (8.8)
When did you start noticing a bad breath?	A year ago	94 (10.5)
	Long time ago	535 (59.9)
	Others	115 (12.9)
	I noticed it myself	610 (68.3)
How did you know you have bad breath?	Someone told me	213 (23.9)
	Others	34 (3.8)
	Mouthwash	167 (18.7)
	Chewing gum	521 (58.3)
What method / s do you use to decrease bad breath?	Others	205 (23.0)
	Yes	112 (12.5)
	No	781 (87.5)
	A week ago	16 (1.8)
Have you ever taken a professional test for bad breath?	A month ago	15 (1.7)
	A year ago	20 (2.2)
	A long time ago	39 (4.4)
	Others	82 (9.2)
When did you take a test for bad breath?	Periodontal examination	55 (6.2)
	Caries examination	64 (7.2)
	Bad breath analyser (halometer)	12 (1.3)
	Others	16 (1.8)
Have you ever been diagnosed with condition / s related to bad breath?	Yes	95 (10.6)
	No	798 (89.4)
Have you ever been treated for bad breath by a doctor / dentist?	Yes	65 (7.3)
	No	828 (92.7)
	When I wake up from sleep	625 (70.0)
	When I am hungry	331 (37.1)
What time in the day do you feel the bad breath?	When I am tired	67 (7.5)
	When I am thirsty	136 (15.2)
	In the morning	135 (15.1)
	In the afternoon	31 (3.5)
Do you face any of the following challenges due to your bad breath?	All day	101 (11.3)
	At worktime	43 (4.8)
	When I am talking with other people	140 (15.7)
	Others	37 (4.1)
In the past month, did your bad breath interfere with your social life or work?	Yes	89 (10.1)
	Sometimes	287 (32.1)
	No	517 (57.9)
	I am uncomfortable when someone is close to me	621 (69.5)
Do you face any of the following challenges due to your bad breath?	I am reluctant to talk to others	306 (34.3)
	I do not like to be close to someone socially	135 (15.1)
	I feel others are avoiding me	79 (8.8)
	I do not like to meet people	67 (7.5)

Table 4. Social and Personal Behaviours among Subjects Reporting Halitosis (n = 893).

All participants were asked whether they currently had halitosis, with 33.4 % (893 / 2,673) responding "Yes." A logistic regression model was used (Table 3) to explore the relation between halitosis and the participants' demographics, oral hygiene practices, oral health status, and general health. After controlling for all variables, the risk for halitosis was less with 1) an increase in age (OR = 0.80, p = 0.001); 2) an increase in flossing frequency (OR = 0.82, p = 0.009); and 3) an increase in the frequency of mouthwash use (OR = 0.82, p = 0.010). In addition, the model indicated gingival bleeding (OR = 1.35, p = 0.003), teeth mobility (OR = 1.46, p = 0.004), mouth dryness (OR = 1.54, p = 0.001), increase in bad taste frequency (OR = 1.72, p < 0.001), tongue coating (OR = 1.77, p < 0.001) increased the odds of halitosis. The presence of underlying conditions was also associated with an increased odds of halitosis, such as diabetes (OR = 2.11, p < 0.001), stomach disease (OR = 1.58, p < 0.001), emotional / psychological disturbances (OR = 1.55, p = 0.002), and sinusitis (OR = 1.52, p < 0.001). In terms of underlying medical conditions, 28.0 % reported a diagnosis of sinusitis or sinus problems, 18.0 %

stomach disease, and 12.5 % emotional or psychological conditions.

This study investigated the patterns and effects of halitosis on social and personal behaviours (Table 4). Among the participants who reported halitosis (893 / 2,673), 76.3 % expressed concerns over people's behaviour around them due to their bad breath. Furthermore, 69.5 % were uncomfortable getting close to people, and 34.3 % were reluctant to talk to others due to bad breath. In addition, 42.2 % reported that halitosis impacted their social or professional life. Moreover, 59.9 % of the participants had been complaining of halitosis for a long time, and 68.3 % were self-diagnosed, compared to 23.9 % who were told by others. In terms of measures taken to help with halitosis, 58.3 % indicated chewing gum to decrease odour intensity, and 18.7 % regularly used mouthwash. Only 12.5 % of the participants reported seeking professional help for their halitosis, from which 7.3 % received treatment on a case-by-case basis.

DISCUSSION

Halitosis is an unpleasant condition with a significant impact on people's social and professional life. Clinically, halitosis can be classified into either real or genuine and pseudo-halitosis or halitophobia.^{1,2} Genuine halitosis can be sub-grouped into either physiological (such as morning halitosis) or pathological, including oral and extra-oral halitosis.¹⁰ Both pseudo-halitosis and halitophobia have a psychological component, with pseudo-halitosis including patient complaints without a true cause and halitophobia being defined as a fear of halitosis. Several management approaches have been proposed to manage halitosis. The first step includes the identification and elimination of all potential predisposing factors, such as active periodontal disease and carious lesions, by professional dental care providers in order to rule out pathological halitosis.¹¹ Other measures include tongue brushing to mechanically remove tongue coating, which harbours higher volumes of sulphide producing bacteria, chlorhexidine gluconate mouth rinse, and other antimicrobial agents, such as chlorine dioxide and zinc-containing mouthwashes to reduce VSCs with inconsistent outcomes.^{12,13}

The reported prevalence of halitosis worldwide ranges between 19.4 % and 65.9 %.¹⁴⁻¹⁷ However, the current literature on the prevalence of halitosis in Saudi Arabia is lacking. Therefore, the aim of this study was to assess the prevalence of self-reported halitosis among the general population of Saudi Arabia. The current data includes responses from all 13 Saudi Arabian provinces, thereby fully representing the country's population. Based on the sampling technique used, the response rate can't be calculated.¹⁸ A majority of the participants reported proper oral hygiene measures such as teeth brushing, flossing, and mouthwash use with variable frequency which were inversely associated with halitosis. Similar findings were reported in a study on the oral hygiene practices of 367 dental patients in six cities in Saudi Arabia.⁶ However, 56.2 % of these patients reported gingival bleeding during brushing and other symptoms such as teeth mobility, which might indicate active inflammatory periodontal disease.

In total, 33.4 % (893 / 2,673) of the participants reported halitosis. Previous regional studies have shown a range of results with heterogeneous sample pools. Two recent studies indicated that the prevalence of halitosis in Riyadh province ranged between 21.4 % and 22.8 %.^{5,7} A study of female only subjects in the city of Abha (Asir) reported a 51.3 % prevalence of halitosis. The prevalence in other cities of Saudi Arabia ranged between 36.8 % and 45.6 %.^{6,8,19} Although the oral environment is considered the dominant source of malodour, several studies have investigated other non-oral sources linked to halitosis, such as chronic sinus disease, the presence of *helicobacter pylori* in the gastrointestinal system, and chronic obstructive pulmonary disease.¹⁰ In the current study, several underlying medical conditions were reported and were associated with increased odds of halitosis, such as diabetes (OR = 2.11, $p < 0.001$), stomach disease (OR = 1.58, $p < 0.001$), emotional / psychological disturbances (OR = 1.55, $p = 0.002$), and sinusitis (OR = 1.52, $p < 0.001$). A previous study, which was in line with the current data, demonstrated that 42.1 % of diabetic patients suffered from halitosis. In addition, there was a significant correlation between self-perceived halitosis and levels of glycated haemoglobin.⁸

Several factors with a potential relation to halitosis were investigated in this study. Older age, an increase in flossing frequency, and mouthwash use were associated with a lower risk of halitosis. Similar outcomes were reported in other studies, indicating that the risk of halitosis decreases with age.^{5,20} However, one study found no significant relationship between age and the risk of halitosis.⁷ Based on the logistic regression model, oral health status was also identified as a risk factor for halitosis. In this model, the risk of halitosis increased significantly with gingival bleeding during brushing (OR = 2.23, $p < 0.001$) and teeth mobility (OR = 2.30, $p < 0.001$), indicating the presence of active periodontal inflammation. A similar relationship was investigated in a recent meta-analysis.²¹ Through a clinical examination of subjects, periodontal disease was reported to increase the risk of halitosis (OR 3.16; 95 % CI: 1.12 – 8.95). In the current study, mouth dryness and oral ulceration reportedly increased the odds of halitosis, in line with a study by Koshimune et al., which reported a significant relation between VSC levels and low salivary flow.²² To understand the role of tongue coating, Kishi et al. assessed the effect of bacterial overgrowth on the tongue surfaces of participants with no significant medical history of VSCs production.²³ There was a remarkable increase in VSC levels in patients with more significant tongue coating measured by weight ($p = 0.004$). Our data were consistent with these findings, as 30 % of our participants reported tongue coating, which was positively associated with halitosis (OR = 3.09, $p < 0.001$). These findings suggest that VSCs producing microorganisms likely colonize tongue surfaces with a thick coating and should be addressed as part of comprehensive patient management.

Several studies have addressed the negative influences of halitosis on a person's social life, such as social anxiety, which has been shown to be strongly associated with halitosis.^{24,25} Moreover, treating malodour has demonstrated a positive impact on social anxiety disorder.²⁶ In the current study, 69.5 % of the participants with halitosis were more likely to keep their distance from people, and 34.3 % were less likely to talk to other people. Further, of the 59.9 % of those who reported experiencing halitosis for a long time, only 12.5 % had received

a professional evaluation, and 7.3 % had received treatment. One explanation could be social pressure and / or dental fear, which are common among Saudi communities, affecting up to 51.6 % of the population.²⁷

The current study has several limitations. First, the self-report design of the survey may not represent the true prevalence of halitosis, although the large number of participants may have compensated for potential errors. In addition, several studies have validated self-perceived conditions, including halitosis, and were confirmed as a helpful tool for measuring prevalence in a particular population and in sharing similar outcomes to clinical assessment.²⁸ Second, the number of participants from a few provinces was low and not representative. Moreover, more female subjects were included in this study.

CONCLUSIONS

Based on the current data, there is a 33.4 % prevalence of self-reported halitosis in the general population of Saudi Arabia, which falls within the worldwide average. Factors such as active periodontal disease, mouth dryness, and tongue coating were reported to increase the risk of halitosis. In addition, the presence of underlying medical conditions, such as diabetes and gastrointestinal symptoms, was a strong indicator of halitosis. There is a need for future national educational programs to increase public awareness and to provide management guidance.

Data sharing statement provided by the authors is available with the full text of this article at jemds.com.

Financial or other competing interests: None.

Disclosure forms provided by the authors are available with the full text of this article at jemds.com.

REFERENCES

- [1] Porter S, Fedele S. Summary of: halitosis: a new definition and classification. *Br Dent J* 2014;217(1):32-3.
- [2] Scully C. Halitosis. *BMJ Clin Evid* 2014;2014:1305.
- [3] Tagerman A, Winkel EG. Intra- and extra- oral halitosis: finding of a new form of extra-oral blood-borne halitosis caused by dimethyl sulphide. *J Clin Periodontol* 2007;34(9):748-55.
- [4] Suzuki N, Yoneda M, Naito T, et al. Relationship between halitosis and psychologic status. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2008;106(4):542-7.
- [5] Mubayrik AB, Al Hamdan R, Al Hadlaq EM, et al. Self-perception, knowledge and awareness of halitosis among female university students. *Clin Cosmet Investig Dent* 2017;9:45-52.
- [6] Almas K, Albaker A, Felembam N. Knowledge of dental health and diseases among dental patients, a multicentre study in Saudi Arabia. *Indian J Dent Res* 2000;11(4):145-55.
- [7] AlSadhan SA. Self-perceived halitosis and related factors among adults residing in Riyadh, Saudi Arabia. A cross sectional study. *Saudi Dent J* 2016;28(3):118-23.
- [8] Al-Zahrani MS, Zawawi KH, Austah ON, et al. Self reported halitosis in relation to glycated hemoglobin level in diabetic patients. *Open Dent J* 2011;5:154-7.
- [9] Satheeshkumar PS, Mohan MP. Halitosis, an imperative constraint in measuring the outcome of the oral care in oncology patients. *Oral Oncol* 2016;56:e9.
- [10] Wu J, Cannon RD, Ji P, et al. Halitosis: prevalence, risk factors, sources, measurement and treatment - a review of the literature. *Aust Dent J* 2020;65(1):4-11.
- [11] Guedes CC, Bussadori SK, Weber R, et al. Halitosis: prevalence and association with oral etiological factors in children and adolescents. *J Breath Res* 2019;13(2):026002.
- [12] de Goncalves ACS, Martins MCN, de Paula BL, et al. A new technique for tongue brushing and halitosis reduction: the X technique. *J Appl Oral Sci* 2019;27:e20180331.
- [13] Ileri Keceli T, Gulmez D, Dolgun A, et al. The relationship between tongue brushing and halitosis in children: a randomized controlled trial. *Oral Dis* 2015;21(1):66-73.
- [14] Aimetti M, Perotto S, Castiglione A, et al. Prevalence estimation of halitosis and its association with oral health-related parameters in an adult population of a city in North Italy. *J Clin Periodontol* 2015;42(12):1105-14.
- [15] Akaji EA, Folaranmi N, Ashiwaju O. Halitosis: a review of the literature on its prevalence, impact and control. *Oral Health Prev Dent* 2014;12(4):297-304.
- [16] Bornstein MM, Kislig K, Hoti BB, et al. Prevalence of halitosis in the population of the city of Bern, Switzerland: a study comparing self-reported and clinical data. *Eur J Oral Sci* 2009;117(3):261-7.
- [17] Du M, Li L, Jiang H, et al. Prevalence and relevant factors of halitosis in Chinese subjects: a clinical research. *BMC Oral Health* 2019;19(1):45.
- [18] Schonlau M, Ronald D. Fricker, et al. Conducting research surveys via e-mail and the web. Santa Monica, CA: RAND Corporation 2002.
- [19] Sedky N. Perceived impact of halitosis on individual's social life and marital relationship in qassim province, KSA. *J Am Sci* 2015;11(3):187-96.
- [20] Alzoubi FQ, Karasneh JA, Daamseh NM. Relationship of psychological and oral health statuses with self-perceived halitosis in a Jordanian population: a cross-sectional study. *BMC Oral Health* 2015;15:89.
- [21] Silva MF, Cademartori MG, Leite FRM, et al. Is periodontitis associated with halitosis? A systematic review and meta-regression analysis. *J Clin Periodontol* 2017;44(10):1003-9.
- [22] Koshimune S, Awano S, Gohara K, et al. Low salivary flow and volatile sulfur compounds in mouth air. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2003;96(1):38-41.
- [23] Kishi MKS, Kishi K, Aizawa F, et al. Oral malodour and periodontopathic microorganisms in tongue coat of periodontally healthy subjects. *Dent Japan* 2002;38:24-8.
- [24] de Jongh A, van Wijk AJ, Horstman M, et al. Self-perceived halitosis influences social interactions. *BMC Oral Health* 2016;16:31.
- [25] Patel J, Kulkarni S, Doshi D, et al. Association between social anxiety with oral hygiene status and tongue coating among patients with subjective halitosis. *J Dent Hyg* 2017;91(5):55-63.

- [26] Zaitse T, Ueno M, Shinada K, et al. Social anxiety disorder in genuine halitosis patients. *Health Qual Life Outcomes* 2011;9:94.
- [27] Fayad MI, Elbieh A, Baig MN, et al. Prevalence of dental anxiety among dental patients in Saudi Arabia. *J Int Soc Prev Community Dent* 2017;7(2):100-4.
- [28] Faria SFS, Costa FO, Silveira JO, et al. Self-reported halitosis in a sample of Brazilians: prevalence, associated risk predictors and accuracy estimates with clinical diagnosis. *J Clin Periodontol* 2020;47(2):233-46.