



ORIGINAL ARTICLE

# Self-perceived halitosis and related factors among adults residing in Riyadh, Saudi Arabia. A cross sectional study



Salwa Abdulrahman AlSadhan

Department of Periodontics and Community Dentistry, College of Dentistry, King Saud University, P.O. Box 6019, Riyadh 11545, Saudi Arabia

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## KEYWORDS

Prevalence;  
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**Abstract Objectives:** This cross-sectional observational study was conducted to determine the prevalence of self-perceived halitosis among adults in Riyadh, Saudi Arabia and to assess the relation of halitosis with some socio-demographic factors, oral habits and health practices.

**Materials and methods:** A questionnaire was distributed to randomly selected subjects including senior high school students, college students and employees working in governmental offices. High schools and governmental offices were selected using systematic random sampling from each of the main five regions of Riyadh. The college students were selected from the major universities in Riyadh. One hundred questionnaires were randomly distributed in each of the 15 locations for males and 15 for females (5 schools, 5 universities and 5 governmental offices for each gender) giving a total of 3000 questionnaires.

**Results:** The prevalence of self-perceived halitosis was 22.8% among the participants. The majority of the subjects with self-perceived halitosis experienced bad breath on waking up (83.5%). Nearly half of the sample with self-perceived halitosis was told by others that they had bad breath, 25.8% visited a doctor regarding that, 23.8% received treatment for their bad breath and 54.1% made trials to control their problem by using some aids. Self-perceived halitosis was found to be more prevalent among males compared to females ( $P < 0.000$ ), whereas, no statistically significant differences were found among the different age groups ( $P = 0.317$ ). A statistically significant relationship was found between self-perceived halitosis and times of mouth cleaning, use of tooth brush, use of tooth paste, tongue cleaning ( $P < 0.000$ ), and the use of dental floss ( $P = 0.004$ ). A statistically significant relationship was also found between self-perceived halitosis and shisha ( $P < 0.000$ ) and cigarette smoking ( $P = 0.045$ ).

E-mail address: [Ssadhan@ksu.edu.sa](mailto:Ssadhan@ksu.edu.sa)

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*Conclusion:* The prevalence of self-perceived halitosis among the population in Riyadh is within the range reported in other countries. Self-perceived halitosis is related to gender, inadequate oral hygiene practices and cigarettes and shisha smoking however, it is not related to age.

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## 1. Introduction

Halitosis, also known as malodor, is a common oral health condition throughout the world (ADA Council on Scientific affairs, 2003; Hughes and McNab, 2008; Bornstein et al., 2009). It is a term used to define the presence of unpleasant or offensive breath emitted consistently from a person's mouth (Hughes and McNab, 2008; Bornstein et al., 2009; Settineri et al., 2010).

Halitosis has a complex etiology with extrinsic and intrinsic causes. Extrinsic causes include tobacco, alcohol, some medications and certain odoriferous foods, such as garlic and onion (ADA Council on Scientific affairs, 2003; Bornstein et al., 2009). Intrinsic causes may be related to both systemic and oral conditions, but a large percentage of cases, about 80–90%, are generally related to oral causes (ADA Council on Scientific affairs, 2003; Bornstein et al., 2009). Systemic conditions may include respiratory tract conditions such as chronic sinusitis, tonsillitis and bronchitis, diabetes, hepatic and renal disorders (ADA Council on Scientific affairs, 2003; Settineri et al., 2010). Oral causes are related to poor oral health care, dry mouth, deep carious lesions, periodontal diseases, oral infections, pericoronitis, mucosal ulcerations, impacted food or debris and, mainly, tongue coating (Bornstein et al., 2009; Settineri et al., 2010; Liu et al., 2006; Lee et al., 2007).

Halitosis can be clinically classified into three groups; Real (Genuine) halitosis which can either be physiologic (eg. morning halitosis) or pathologic (oral or extra-oral halitosis), or Pseudohalitosis, where there are complaints of halitosis without its actual existence, and Halitophobia where people fear that they have halitosis (Madhushankari et al., 2015). A number of methods have been used to detect the presence of halitosis either directly or indirectly. The most commonly used diagnostic methods include organoleptic (hedonic) measurement, gas chromatography, sulfide monitoring, the BANA test, and the use of chemical sensors (Aylikci and Colak, 2013).

Halitosis may have major social impacts for the sufferers and significant effects on their normal daily life activities, such as communicating with others and social and professional interactions. It may also affect the individual's self-esteem and confidence, cause embarrassment and reduce employment and career opportunity and decrease the quality of life (Eli et al., 2001; Azoda et al., 2010, 2011). Several studies were conducted to evaluate self-reported halitosis among the population. The prevalence of self-reported halitosis in Kuwait was found to be 23.3% among adults, 19.4% among Italian subjects aged 15–65 years, 32% among subjects from the city of Bern, Switzerland, 61.1% among Thai dental patients, and 62.8% among patients visiting periodontal clinics in China (Bornstein et al., 2009; Settineri et al., 2010; Al-Ansari et al., 2006; Youngnak-Piboonratanakit and Vachirarojpisarn, 2010; Wang et al., 2010).

In Riyadh, data on self-reported halitosis and related factors among adults are considered to be rare. This study will help to identify the magnitude of this problem and plan for proper management practices, since management of halitosis requires proper investigations, diagnosis and identification of causal factors involved in the etiology of the condition.

So the aims of this present study are:

- To determine the prevalence of self-perceived halitosis among adults in Riyadh, Saudi Arabia.
- To assess the relation of halitosis with some socio-demographic factors and oral habits and health practices.

## 2. Materials and methods

This cross-sectional observational study was conducted during the period from February to July 2012. Ethical approval was obtained from the College of Dentistry Research Center, King Saud University, Riyadh, Saudi Arabia.

A specially designed self-administered questionnaire was developed in English then translated to Arabic. To ensure the validity of the questionnaire, a pilot study was done on 150 people who were not included in the study to ensure the feasibility and practicality of the questionnaire and modifications were done accordingly.

The questionnaire was made up of 3 parts. The first part was related to some socio-demographic factors including gender, age, educational level and occupation. The second part was related to the participant's perception of any malodor (halitosis) and its history and social effects. The third part was concerned with some oral hygiene and health habits. The questions called for a yes/no and sometimes don't know answers. A tick box layout was used for the provision of the appropriate answer.

The questionnaire was distributed to randomly selected subjects including senior high school students, college students and employees working in governmental office (1000 subjects from each; 500 males and 500 females). The selection of high schools and governmental offices was done using systematic random sampling from each of the main five regions of Riyadh (East, West, North, South, and Central). The college students were selected from the 4 major universities for males and females in Riyadh which were, King Saud University, Al-Imam Mohammad Ibn Saud Islamic University, Prince Sultan University, and AlYammamah Private University in addition to Princess Nora Bint Abdulrahman University for female students and AlFaisal University for male students giving a total of 5 universities for males and 5 for females. The sample size for each level of location within gender level and level of occupation was calculated to be at least 100, giving a total of 3000 questionnaires ( $5 \times 2 \times 3 \times 100$ ).

**Table 1** Socio-demographic characteristics of the surveyed sample ( $n = 2343$ ).

Variables	Number (%)
Age group	
17–24	1556 (66.7)
25–34	436 (18.6)
35–44	190 (8.1)
45–54	113 (4.8)
$\geq 55$	40 (1.7)
Gender	
Male	1093 (46.6)
Female	1250 (53.4)
Education level	
Illiterate	8 (0.3)
< High school	915 (39.1)
High school $\leq$ Bachelor degree	1292 (55.1)
Post graduate	111 (4.7)
Missing	25 (1.1)
Occupation	
High school student	907 (38.7)
College student	638 (27.2)
Employee	798 (34.1)

The data were transferred to a computer for analysis using Statistical Package for Social Sciences program for Windows (version 16 SPSS Inc., Chicago, IL, USA). Simple descriptive statistics as frequency distributions and percentages were calculated for the study variables. The relation of the variables

with self-perceived halitosis was also evaluated using Chi square at 95% confidence ( $P \leq 0.05$ ).

### 3. Results

Out of the 3000 questionnaires distributed, 2343 were filled and returned giving an overall response rate of 78.1%.

Table 1 presents the socio-demographic characteristics of the study sample. The age range of the participants was (17–65 years) and the majority (66.7%) was in the 17–24-year old age group. Females and males accounted for 53.4% and 46.6% of the sample, respectively. With regard to education, 39.1% of the participants had an educational level less than high school, 55.1% had graduated from high school and still undergraduate, and the postgraduates represented 4.7% of the sample.

The prevalence of self-perceived halitosis was 22.8% among the participants (Table 2). The majority of the subjects with self-perceived halitosis experienced bad breath after waking up (83.5%) followed by when hungry (34.3%) and only 7.1% felt it all day (Table 2). Over 60% of these participants noticed their halitosis years ago.

Among the study sample with self-perceived halitosis, nearly half were told by others that they had bad breath, 25.8% visited a doctor regarding that, 23.8% received treatment for their bad breath and 54.1% have tried to control their problem by the use of mouthwash, gum/mentos and toothpaste (Table 2). Around one third of the sample with self-perceived halitosis suspected that they suffered from bad breath based on the action of others (Table 2). Out of the total sample, 41.5% had relatives who suffered from halitosis.

The effect of halitosis on the social life from the respondents' point of view is presented in Table 3. Nearly 47% of the respondents with self-perceived halitosis stated that halitosis affected their social life.

**Table 2** Parameters related to self-reported halitosis among the surveyed sample.

Question	Number (%)
Do you think you suffer from bad breath?	
Yes	534 (22.8)
No	1809 (77.2)
What time of the day do you feel it more? <sup>*1</sup>	
When you wake up	446 (83.5)
When you are hungry	183 (34.3)
When you are thirsty	55 (10.3)
All day long	38 (7.1)
At other times	9 (1.7)
When did you notice it? *	
Weeks ago	78 (14.6)
Months ago	123 (23.0)
Years ago	333 (62.4)
Have you been told that you have bad breath? *	265 (49.6)
Yes	
Have you ever suspected that you have bad breath based on the actions of others? *	187 (35.0)
Yes	
Have you visited a doctor for your bad breath? *	138 (25.8)
Yes	
Have you received treatment for your bad breath? *	127 (23.8)
Yes	
Have you treated yourself for bad breath? *	289 (54.1)
Yes	
If your answer was yes, what did you use? **	
Mouthwash	88 (30.4)
Gum/mentos	60 (20.8)
Tooth paste	38 (13.1)

\* Out of 534.

\*\* Out of 289.

<sup>1</sup> Multiple responses allowed.

Over half of the respondents reported that they suffered from alienation from others, 26.5% felt isolated from society and 5.6% had reduced career opportunities.

Regarding the oral hygiene practices of the participants, the majority (84.3%) cleaned their teeth (Table 4). Over half of them cleaned their teeth twice a day, using a toothbrush (98.8%) and toothpaste (98.6%). Out of the total sample, only 14.6% and 19.2% used the dental floss and mouth wash, respectively. With regard to cleaning the tongues, only 26.7% of the surveyed sample cleaned their tongue (Table 4). Around three quarters used the toothbrushes and only 3% used special devices to clean their tongues. With regard to the habits, shisha smoking was more prevalent (12.2%) among the study sample compared to cigarette smoking (10.2%) and over half of the participants were regular tea and coffee drinkers.

Table 5 presents the relation between self-perceived halitosis and some demographic factors, oral habits and health practices of the participants. Self-perceived halitosis was found to be more among the males compared to female participants ( $P < 0.000$ ). No statistically significant differences were found among the different age groups in relation to self-perceived halitosis ( $P = 0.317$ ). A statistically significant

relationship was found between self-perceived halitosis and people not cleaning their teeth, times of mouth cleaning, use of tooth brush, use of tooth paste, tongue cleaning ( $P < 0.000$ ), and the use of dental floss ( $P = 0.004$ ). Self-perceived halitosis was also found to be statistically significantly related to shisha and cigarette smoking ( $P < 0.000$  and  $P = 0.045$ , respectively). Being told that they have bad breath and suspecting to have bad breath based on the others' reactions was found to be statistically related to self-perceived halitosis ( $P < 0.000$ ).

#### 4. Discussion

There are limited data available on the prevalence of self-perceived malodor among the general population in Riyadh, Saudi Arabia. In the present study the prevalence of self-perceived halitosis was found to be 22.8%. This figure is similar to the results reported in other populations such as in Kuwait (23.3%) (Al-Ansari et al., 2006) and in Italy (19.4%) (Settineri et al., 2010). However it was found to be lower than the prevalence of 42.1% found among 16 diabetic patients in Riyadh (Al-Zahrani et al., 2011). It was also found to be lower than the prevalence of subjective halitosis found among a group of dental patients from 6 cities in Saudi Arabia (36.8%) and from Thailand and China (61.1% and 62.8%, respectively) but this could be related to the fact that the sample of these studies were obtained from groups of dental patients (Almas et al., 2000; Youngnak-Piboonratanakit and Vachirarojpisarn, 2010; Wang et al., 2010).

**Table 3** Effect of halitosis on social life from the respondents' points of view.

Question	Number (%)
Does your halitosis affect your social life? (Yes)	249 (46.6)
In what way?	
Alienating others	125 (50.2)
Isolation from society	66 (26.5)
Mishandling	23 (9.2)
Reduced career opportunities	14 (5.6)
Others	14 (5.6)
Missing	7 (2.9)

\* Total number = 249.

**Table 4** Oral hygiene practices and habits of the surveyed sample.

Oral hygiene practices and habits	Number (%)
Do you clean your teeth? (yes)*	1974 (84.3)
If yes, how many times a day? **	
Once	597 (30.2)
Twice	996 (50.2)
≥ Three times	325 (16.0)
Do you use a tooth brush? (yes)	1950 (98.8)
Do you use toothpaste? (yes)	1946 (98.6)
Do you use the dental floss daily? (yes)	342 (14.6)
Do you use siwak? (yes)	961 (41.0)
Do you use a mouth wash regularly? (yes)	451 (19.2)
Do you clean your tongue? (yes)	626 (26.7)
If your answer is yes, what do you use?	
Tooth brush	464 (74.1)
Mouth wash	64 (10.2)
Back of tooth brush	39 (6.2)
Special device	20 (3.2)
Water/salt and water	20 (3.2)
Siwak	19 (3.0)
Cigarette smokers	239 (10.2)
Shisha smokers	286 (12.2)
Regular tea/coffee drinkers	1293 (55.2)

\* Missing values = 27.

\*\* Missing values = 56.

**Table 5** Relation between self-perceived halitosis and some demographic and oral health practices and habits of the participants.

	Perceived halitosis		P value
	Yes (%)	No (%)	
Gender			
Male	298 (55.8)	790 (43.9)	< 0.000*
Female	236 (44.2)	1010 (56.1)	
Age group			
17–24	346 (65.2)	1208 (67.2)	
25–34	93 (17.5)	340 (18.9)	
35–44	55 (10.4)	134 (7.5)	0.317
45–54	26 (4.9)	87 (4.8)	
≥ 55	11 (2.1)	40 (1.7)	
Do not clean their teeth	106 (31)	236 (69)	< 0.000*
Times of mouth cleaning/day			
Once	173 (40.4)	463 (29.9)	
Twice	197 (46.0)	813 (52.6)	< 0.000*
≥ Three times	58 (13.6)	270 (17.5)	
Use of tooth brush	483 (91.0)	1718 (95.7)	< 0.000*
Use of toothpaste	483 (90.6)	1710 (95.4)	< 0.000*
Use of dental floss daily	58 (10.9)	279 (15.6)	0.004*
Use of mouth wash regularly	94 (17.7)	355 (19.8)	0.153
Use of siwak	225 (42.3)	732 (40.9)	0.306
Clean the tongue	283 (53.1)	1150 (64.1)	< 0.000*
Cigarette smokers	66 (12.4)	173 (9.7)	0.045*
Shisha smokers	90 (17.1)	196 (11.2)	< 0.000*
Regular tea/coffee drinkers	304 (57.7)	989 (55.7)	0.231
Have you been told that you have bad breath?	223 (43.2)	42 (17.9)	< 0.000*
Have you ever suspected that you have bad breath based on the actions of others?	151 (28.9)	36 (15.2)	< 0.000*

\* Statistically significant at  $P \leq 0.05$ .

The majority of the subjects reported having bad breath on waking up followed by being hungry and thirsty. This is consistent with the findings of previous studies (Almas et al., 2003; Eldarrat et al., 2008). Sleeping and being hungry or thirsty may reduce the saliva flow and promote anaerobic bacterial purification which might contribute to oral malodors (Suarez et al., 2000; Eldarrat et al., 2008).

Around half of the subjects with perceived malodor were told by others that they had malodor and one third suspected that they had bad breath based on the others' reactions. This indicates that other people could help in confirming whether the person had malodor or not. Only one quarter of the subjects consulted doctors and received treatment regarding their conditions, which indicates that this might be an embarrassing condition for the individuals discouraging them from having consultations and examinations by the professionals.

Individuals with self-perceived halitosis tried to control the problem by commercially available mouth freshening products such as mouthwashes and chewing gums. These products can temporarily relieve bad breath. It was reported that mouth washes containing chlorine dioxide and zinc salts have substantial effects on masking halitosis and the use of chewing gum can decrease halitosis through increasing salivary secretions (Rösing et al., 2009; Rösing and Loesche, 2011).

In this study, about 47% of the respondents with self-perceived halitosis reported that halitosis affected their social life either through being alienated by others, feeling isolated from society, being mishandled by others or reducing career opportunities. It has been reported previously that bad breath becomes a social handicap and leads the affected person to avoid socializing with others (Eldarrat et al., 2008).

Self-reported halitosis was found in this study to be related to inadequate oral hygiene practices which is consistent with the findings of Settineri et al. (2010) who found that self-reported halitosis was linked to poor oral hygiene practices. This finding was also reported in other previous studies (Lee et al., 2007; Al-Ansari et al., 2006). Tanaka et al. (2003) reported that mechanical means of cleaning the mouth through brushing and flossing reduced the amount of oral bacteria and substrates therefore reducing malodor. However this contradicts the findings of Liu et al. (2006) who found that oral hygiene did not contribute to the incidence of halitosis.

Cleaning of the tongue was also found to be significantly related to self-perceived halitosis in the present study. Studies have demonstrated that reducing the number of bacteria on the tongue through tongue cleaning is one of the most important methods for treating halitosis (Faveri et al., 2006; Rösing and Loesche, 2011).

The prevalence of self-perceived halitosis was found to be higher among males in this study. A former study conducted in Rio de Janeiro reported that the prevalence of halitosis was approximately three times higher among males compared to females (Nadanovsky et al., 2007). A higher percentage of male dental students were also found to have self-perceived malodor compared to females in Riyadh, Saudi Arabia (Almas et al., 2003). Other studies, however, could not demonstrate any difference in the prevalence of halitosis among the genders (Bornstein et al., 2009; Youngnak-Piboonratanakit and Vachirarojpisan, 2010; Hammad et al., 2014).

Self-perceived halitosis was found among all age groups and no statistically significant differences were found between these groups which is in agreement with the results obtained by

Liu et al. (2006) and Hammad et al. (2014). On the contrary, former studies reported that self-perceived halitosis was found more among the older age groups (Al-Ansari et al., 2006; Youngnak-Piboonratanakit and Vachirarojpisan, 2010).

Cigarette and shisha smoking was found to be low among the surveyed sample, however, it was found to be statistically related to self-perceived halitosis. This is in agreement with the findings of previous studies (Al-Ansari et al., 2006; Bornstein et al., 2009; Alzoubi et al., 2015). Smoking is considered to be an extrinsic cause of malodor and can lead to transient halitosis as the cigarette smoke contains some volatile compounds (Hughes and McNab, 2008).

Tea and coffee are among the most preferred drinks all around and over half of the participants were regular tea/coffee drinkers. Information regarding the role of these drinks in oral malodor is scarce. The results of this study found no statistically significant relation between drinking those two drinks and self-perceived halitosis. A former study by Signoretto et al. (2006) reported an association between tea and coffee drinking and the reduction of certain types of oral microorganisms.

In the present study, halitosis was assessed through the use of a questionnaire without any clinical examination or assessment by health professionals, therefore the reliability cannot be ascertained. However, the data may be useful in giving an idea about the magnitude of the problem and shedding the light on some of the factors that may be linked to oral malodor.

In conclusion, the results of this study indicated that:

- The prevalence of self-perceived halitosis among the general population in Riyadh is within the range reported in other countries by other studies.
- Self-perceived halitosis was found to be related to gender; however, age was not related to halitosis.
- Inadequate oral hygiene practices and cigarettes and shisha smoking were found to be related to self-perceived halitosis.
- The use of mouth wash, siwak and regular tea and coffee drinking were not related to self-perceived halitosis.

Due to the multifactorial complexity of halitosis, further longitudinal studies including objective assessment of malodor are required to determine its prevalence and to further investigate the association of this problem with other etiological factors in Saudi Arabia.

Management of halitosis, whether actual or perceived, requires proper diagnosis and investigation of the underlying causes and an appropriate multidisciplinary approach, when appropriate, taking into consideration the management of people who may harbor perceptions that do not reflect any objective findings.

#### Conflict of interest

The author declares no conflict of interest associated with this publication.

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## References

- ADA Council on Scientific Affairs, 2003. Oral malodor. *J. Am. Dent. Assoc.* 134, 209–214.
- Al-Ansari, J.M., Boodai, H., Al-Sumait, N., Al-Khabbaz, A.K., Al-Shammari, K.F., Salako, N., 2006. Factors associated with self-reported halitosis in Kuwaiti patients. *J. Dent.* 34 (7), 444–449.
- Almas, K., Albaker, A., Felembam, N., 2000. Knowledge of dental health and diseases among dental patients, a multicentre study in Saudi Arabia. *Indian J. Dent. Res.* 11 (4), 145–155.
- Almas, K., Al-Hawish, A., Al-Khamis, W., 2003. Oral hygiene practices, smoking habits, and self-perceived oral malodor among dental students. *J. Contemp. Dent. Pract.* 15, 77–90.
- Al-Zahrani, M.S., Zawawi, K.H., Austah, O.N., Al-Ghamdi, H.S., 2011. Self reported halitosis in relation to glycosylated hemoglobin level in diabetic patients. *Open Dent. J.* 5, 154–157.
- Alzoubi, F.Q., Karasneh, J.A., Daamseh, N.M., 2015. Relationship of psychological and oral health statuses with self perceived halitosis in a Jordanian population: a cross-sectional study. *BMC Oral Health* 15, 89. <http://dx.doi.org/10.1186/s12903-015-0078-7>.
- Aylikci, B.U., Colak, H., 2013. Halitosis: from diagnosis to management. *J. Nat. Sci. Biol. Med.* 4 (1), 14–23.
- Azoda, C.C., Osazuwa-Peter, N., Omili, M., 2010. Psychological and social impacts of halitosis. A review. *J. Soc. Psychol. Sci.* 3, 74–91.
- Azoda, C.C., Onyeagba, M.I., Odai, C.D., 2011. Does concern about halitosis influence individual's oral hygiene practices? *Niger. Med. J.* 52, 254–259.
- Bornstein, M.M., Kislig, K., Hoti, B.B., Seemann, R., Lussi, A., 2009. Prevalence of halitosis in the population of the city of Bern, Switzerland: a study comparing self-reported and clinical data. *Eur. J. Oral Sci.* 117, 261–267.
- Bornstein, M.M., Stocker, B.L., Seemann, R., Bürgin, W.B., Lussi, A., 2009. Prevalence of halitosis in young male adults: a study in swiss army recruits comparing self-reported and clinical data. *J. Periodontol.* 80, 24–31.
- Eldarrat, A., Alkhabuli, J., Malik, A., 2008. The prevalence of self-reported halitosis and oral hygiene practices among Libyan students and office workers. *Libyan J. Med.* 3, 170–176.
- Eli, I., Baht, R., Koriat, H., Rosenberg, M., 2001. Self-perception of breath odor. *JADA* 132, 621–626.
- Faveri, M., Hayacibara, M.F., Pupio, G.C., Cury, J.A., Tsuzuki, C.O., Hayacibara, R.M., 2006. A cross-over study on the effect of various therapeutic approaches to morning breath odour. *J. Clin. Periodontol.* 33, 555–560.
- Hammad, M.M., Darwazeh, A.M.G., Al-Waeli, H., Tarakji, B., Alhadithy, T.T., 2014. Prevalence and awareness of halitosis in a sample of Jordanian population. *J. Int. Soc. Prev. Commun. Dent.* 4 (3), 178–186.
- Hughes, F.J., McNab, R., 2008. Oral malodour – a review. *Arch. Oral Biol.* 53, 1–7.
- Lee, S.S., Zhang, W., Li, Y., 2007. Halitosis update: a review of causes, diagnoses, and treatments. *J. Calif. Dent. Assoc.* 35, 259–268.
- Liu, X.N., Shinada, K., Chen, X.C., Zhang, B.X., Yaegaki, K., Kawaguchi, Y., 2006. Oral malodor-related parameters in the Chinese general population. *J. Clin. Periodontol.* 33, 31–36.
- Madhushankari, G.S., Yamunadevi, A., Selvamani, M., Mohan Kumar, K.P., Basandi, P.S., 2015. *J. Pharm. Bioall. Sci.* 7 (2), 339–343.
- Nadanovsky, P., Carvalho, L.B.M., Ponce, D.E., Leon, A., 2007. Oral malodour and its association with age and sex in a general population in Brazil. *Oral Dis.* 13, 105–107.
- Rösing, C.K., Loesche, W., 2011. Halitosis: an overview of epidemiology, etiology and clinical management. *Braz. Oral Res.* 25, 466–471.
- Rösing, C.K., Gomes, S.C., Bassani, D.G., Oppermann, R.V., 2009. Effect of chewing gums on the production of volatile sulfur compounds (VSC) in vivo. *Acta Odontol. Latinoam.* 22, 11–14.
- Settineri, A., Mento, C., Gugliotta, S., Saitta, A., Terranova, A., Trimarchi, G., Mallamace, D., 2010. Self-reported halitosis and emotional state: impact on oral conditions and treatments. *Health Qual. Life Outcomes* 8, 34–44.
- Signoretto, C., Burlacchini, G., Bianchi, F., Cavlieri, G., Canepari, P., 2006. Differences in microbiological composition of saliva and dental plaque in subjects with different drinking habits. *New Microbiol.* 29, 293–302.
- Suarez, F.L., Furne, J.K., Springfield, J., Levitt, M.D., 2000. Morning breath odor: influence of treatments on sulfur gases. *J. Dent. Res.* 79, 1773–1777.
- Tanaka, M., Anguri, H., Nishida, N., Ojima, M., Nagata, H., Shizukuishi, S., 2003. Reliability of clinical parameters for predicting the outcome of oral malodor treatment. *J. Dent. Res.* 82, 518–522.
- Wang, J., He, L., Liu, T.T., 2010. Study on self-reported halitosis and the associated factors in patients in a periodontal clinic. *Beijing Da Xue Xue Bao* 44, 295–298.
- Youngnak-Piboonratanakit, P., Vachirarojpisan, T., 2010. Prevalence of self-perceived oral malodor in a group of Thai patients. *J. Dent. Tehran.* 7, 196–204.