

Prevalence and related parameters of halitosis in general population and periodontal patients

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Abstract

Introduction

The present review aimed to focus on the studies on halitosis prevalence and related parameters in general population and periodontal patients because the number of epidemiological researches on halitosis is limited. In this review, PubMed-MEDLINE and Lilacs/SciELO were searched through February 2014 for appropriate studies. 'Volatile sulphur compounds', 'halitosis', 'periodontitis+halitosis' and 'prevalence+halitosis' were selected as outcome variables.

Discussion

The review showed different prevalence of halitosis between 2% and 87% in the general population. Halitosis-related parameters such as periodontal disease, older age, men, tongue coating were more associated with high levels of halitosis.

Conclusion

Hence, one standard protocol should be created to make the comparison of the studies easy and to show the real prevalence of halitosis around the world, because there is no uniformity in evaluation methods and diagnosis in the prevalence and related parameter studies on halitosis.

Introduction

Periodontal diseases have high prevalence worldwide, and they have been described by several studies. A study conducted in Germany¹ verified the prevalence to be 76.9% in adults, and another study in France² observed a prevalence of 82.2%, and a literature

review³ of 19 studies between 1993 and 2003, with 9400 people, showed a prevalence of 92.9% of gum and periodontal diseases.

However, only few studies are available which evaluated the prevalence of halitosis in general population, with reported rates ranging from 22 to 50%⁴. The number of studies with the aim of analysing the prevalence of halitosis in periodontal patients is more limited.

The number of epidemiological researches on halitosis is limited probably because of the difference in cultural and racial appreciation of the bad breath, as for patients as well as for investigators, and also because there is no uniformity in evaluation methods and diagnosis⁵. Owing to different methodologies, the prevalence of halitosis is unclear and there are only a few community-based studies evaluating the prevalence⁶. However, extensive studies on halitosis are necessary because it can be considered as a factor that influences the quality of life of patients, which is preventable, as oral hygiene is considered as responsible⁷.

In the present review, PubMed-MEDLINE and Lilacs/SciELO were searched through February 2014 to identify appropriate studies. 'Volatile sulphur compounds', 'halitosis', 'periodontitis+halitosis' and 'prevalence+halitosis' were selected as outcome variables. There were no restrictions regarding language or date of publication. The reference lists of articles were also searched to check the availability of further studies. So, the present review aimed to focus on the studies on halitosis prevalence and halitosis-related parameters in the general population and periodontal patients.

Prevalent studies

The precise prevalence of halitosis is still uncertain⁸ due to limited number of studies, and even lesser number of studies with large samples⁹. It could also be due to the difficulty in evaluating some studies available that have no specification on classification, diagnosis or methodology used⁸.

The prevalence of halitosis, according to the studies published, is between 2% and 44% and this disparity is justified by the subjectivity of the diagnostic criteria, assessment methods and sampling techniques¹⁰. Although the prevalence of halitosis has been studied in various populations in different parts of the world, different assessments and cut-off points were presented. Therefore, precise estimate of the prevalence of halitosis is not possible to obtain¹¹.

Many young adults complain of halitosis; it is estimated that 30% of the world population suffers with this problem regularly¹². A study¹³ conducted in a group of 2672 Japanese workers showed a prevalence of 14% of halitosis in the morning, 23% in the late morning, 6% in the afternoon and 16% at night. An observational study¹⁴ conducted in a sample of 99 volunteers measured halitosis with gas chromatography and found a prevalence of 49%. A French study¹⁵ showed about 22% of self-reported halitosis.

According to another study¹⁶, nearly more than 50% of the general population has halitosis. In a Swedish¹⁷ study conducted in 840 men, halitosis was reported to be around 2% of the population. Studies based on a questionnaire in 1551 subjects in Kuwait¹⁸ and 254 healthy elderly subjects¹⁹ reported 23% and 28% of the

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samples with halitosis, respectively. Another study²⁰ with 1052 subjects in Italy showed 19% of self-reported halitosis.

A cross-sectional Brazilian study²¹ among university students and their families showed a halitosis incidence of 15%. Japanese researchers investigated²² 33,000 adults and 15% of them were reported to be suffering from halitosis, with a peak of more than 20% in the city of Tokyo.

A study²³ evaluated a sample of 2000 Chinese subjects (1000 men and 1000 women), aged between 15 and 64 years, to try to establish the relationship between halitosis and oral health, and social and behavioural factors. The authors found prevalence of halitosis to be 27% in the sample, and the tongue coating and periodontal condition were the main related factors.

In Switzerland, 626 young male adults were evaluated through a unified questionnaire and clinical examination to study the prevalence of halitosis²⁴. The questionnaire revealed that only 17% of recruits had never complained of halitosis. The organoleptic evaluation identified 8 people with grade 3, 148 people with grade 2 and 424 people with grade 1 or 0 halitosis. The study also found that tongue coating was the only factor that contributed to high counts of volatile sulphur compounds (VSCs) and organoleptic values. The same group of researchers²⁵ in Switzerland, with 419 subjects of the city of Bern, revealed the prevalence of self-reported halitosis to be 32%.

In a retrospective study conducted from February 2003 to February 2010²⁶, with medical histories of 465 patients, all reported to have suffered from halitosis, but 87% of patients were diagnosed with true halitosis. Within this group, 96% had an oral cause. Most of the patients (94%) had used a mouthwash (62.9%) and only 11% attempted a tongue cleaner.

In children, the literature describes the prevalence of mouth breathing

ranging from 5% to 75% of subjects tested^{27,28}. Another study²⁹ showed 40% of children with a mouth-breathing pattern. This was observed in a greater number of males, than females, according to a study²⁸.

In 2012, a study³⁰ was conducted to evaluate the prevalence of halitosis in subjects with periodontal disease. The average of VSC in 50 patients with chronic periodontitis and 50 patients without periodontitis were, respectively, 455.08 and 150.34 ppb. Hence, the amount of VSC was higher in patients with chronic periodontitis, which suggests that control of periodontal disease could be effective in reduction of VSC values.

Another study³¹ evaluated oral health status and halitosis in 137 periodontal and 80 gingivitis patients. In the periodontitis group, halitosis was significantly correlated with decayed teeth, periodontal parameters and tongue coating. In the gingivitis group, halitosis was significantly correlated with the plaque index, bleeding on probing and tongue coating. The authors concluded that dental plaque, bleeding on probing and tongue coating contribute to halitosis, but in different degrees in periodontitis and gingivitis patients.

In an assessment of halitosis³² in 27 patients diagnosed with chronic periodontitis, the VSC was 463.41 ppb and the frequency of high organoleptic scores (3–5) declined from 96.29% (day 0) to 81.48% (day 30), with a reduction of around 50% by day 180. The authors concluded that supragingival plaque control reduced halitosis in patients with periodontitis.

Approximately one-third of the individuals with halitosis were affected with moderate chronic halitosis; whereas less than 5% of the population were affected with severe halitosis. It is clear that halitosis is a prevalent problem, and that the dental profession needs to take its responsibility in its management¹¹.

According to the Brazilian Association of Halitosis³³, the incidence of bad breath in Brazilian population may reach 40%. And, according to the American Dental Association³⁴, about 50% of the adult population had at least an occasional complaint of oral halitosis. In a study conducted in a group of patients in Brazil³³, the authors found that about 17% of population were aged 0–12 years, 41% were 12–65 years and 71% over 65 years. In 679 Brazilian citizens interviewed through a questionnaire, halitosis was found to be a common problem; with 87% of them reporting to know some people with halitosis and 59% knew more than seven people with this problem.

Halitosis-related parameters

Halitosis can be treated if its aetiology can be detected accurately. If the aetiology is not accurate, the treatment can be unsuccessful; therefore, investigation and adequate diagnosis are crucial. Therefore, the most important issue in the treatment of halitosis is detecting aetiology, which in turn helps make the analyses of the correct halitosis-related parameters. Although most of the cases are from the oral cavity, sometimes other aetiologies can also contribute to oral halitosis. If halitosis is not related to oral cavity causes, such as respiratory, gastrointestinal and hepatic, renal, endocrine or haematological disease, the patients should consult the specialist³⁵.

A population study conducted in Germany³⁶ showed a strong positive association between gastro-oesophageal reflux disease and halitosis in denture-wearing subjects and a moderate positive association in dentate subjects. Two Swiss studies^{24,25} showed that tongue coating was an important factor for halitosis development, and smoking and periodontal disease were associated with higher halitosis rankings.

A cross-sectional study⁶ conducted in 901 patients who responded to an

anonymously constructed questionnaire between October 2007 and February 2009 showed high prevalence of self-perceived halitosis, but a low prevalence those seeking treatment in Thailand. Older age, tongue coating and bleeding when brushing teeth were the factors most strongly associated with self-perceived halitosis.

A study³⁷ conducted among patients of the dentistry course showed that the knowledge about halitosis is controversial in some aspects, especially about the causes and prevention methods, and there was no improvement in the knowledge on halitosis in the group that received additional information. The authors concluded that both, professionals and patients, should be better oriented in relation to physiological and pathological factors of halitosis to act in preventing their individual and social effects.

An observational study¹⁴ found a statistically significant association between halitosis and male sex, age ≥ 61 years, antidepressant use and lack of regular hygiene habits such as flossing and tongue cleaning. However, there was no statistical association between halitosis and smoking and alcohol consumption, frequent brushing of teeth and self-perception of halitosis. A study¹⁹ showed association of dental caries, older age and smoking with halitosis.

A research²³ showed that men had more halitosis than women; and other studies^{38,39} suggested that women seek help and treatment. Men and women seem to suffer in the same proportions; however, women look for professional help faster than men⁴⁰. In adults, there was a huge correlation between age and halitosis; whereas older groups had more intense bad breath¹³. This study also showed that patients with severe periodontitis had higher halitosis scores than healthy subjects.

In the United States⁴¹, it was found that 43% of people aged over 60 years complained about halitosis.

A study⁴² with Turkish individuals showed an incidence of around 28%. The Swiss studies^{24,25} also found the same incidence. In Sweden¹⁷, it was verified that plaque and dental calculus were significantly correlated with severe halitosis. Tongue coating area exposed to the oral cavity is much larger than the area of subgingival plaque from the gingival margin, which is alone considered to be responsible for halitosis⁴³. Plaque and tongue coating were highly associated with halitosis⁴⁴. A study⁵ suggested that halitosis is caused by tongue coating in the younger generation and by periodontitis with tongue coating in elderly population.

Discussion

The authors have referenced some of their own studies in this review. These referenced studies have been conducted in accordance with the Declaration of Helsinki (1964) and the protocols of these studies have been approved by the relevant ethics committees related to the institution in which they were performed. All human subjects, in these referenced studies, gave informed consent to participate in these studies.

Varieties of data suggest that there are large shortcomings in the methodology of the overall research projects⁴⁵, and a standardised evaluation protocol is needed to compare epidemiological data of halitosis⁵. The prevalence of halitosis, as reported by several studies, is ranging from 2% to 87% (Table 1), but the diagnostic methods, the samples and protocols of the studies were different to compare.

As studies do not have a standardised evaluation protocol, it is difficult to obtain exact data on the halitosis-related parameters. In a study⁶, the authors found no difference in terms of gender, smoking and dental floss, but found differences in terms of age, gingival bleeding and frequency of brushing. However, other studies^{13,43} found a relationship between VSC and tongue coating. A study²³ did not

find age as a risk factor, but another study⁴⁶ found a higher incidence of halitosis in elderly population.

A study⁴⁷ found higher rate of halitosis among male students than female students (83% versus 71%), and there were no differences in the rate of halitosis among students from different academic years or age groups. Some authors⁴⁸ stated that the use of dental floss did not contribute significantly to reduce the VSC, and other authors^{13,43} found no difference in regards to smoking.

A study²¹ found that the prevalence was higher in men, according to gender, and above 20 years in age. The study in Japan¹³ found that men showed a higher level of VSC than women. In a study⁴⁹ conducted in periodontal patients in Israel, men had a higher degree of halitosis. Some authors^{18,19,50,51} found no difference in the prevalence of halitosis between men and women; however, others^{52,53} found a higher prevalence in men compared with women.

In a Chinese evaluation²³, the tongue coating and periodontal condition were the main factors related to halitosis. In other studies^{24,25}, the tongue coating was found as the only factor contributing to organoleptic scores and the highest values of VSC. Some authors^{54,55} found a strong relationship between the tongue coating on the organoleptic test; however, others authors⁵⁶ did not find this relationship. A strong relationship between tongue coating and organoleptic test was also verified⁵⁰, but the coating was not related to periodontal parameters. Yet according to a few authors, there was a reduction in halitosis, according to the organoleptic test and VSC, only with the removal of tongue coating.

Patients with chronic periodontitis have more tongue coating, and also found that the production of coating in these patients was higher when compared with healthy subjects⁵⁷. Few studies^{48,58,59} showed that the tongue has been identified as the

Table 1 Chronological summary of halitosis prevalence and related parameters in general population							
Authors	Year	Population (n)	Place	Diagnostic method	Prevalence (%)	Related parameters	
						Association	No association
Sulser et al. ⁶⁸	1939	200	—	Osmoscope	56	Age	Gender
Tonzetich and Kestenbaum ¹²	1977	—	—	Organoleptic	30	Plaque and tongue coating	
Miyazaki et al. ¹³	1995	2672	Japan	Halimeter	14	Age, men, tongue coating and severe periodontitis	Smoking
Loesche et al. ⁴¹	1996	370	USA	Self-report	31	Age	—
Frexinos et al. ¹⁵	1998	4815	France	Self-report	22	—	—
Söder et al. ¹⁷	2000	1681	Sweden	Organoleptic	2.4	Periodontitis patients and dental visits	Smoking
Saito and Kawaguchi ²²	2002	33000	Japan	Interview	15	—	—
ADA Council on Scientific Affairs ³⁴	2003	—	USA	—	50	—	—
Al-Ansari et al. ¹⁸	2006	1551	Kuwait	Questionnaire self-report	23.3	Gastrointestinal disorders, chronic sinusitis, older age, and lower education levels	Gender
Liu et al. ²³	2006	2000	China	Organoleptic and halimeter	27.50	Men, tongue coating and periodontal condition	Age
Faveri et al. ⁴⁸	2006	19	Brazil	Clinical analysis		Tongue coating	Dental floss
Nadanovsky et al. ²¹	2007	—	Brazil	Interview	15	Over 20 years and men	—
Nalcaci and Baran ¹⁹	2008	254	Turkey	Questionnaire self-reported and perceived taste	28.3	Tongue coating, hygiene practice, older age, lower education levels and smoking	Gender
Struch et al. ³⁶	2008	3005	Germany	Self-reported interviews	—	Heartburn or acid regurgitation	—
ABHA ³³	2009		Brazil	Questionnaire	40	—	—
Bornstein et al. ²⁵	2009	419	Switzerland	Self-report and VSC	32 and 28	Tongue coating, smoking and periodontal disease	—
Bornstein et al. ²⁴	2009	626	Switzerland	Self-report and clinical analysis	20	Tongue coating, smoking and periodontal disease	—
Settineri et al. ²⁰	2010	1052	Italy	Self-reported questionnaire	19.39	Anxiety, stress, smoking, gum problems, oral hygiene, medication and gastrointestinal urinary problems	—
Yokoyama et al. ⁴⁴	2010	474	Japan	Self-report and clinical analysis	39.6	—	—
Youngnak-Piboonratanakit and Vachirarojpisarn ⁶	2010	839	Thailand	Self-perceived questionnaire, organoleptic test and halimeter	61.1	Tongue coating, bleeding when brushing teeth and more than 30 years of age	Gender, smoking and dental floss

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FOR CITATION PURPOSES: Soares LG, Tinoco EMB. Prevalence and related parameters of halitosis in general population and periodontal patients. OA Dentistry 2014 Feb 25;2(1):4.

Competing interests: none declared. Conflict of interests: none declared.
All authors contributed to conception and design, manuscript preparation, read and approved the final manuscript.
All authors abide by the Association for Medical Ethics (AME) ethical rules of disclosure.

Table 1 (Continued)

Authors	Year	Population (n)	Place	Diagnostic method	Prevalence (%)	Related parameters	
						Association	No association
van der Sleen et al. ⁶²	2010		The Netherlands	Literature review	—	Tongue brushing and tongue scraping	—
Motta et al. ²⁹	2011	55	Brazil	Clinical evaluation and Breath Alert™ in children	23.6	Boys	—
Nunes et al. ¹⁴	2012	99	Portugal	Gas chromatography	49.5	Men, older age, dental floss, tongue brushing	Smoking
Zurcher and Filippi ²⁶	2012	465	Switzerland	Clinical analysis	87.2	—	—
Pham et al. ³¹	2012	218	Japan	Clinical analysis	—	Dental plaque, bleeding on probing, tongue coating	—
Silveira et al. ³²	2012	27	—	Organoleptic, VSC and clinical analysis	96.29	Supragingival plaque	Tongue cleaning
Arinola and Olukoju ⁶⁷	2012	100	Nigeria	Questionnaire and practical testing	2–22%	—	—
Evirgen and Kamburoğlu ⁴⁷	2013	268	—	Halimeter and organoleptic	—	Men	Age
Scala et al. ⁶⁹	2014	42	Italy	Neuropsychologic rating test and halimeter	—	Greater age, lower educational level	Demographic differences
Tseng ⁷⁰	2014	—	—	—	—	Stroke patients	—

most responsible for the production of VSC; whereas other studies^{48,60} still reveal that just brushing your teeth is not effective in reducing halitosis scores, generating the need for tongue scrapers as adjuncts.

The concentration of VSC in a group with destructive periodontal condition (including probing pockets >0.4 mm) reduced by 50% by only scraping the tongue. Soon after, periodontal treatment was performed, where the halitosis, however, significantly reduced the concentration of CH₃SH. The authors⁴⁸ found that patients with periodontal disease have more CH₃SH than healthy subjects,

but this was not reported by other authors⁵⁰.

A study⁶¹ attempted to demonstrate that the mechanical cleaning of tongue could be an effective method for reducing VSC, and the authors concluded that brushing your teeth and scraping your tongue was slightly more effective in reducing VSC than just brushing teeth or scraping the tongue separately; however, the authors questioned the clinical effects of this reduction due to the limitation of the duration, which was about 30 minutes. A systematic review⁶² attempted to demonstrate the potential of mechanical scraping of

the tongue, but the evidence was not convincing enough and the authors concluded that further studies are needed to define this relationship.

Other studies^{62–64} have shown a relationship between tongue scraping and reduced levels of VSC; however, in a report⁶⁵, the duration was mentioned to be only 100 minutes. According to a study¹¹, scraping the tongue is a component for reduction of halitosis but cannot be the only treatment. A scraped tongue proved superior with less than 35% VSC⁶⁶. Most of the studies^{13,23,54,61} have found a strong relationship between tongue cleaning and reduction of organoleptic scores.

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But we are still missing a defined standard for the treatment of halitosis because the protocols defined vary widely without consensus^{8,9,48,55}.

Conclusion

The review showed different prevalence of halitosis, between 2% and 87% in the general population. It was not possible to identify the correct prevalence of halitosis in periodontal patients.

Halitosis-related parameters, periodontal disease, older age, men, and tongue coating were associated with high levels of halitosis. Tongue cleaning (scraping or brushing the tongue) was considered just a complement and not the only treatment for halitosis.

Hence, it is concluded that there is no uniformity in evaluation methods and diagnosis in prevalent studies of halitosis. The number of studies on relationship between periodontal patients and halitosis are limited. So, one standard protocol should be created for comparison of the studies and to show the real prevalence of halitosis around the world.

Abbreviation list

VSC, volatile sulphur compound.

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FOR CITATION PURPOSES: Soares LG, Tinoco EMB. Prevalence and related parameters of halitosis in general population and periodontal patients. *OA Dentistry* 2014 Feb 25;2(1):4.