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Research Article

Halitosis Awareness among Italian Dentists, Hygienists and Students

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Abstract

Purpose: The term halitosis refers to an odor deemed unpleasant or offensive to others that emits from the oral cavity. The pathogenesis of intraoral halitosis is due to sulphur-containing amino acids degradation by oral bacteria in volatile sulphur compounds (VSCs). It is important to stress that oral bacteria responsible for this situation are normally hosted between tongue buds, also in people without periodontal disease. The purpose of this study was to establish the awareness and knowledge of this common oral status among 503 oral practitioners and students.

Methods: Everyone was sent a web link with a questionnaire on SurveyMonkey.com of 7 multiple-choice anonymous questions.

Results: The majority of people surveyed believe halitosis is treatable as assessed in literature. Whether most of clinicians and students always propose tongue hygiene at home to their patients is heartening, but it reveals that a quarter of them should be made conscious about the need to add this practice to a normal at-home oral care procedure.

Conclusions: It should be noticed the risk of side effects of chlorhexidine and other antimicrobial substances at high percentage for a long period of time and that's way it is recommended low concentration medicated mouthwashes daily used for tongue cleaning in addition to a mechanical instrument.

Keywords

Halitosis; bad breath; oral malodor; foetor ex ore; oral health.

Declaration of Conflicting Interest

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Introduction

In the 1920s, the term "halitosis" was coined by Gerard Lambert, the son of Listerine founder Jordan Wheat Lambert. He took the Latin word for breath, "halitus" and combined it with the medical ending "osis" to get a medical-sounding term for bad breath [18].

Halitosis is a common condition characterized by an unpleasant odour from the mouth. It is also referred as bad breath, oral malodor, or foetor ex ore [1]. Clearly, this can lead to a social restriction for people who suffer from bad breath or think that they do. Suffice it to say that in Jewish culture marriage contract can be legally terminated due to halitosis because it is considered a major disability according to the Talmud [2].

Epidemiology

Oral malodor has a great prevalence, it is worldwide in adolescents and adults, but its incidence remains undefined (1), although several studies report the population prevalence of bad breath (physiological or because of underlying disease) to be about 50%. It would seem to be no relation with age and sex (14).

Etiology

In patients breath with this status numerous compounds have been found responsible for

COMPOUNDS	SMELL	100% DETECTION THRESHOLD (ppb)
Hydrogen sulfide	Rotten eggs	1000
Methyl mercaptan	Rotten cabbage, pungent odor	35
Dimethyl sulfide	Sweet, unpleasant	100
Dimethyl disulfide	Pungent odor	7
Allyl mercaptan	Garlic	0.5
Allyl methylsulfide	Garlic	Unknown
Propyl mercaptan	Unpleasant, pungent odor	0.7
Methyl propyl sulfide	Not referred	Unknown
Carbon disulfide	Slightly pungent odor	900
Ammonia	Sweet, pleasant	55000
Dimethylamine	Fish, like ammonia	6000
Trimethylamine	Fish, like ammonia	4000

Table-1 Compound isolated in patients breath with halitosis. The 100% detection threshold represents the concentration in which 100% panel shows a certain smell as the object of study substance. ppb: parts per billion. (4)

the bad smell such as volatile sulfur compounds (VSCs) and amines. VSCs are mainly represented by hydrogen sulfide (H₂S), methyl mercaptan (CH₃SH) and dimethyl sulfide (CH₃SH) (Table 1).

This problem can have several different origins that allow to distinguish: genuine halitosis, pseudo-halitosis and halitophobia (10). Genuine halitosis can be physiological or pathological. Physiological genuine halitosis is also called transitory halitosis, for example after eating certain foods (onions, garlic, spices) or habits (smoke), or even to the awakening due to saliva flow reduction during the night. Pathological genuine halitosis is caused by intraoral and extraoral factors. Pseudohalitosis refers to people convinced of suffering from oral malodor but that can not be assessed by another person. Instead halitophobia concerns patients who suffered from genuine halitosis in the past and think they still do despite the therapy success. Pseudo-halitosis can be treated by dental practitioners, but halitophobic patients must be referred to psychological specialists (10). Approximately 90% of all types of halitosis can be classified as intraoral halitosis, which originates from oral cavity-associated pathological conditions (periodontitis and gingivitis) and physiological traits, particularly tongue microbial coating (5, 6). It is worth adding that there is also a drug-related halitosis caused by the use of several drugs such as antihypertensive agents, antidepressants, antiallergics, antibiotics which induce volatile substances formation from the blood to the exhaled air. A special case is represented by Disulfiram that is reduced to carbon disulfide, a stable compound in blood carried to the lungs, passively diffused across the pulmonary alveolar membrane to enter the breath (11). Indirectly, also antineoplastic agents could entail bad breath as a result of xerostomia following head-neck district radiotherapy or mucositis.

Intraoral halitosis

Halitosis of oral origin represents the majority of kinds for this condition. It depends on periodontal disease and tongue coating, a greyish-white deposit on the tongue, which are the two main sources of VSCs.

VSCs are the end-products of sulfur-containing amino acids (cysteine and methionine) degradation from both Gram-positive and Gram-negative anaerobic bacteria. There is a wide list of oral bacteria able to produce VSCs: *Porphyromonas gingivalis* (P. gingivalis), *Fusobacterium nucleatum* (F. nucleatum), *Prevotella intermedia* (P. intermedia), *Treponema denticola* (T. denticola) and *Tannerella forsythia* (T. forsythia) (7). Among VSCs in periodontal patients the most observed is methyl mercaptan which increased in proportion to the bleeding index and probing depth. Furthermore, the average

amount of tongue coating removed from patients with periodontal disease seems to be significantly higher than from healthy controls (8). Methyl mercaptan alone or in combination with interleukin-1 (IL-1) or lipopolysaccharide, can significantly enhance the secretion of prostaglandin E2 (PGE2), cAMP and procollagenase by human gingival fibroblasts cultures. CH3SH also stimulated mononuclear cells to produce IL-1, which can increase cAMP production, and act in synergism with the direct effect of CH3SH on cAMP (9). In light of this, methyl mercaptan could contribute to immunological and enzymatic reactions leading to tissue destruction in periodontal disease.

A crucial role in intraoral halitosis is played by the microbiota hosted on the tongue surface. The bacterial qualitative composition of the tongue coating in patients with and without intraoral malodor is almost the same (12). The tongue surface presents favourable morphological features (such as papillae, crypts, fissures and roughness) which facilitate the rapid growth of microorganisms, especially anaerobic bacteria, due to the low oxygen potential in these sites. The tongue coating acts as a reservoir for periodontal pathogenic bacteria in both periodontally healthy and inflammatory environments. Due to the large amount of microorganisms and exfoliated cells from these large papillary surfaces, the tongue dorsum has been considered as a major source of VSC production (5). Nowadays the understanding of all the ecological niches harbored by the complex area of the tongue is encouraged by the coming of Next-Generation Sequencing (NGS) used for microbiome analysis, providing a wider scene of halitosis-related microbial communities, including previously uncultured taxa (13).

Extraoral halitosis

Extra-oral halitosis can be subdivided into: halitosis from the upper respiratory tract including the nose; halitosis from the lower respiratory tract; blood-borne halitosis. In blood-borne halitosis, malodourant compounds in the bloodstream are carried to the lungs where they volatilize and enter the breath (3). Extraoral halitosis has an estimated prevalence of 0.5–3% in the general population (15), and it can be caused by conditions affecting the upper airways (nose, sinuses, tonsils, larynx, oropharynx),

QUESTION	ANSWER
Do you suffer from dry mouth? (xerostomia)	
Do you breathe through your mouth?	
How many times a day do you drink? (include any beverage)	
How many cups of coffee do you drink each day?	
How many alcohol doses do you drink each day?	
Do you often feel a bad taste?	
Do you think there is a link between bad taste and your bad breath?	
What time of the day you notice bad breath?	
Who do you find out having bad breath?	
How many years have you had this problem?	
How would you rate your problem?	
How would others rate your problem?	
Do you feel mucus behind your tongue? (postnasal drip)	
Do you think there is a link between digestive problems and your bad breath?	
Do you smoke? If yes, how many years and how many cigarettes packs?	
Do you ever brush your tongue?	
Do you use a tongue scraper?	
Do you use a mouthrinse? If yes, what kind?	
Do you practice social distancing because of your bad breath?	
Do you eat mints to disguise your bad breath?	

Table-2 Survey example to be sent to the patient before the first appointment. [4]

the lower airways (bronchial tubes, lungs), digestive tract (esophagus, hiatal hernias), the endocrine system and metabolic disorders (liver cirrhosis, diabetes, renal insufficiency, trimethylaminuria). Several systemic diseases have been found to provoke malodor or to be a cofactor; bad breath may be an early sign of a serious local or systemic condition. It is important to determine quickly whether the odor comes from an oral cause or not: if so, it requires referral to a dentist or dental hygienist; if not its management requires the treatment of the underlying causes [16].

Diagnosis

Make a proper diagnosis is critical for the purpose of directing each patient toward the best therapeutic option. A whole medical and dental history is fundamental. Attention should be paid to systemic diseases, medications, oral breathing, postnasal drip, tonsilloliths, tonsillitis, nasal obstruction, report of snoring and sleep apnoea as well as gingivitis and periodontitis. Before the first breathe examination, it could be helpful sending a medical survey (Table 2) and instructions to the patient.

In order not to distort the assessment on the day of the medical examination the subject should follow some measures:

- Refrain from antibiotic therapy in the 8 weeks before the appointment.
- Refrain from eating garlic, onion, spices 48 hours earlier.
- Avoid alcohol and smoking at least 12 hours earlier.
- Avoid food 8 hours before and water 3 hours before the appointment.
- Avoid oral hygiene at home on the day of the examination.
- Avoid using perfumes, aftershave or face cream with scent.

During the first appointment the intraoral examination of soft and hard tissues is a basic step. The tongue plays the major role and to analyse its surface the Winkel Tongue Coating Index (WTCL) is very useful [17]. The dorsum of the tongue is divided into six areas, i.e. three in the posterior and three in the anterior part of the tongue. The tongue coating in each sextant was scored as 0: no coating; 1: light coating; and 2: severe coating. WTCL score is obtained summing each sextant score.

Organoleptic assessment

After the first examination of oral tissues, the clinician can proceed with the organoleptic assessment, that is smelling the exhaled air directly from patient mouth. According to several studies one judge is enough to perform the assessment, actually a panel of judges does not necessarily improve the accuracy of the exam [19; 20]. However, it is highly recommended to have a second judge available in the dental practice in order to provide a second opinion (especially when dealing with pseudo halitosis patients) or in order to perform measurements when the first judge is not available or shows fatigue and is unable to perform the organoleptic judging for a short period of time [21]. For dental practitioners with no or limited experience a simple evaluation scale by Rosenberg M. et al. (1991) [22] is available (Table. 3).

Grade	Description
0	No appreciable odor
1	Barely noticeable odor
2	Slight but clearly noticeable odor
3	Moderate odor
4	Strong odor
5	Extremely foul odor

Table-3 Rosenberg et al. (1991) organoleptic assessment index

In order to standardize the procedure and to avoid adaptation of the examiner's sense of smell to possibly detectable odors [23], an interval of about 5 min between each examination should be used.

VSCs monitoring

An instrumental detection method for VSCs can be recommended as a second opinion, as aid for the calibration of odor judges, and for building trust with the patient, especially for patients with pseudo halitosis and halitophobia [21]. Based on the currently available data in the literature [20] two devices for the detection of VSCs can be recommended for the use in the dental practice: the Halimeter® (Interscan, Chatsworth, CA, USA) and the Oral Chroma™ (Nissha FIS, Inc. Osaka, Japan). However, Halimeter has low sensitivity for methyl mercaptan and almost absence of sensitivity for dimethyl sulphide, for this

reason is not suitable for detecting extraoral bloodborne halitosis. Both instrumental methods work with exhaled air samples obtained by a straw on the back third of the tongue or by a negative pressure syringe after the patient closed his mouth for at least one minute. More details about exams, pros and cons of Halimeter and Oral Chroma are well explained by Salako NO. & Philip L. (2011) [24].

Methods

From January to May 2020 Italian dentists, dental hygienists and students of both Dentistry and Dental Hygiene were surveyed on the topic of oral malodor. An anonymous 7 multiple choice questions survey was developed on SurveyMonkey.com (One Curiosity Way, San Mateo, CA) as reported in Table 4.

The web link was spread via e-mail to the Italian President and Vice-President of Dental Hygiene Degree Course National Committee who spread it to all Dental Hygiene Degree Course President in order to send the link to their students and coworkers. Dentists - but also dental hygienists - were also reached via Instagram (Instagram Inc., California, USA) direct messages following hashtags as #dentistry #italiandentist #odontoiatria #igienistadentale. The percentages calculation and the

Question	Options
Are you a graduated practitioner or a student?	Graduated Practitioner Student
Did you ever study halitosis in your educational path?	Yes No
Does a patient ever ask you to be visited for halitosis?	Yes No
Do you ever perform scaling on a patient with halitosis detectable in an organoleptic way?	Yes No
Do you think halitosis is a resolvable problem?	Yes No
How often do you suggest tongue hygiene at home to you patients?	Never Rarely Only to the patient telling me the problem Always
Which medical device do you recommend to a patient with halitosis?	Only cosmetic mouthrinse Only not cosmetic mouthrinse (e.g. chlorhexidine) Only tongue dorsum brushing with a toothbrush Only tongue scraper Tongue dorsum brushing with a toothbrush + not cosmetic mouthrinse (e.g. chlorhexidine) Tongue scraper + not cosmetic mouthrinse (e.g. chlorhexidine) Equally tongue dorsum brushing with a toothbrush or a tongue scraper + not cosmetic mouthrinse (e.g. chlorhexidine)

Table-4 Questionnaire

statistical analysis through chi-square test with $p = 0.05$ and 95% confidence interval were performed directly by SurveyMonkey.

Results

Data currently available cover a sample of 503 applicants and are shown in Table 5. The first question saw 46,81% graduated practitioners and 53,19% students. In the second question 76.94% have studied halitosis in their educational path of which 88,94% is graduated practitioners, while 23,06% have not. Oral malodor was reported as a reason to be visited for in 63,82%. Only 31,21% have never performed scaling on a patient with halitosis detectable in an organoleptic way, while 68,79% did it.

The majority of applicants equal to 96,22% considers bad breath a solvable problem. The second to last question reveals 65,14% responding always recommending tongue hygiene at home, 17,93% rarely, 14,14% only to patients referring the problem and 2,79% never. Finally the last question shows that 40,92% recommend equally tongue dorsum hygiene with a toothbrush or a tongue scraper and a not cosmetic mouthrinse (e.g. chlorhexidine), of which 38,89% is graduated professionals (Table 5).

Discussion

Bad breath is gradually discussed more and more in many degree programs in Italy, however its treatment changes according to several factors. Also its diagnosis is variable in the same way. Dental practitioners have to consider the possibility of pseudohalitosis when oral malodor can not be found with organoleptic method in a patient who complains about bad breath, when the VSCs monitoring is negative and when there is no one who can assess that problem. When the patient still believes to suffer from halitosis even after the treatment of bad breath or pseudohalitosis, the diagnosis is halitophobia [25] and a psychiatric consultation is essential. It is worth pointing out that the clinician should not

Q1: Are you a graduated professional or a student?				
Graduated professional			46,81%	
Student			53,19%	
Q2: Do you ever studied halitosis in your educational path?				
	Total	Graduated Professionals	Students	Significance
Yes	76,94%	88,94%	66,67%	Significant
No	23,06%	11,06%	33,33%	Significant
Q3: Does a patient ever ask you to be visited for halitosis?				
	Total	Graduated Professionals	Students	Significance (p= 0.05)
Yes	63,82%	87,23%	43,07%	Significant
No	36,18%	12,77%	56,93%	Significant
Q4: Do you ever perform scaling on a patient with halitosis detectable in an organoleptic way?				
	Total	Graduated Professionals	Students	Significance (p= 0.05)
Yes	68,79%	85,53%	53,93%	Significant
No	31,21%	14,47%	46,07%	Significant
Q5: Do you think halitosis is a resolvable problem?				
	Total	Graduated Professionals	Students	Significance (p= 0.05)
Yes	96,22%	95,74%	96,62%	Not significant
No	3,78%	4,26%	3,38%	Not significant
Q6: How often do you suggest tongue hygiene at home to you patients?				
	Total	Graduated Professionals	Students	Significance (p= 0.05)
Never	2,79%	1,71%	3,75%	Not significant
Rarely	17,93%	16,67%	18,73%	Not significant
Only to the patient telling me the problem	14,14%	15,38%	13,11%	Not significant
Always	65,14%	66,24%	64,42%	Not significant

Table-5 Results

Q7: Which medical device do you recommend to a patient with halitosis?				
	Total	Graduated Professionals	Students	Significance (p= 0.05)
Only cosmetic mouthrinse	1,40%	0,43%	2,26%	Not significant
Only not cosmetic mouthrinse (e.g. chlorhexidine)	2,00%	1,71%	2,26%	Not significant
Only tongue dorsum brushing with a toothbrush	10,98%	14,10%	8,27%	Significant
Only tongue scraper	6,59%	8,12%	5,26%	Not significant
Tongue dorsum brushing with a toothbrush + not cosmetic mouthrinse (e.g. chlorhexidine)	25,15%	21,79%	27,82%	Not significant
Tongue scraper + not cosmetic mouthrinse (e.g. chlorhexidine)	12,97%	14,96%	11,28%	Not significant
Equally tongue dorsum brushing with a toothbrush or a tongue scraper + not cosmetic mouthrinse (e.g. chlorhexidine)	40,92%	38,89%	42,86%	Not significant

recommend anti-halitosis products to this kind of patient, otherwise he will think the specialist has observed halitosis.

Transitory halitosis spontaneously disappears eating or refraining from smoke and spices intake. Awakening bad breath is a cosmetic question and it can be solved recommending a tongue scraper before sleeping [26; 27]. Extraoral halitosis should be discussed with specialists depending on the origin.

Several studies agree upon tongue coating as the major cause of intra-oral halitosis [12; 26]. Evidently other oral factors can lead to bad breath, such as periodontitis [28], pericoronitis, plaque index, Decay Missed Filled Index (DMFI) [29], necrotizing ulcerative gingivitis and periodontitis [30]. It has been proved that mechanical tongue cleansing reduces VSCs, however on the basis of literature, there appears to be no data to justify the necessity to clean the tongue on a regular basis (without oral malodor) [31].

Tongue scrapers, regular toothbrushes or tongue cleaner (a combination brush and scraper) have basically a comparable potential in reducing VSCs [32], because there is weak and unreliable evidence to show the superiority of tongue cleaner on mechanical instruments [33]. Actually also tongue brushing with a hard toothbrush wetted with 0.12% chlorhexidine gluconate decreases oral malodor [34]. The patient with tongue coating should be made aware of cleaning the posterior third of tongue surface as much as possible, reducing the substrata for putrefaction, rather than the bacterial load tongue moreover scrapers improve taste sensation [35].

In spite of proven effectiveness of chlorhexidine 0.2% and 0.12%, its long-term use should not be recommended because of its side effects such as mucosa and teeth staining, dysgeusia [36]. The most appropriate agents seem to be mouthrinses with low concentrations agents i.e. chlorhexidine 0.05%, cetylpyridinium chloride 0.05% and zinc lactate 0.14% [17], to use as gargling in order to reach the most posterior tongue surface.

Conclusion

Even if an effective treatment for halitosis exists, a part of dental practitioners thinks it is not solvable. Since the majority of bad breath cases have an intraoral origin, dentists and dental hygienists

should be made aware about oral malodor diagnosis and therapeutic approaches such as combination mechanical tongue cleanser (scrapers or hard toothbrushes) and low concentrations mouthrinse.

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