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Halitosis

Swati Nandi

Department of Public Health, Azusa Pacific University GSPH 526: Public Health Biology

ABSTRACT

Halitosis or bad breath is a common complaint among the general population. Halitosis is estimated to be the third most frequent reason for seeking dental aid, following tooth decay and periodontal disease. Recently this area has witnessed growing technology and communications, particularly an enormous increase in advertisements for bad breath remedies on television, internet and in magazines. Thus, in turn has raised the levels of information and misinformation about bad breath among the patient population. No one appears to be immune to having bad breath one time or another. Bad breath can mean a problem with your digestion, gum disease, point to an allergy, an acidic system, low immunity or more often than anything else – inadequate oral hygiene or bacterial overgrowth. Lack of knowledge on how to prevent halitosis allows for its occurrence, limiting quality of life. As social relationships are one of the pillars of the quality-of-life concept, -halitosis needs to be considered a factor of negative interference. This paper provides a comprehensive review of the etiology of breath odor, its prevalence, diagnosis, and treatment strategies for this condition. Keywords: Oral malodor, Breath malodor, Halitosis, Volatile Sulphur compounds

INTRODUCTION

Halitosis is a term coined from the merger of the Latin halitus (breath) and Greek osis (pathological process) to describe a condition that meant an unpleasant odor from the mouth or "bad breath," as we commonly call it. It is a serious concern for the patient as it could lead to social embarrassment and leave the individual reclusive or occasionally even stigmatized. It is sometimes discovered by the dental practitioner or primary care clinician during a routine examination, and the individual may have been unaware.

Several studies have demonstrated the high prevalence of halitosis, which is a public health concern that affects quality of life, social embarrassment, and psychological restriction. The most common intra-oral causes of halitosis include poor oral hygiene, bacterial coating of the tongue, stomatitis, xerostomia, or chronic bacterial infections such as caries, gingivitis, and periodontitis (Bornstein et al., 2009). In addition, age and dental caries may also contribute to halitosis in children (Nalcaci and Sonmez, 2008). Longitudinal cohort studies have determined the process of halitosis development in terms of microbiome changes (Teng et al., 2015; Xu H et al., 2018; Dashper et al., 2019). Oral microbiota of halitosis and healthy adults, and reported remarkable variations in terms of microbiome composition and richness (Yang et al., 2013; Ren et al., 2016a; Seerangaiyan et al.,2017)

History

Odors are essential clues in the creation and conservation of social bonds, as they are loaded with cultural values. The problem of halitosis has been reported for many years. References were found in papyrus manuscripts dating back to 1550 BC.7 During Christianity, the devil's supreme malignant odor smelled of sulfur, and it was presumed that sins produced a more or less bad smell.

A treaty in Islamic literature from the year 850 talked about dentistry, referring to the treatment of fetid breath, and recommended the use of siwak when breath had changed or at any time when getting out of bed. The Hindus consider the mouth as the body's entry door and, therefore, insist that it be kept clean, mainly before prayers. The ritual is not limited to teeth brushing, but includes scraping the tongue with a special instrument and using mouthwash.
Buddhist monks in Japan also recommended teeth brushing and tongue scraping 8 before the first morning prayers.

Epidemiology

One study has linked the rising incidence of halitosis with age. According to one study, halitosis is amongst the top 100 most distressful diseases in humans.

Etiology
Oral malodor can be caused by a number of etiologic factors associated with both systemic and local oral conditions (Rosenberg, 2006). Approximately 90% of all types of halitosis originates from the oral cavity, (intra-oral halitosis) (Cortelli et al., 2008) (Refer: Appendix no.5)

The International Society for Breath Odor Research (ISBOR) has established a simple means of classifying halitosis based on its origins. This system serves as the global standard for classifying halitosis . Halitosis can be classified into three main categories: genuine halitosis, pseudo- halitosis, and halitophobia. Delusional or Imaginary Halitosis Pseudo halitosis: Here, the patient complains of having oral malodor, which others do not experience, including the clinician

Halitophobia: In this condition, the patient fears that his breath will be considered malodorous by everyone around him and will remain so despite treatment. This is a cause of great anxiety. This pathology affects about 0.5% to 1% of the adult population. Genuine Halitosis Physiological halitosis Pathological halitosis

Intraoral Causes
These account for nearly 80% to 85% of all halitosis cases. Gingival and periodontal diseases (acute necrotizing ulcerative gingivitis, herpetic gingivitis, periodontitis, pericoronitis, periodontal abscess), Sjogren syndrome, cancer treatment, and bone pathologies like alveolitis and osteomyelitis attribute to halitosis. Contributing factors are deep carious lesions and large interdental areas where retention of food debris could occur, maligned teeth, exposed necrotic pulp, ill-fitting dentures and orthodontic appliances, tongue biofilm, and candidiasis A drop in the oxygen saturation of saliva results in a lowering of the pH of saliva, causing diamines to form, resulting in malodor

Extraoral Causes
Respiratory system: The nose, sinuses, tonsils, and upper respiratory system, including the pharynx and larynx, can be the focus of halitosis. Foreign bodies in the nose form a nidus for bacteria to thrive. Klebsiella ozaenae can cause atrophic rhinitis, Streptococcus species is responsible for acute pharyngitis and sinusitis, and nasopharyngeal abscesses and laryngeal carcinoma can cause halitosis. Acute and chronic tonsillitis and tonsilloliths contribute to halitosis as the tonsils, like the surface of the tongue, have crypts that house bacteria producing volatile sulfur compounds (VSCs) and, consequently, malodor.

Systemic/Metabolic/Endocrine Disorders: Certain endocrinological and metabolic disorders like diabetes mellitus render a fruity or acetone-like odor to the breath, while in uremia, the breath gets an ammoniacal odor. Likewise, some other medical disorders altering the odor of the breath are listed below.
Acute febrile illness, Upper respiratory tract infection Cystic fibrosis, Diabetes mellitus Leukemia Hepatic failure Renal failure Menstruation

Drug-Related Halitosis: Certain drugs like chloral hydrate, disulfiram, acetaminophen, phenothiazines, antihistaminic, ethyl alcohol, griseofulvin, amphetamines, arsenic salts, bisphosphonates, chemotherapeutic agents, among others, cause oral malodor Pathophysiology

The gases emanating from the mouth that cause oral malodor are the volatile sulfur compounds (VSCs). These include hydrogen sulfide, methyl mercaptan, and dimethyl sulfide. Gram-negative and anaerobic bacteria from periodontal infections generate these compounds.{ Delanghe et al 1997}(Refer appendix no. 6)

The intraoral milieu contributes to 80% to 85% of cases of halitosis, where decarboxylation of amino acids such as acetic acid and propionic acid leads to malodorous amines like putrescine and cadaverine and other volatile aromatic compounds like indole and skatole.

In physiological halitosis, which occurs on waking, the cause is putrefaction of entrapped food particles and desquamated epithelial cells by bacteria.{Wilhelm D et al 2012}. The surface of the tongue has desquamated epithelial cells, leucocytes from periodontal pockets, food residues, and bacteria. The depth of the tongue papillae affects the biofilm coating on top, which prevents the cleansing action of saliva and promotes the growth of anaerobic bacteria, giving rise to halitosis. This occurs even in individuals with healthy periodontal tissues and good dental hygiene. Contributing factors in the diet include the consumption of volatile foods like onions, garlic, spices, pickles, radish, condiments, betel nut tobacco, and alcohol resulting in malodor. Garlic and onions have a high sulfur concentration in their composition, which on degradation through the gastrointestinal tract, emits the characteristic odor which lasts for hours after consumption. The microbiome metabolic pathways analysis revealed the abundance of pathways for the metabolism of cysteine and methionine in the HB group, which transforms amino acids into H2S (Xu L. et al., 2018; Dzidic et al., 2018).These

findings are in line with earlier studies that reported that the main cause of oral halitosis is the microbial degradation of methionine and cysteine (Spencer et al., 2007; Scully and Greenman, 2012).The accumulation of bacterial plaque and poor oral hygiene are the main risk factors for halitosis in adults (Chen et al., 2016). Furthermore, poor oral hygiene, dry mouth and periodontal diseases (such as periodontitis and gingivitis) are the main contributory factors for oral halitosis (Amir et al., 1999; Lin et al., 2003; Motta et al., 2011; Yilmaz et al., 2012; Villa et)

Histopathology
In individuals with halitosis, the posterior dorsum of the tongue is the main source of malodor. Smears taken from this biofilm or scrapings would show desquamated epithelial cells, leucocytes from periodontal pockets, blood metabolites, different food residues, and bacteria. Some bacteria associated with this condition are: Oral cavity: Gram-negative and anaerobic bacteria Nasal mucosa: K. ozaenae Pharynx, sinuses: Streptococcus species Respiratory system (bronchitis, bronchiectasis, lung diseases): P. aeruginosa Stomach: H. pylori GI tract: E. faecalis.

An assessment of tongue coating is also an integral part of the oral assessment for breath malodor. An index for assessing tongue coatings has been used in which the dorsum of the tongue is divided into six sections (REFER appendix no 4). The presence of any tongue coating is then graded and recorded for each of the sections. If no coating is present, a score of 0 is given; a light, thin coating is given a score of 1; and a heavy, thick coating is given a score of 2. The final score, ranging from 0 to 12, is calculated by adding the six section scores

Evaluation
Assessment methods discriminate between pseudo-halitosis and halitophobia. Diagnostic tests include organoleptic measurement, gas chromatography, sulfide monitoring, the BANA test, quantifying β-galactosidase activity, salivary incubation test, ammonia monitoring, or ninhydrin method.

Direct Methods of Screening Organoleptic.

Method
This is by far the commonest method used and the most effective in the clinical scenario. A plastic tube is placed in the patient's mouth, and the clinician tests the odor from the other end of the tube as the patient exhales into one end of the tube, grading it between 0 and 5:

Grade 0: No odor detectable
Grade 1: Malodor is hardly detectable
Grade 2: Odor slightly exceeding the threshold of malodor recognition Grade 3: Most certainly identifiable malodor
Grade 4: Strong malodor
Grade 5: Very strong malodor (Greenman J 2004)

The test is easy, inexpensive, and does not require specialized tools but could get a little uncomfortable for the clinician. Females are more prone to halitosis according to few studies. (Refer appendix no2) saliva, tongue debris, or any other oral fluid. It is a highly reliable test; the only drawbacks are expense, it is nontrans portable, and requires specialized trained personnel for its usage. This test is only for academic and research purposes. Its inability to detect non-sulfur-containing odoriferous molecules is another disadvantage to its use. {Van den Broek AM 2007}

Portable Sulfide Monitor
The portable sulfide monitor is a portable device. In this test, a single-use tube is inserted into the patient's mouth, which is closed for 5 minutes, while the patient breathes through his nose. The device detects sulfur-containing molecules in the breath, and this is reflected in the readings. It cannot detect non-sulfur containing molecules.
Indirect Methods of Screening

Benzoyl-DL-Arginine-Alpha-Naphthylamide (BANA)
This user-friendly and quick test detects certain gram-negative proteolytic obligate anaerobes like Porphyromonas gingival is, Treponema denticola, and Tannerella forsythia, which form a red complex when treated with BANA, a synthetic trypsin substrate. This provides proof for the presence of these bacteria, which are often present on the dorsum of the tongue and sublingual plaques and cause halitosis.

Ammonia Monitoring
This method uses a pump and disposable tube that measures the ammonia produced orally in a patient with halitosis and measures the reading quantitively.

Ninhydrin Technique- This technique is user-friendly. It requires the addition of isopropanol to the patient's sample to detect amines and polyamines, which contribute to the malodor. Salivary Incubation Test This test is more sensitive than the organoleptic test but is more time-consuming. It involve incubation of the patient's saliva at 37 C under anaerobic conditions for a few hours, after which the odor is detected.

Darkfield/Phase Contrast Microscopy-Quantifying Beta-Galactosidase Activity -The enzyme beta-galactosidase is directly associated with oral malodor and forms the basis for this test. The saliva is placed on a paper disc used for the test, which gives quantitative results in terms of color change.

Polymerase Chain Reaction-Today, many prefer polymerase chain reaction (PCR), which is sensitive, specific, and quick to detect VSCs from any sample taken from the oral cavity.

Supportive and Sympathetic Reassurance-The primary step after ruling out physiological halitosis is a thorough examination of the oral cavity to know whether it is tongue biofilm, deep carious lesions or large interdental areas with entrapped necrotic food debris, exposed necrotic pulp, ill-fitted prosthesis or dentures, mucosal lesions like tuberculosis, syphilis or even malignancies like carcinoma of the cheek or tongue, and treat accordingly.

Traditional methods of prevention
The use of medicinal plants is still widespread in the Moroccan society. According to the WHO 2003 statistics (World Health Organization [WHO]), in some developing countries in Asia, Africa, and Latin America, 80% of the population use traditional medicine to meet their needs for primary health care.

China Current western medicine (WM) for halitosis mainly includes mechanical methods (periodontal initial treatment, oral prophylaxis, tooth brushing, flossing, and tongue cleaning) and chemical methods (chlorhexidine, essential oil, menthol, chlorine dioxide, and two-phase oil-water rinse) However, WM mainly diminish the level of VSCs or related anaerobic bacteria thus having drug resistance and side effect on the existing oral microbial ecology.

Home remedies
Water: Taking an adequate amount of water throughout the day. Good amount of water consumption helps in keeping bacteria-fighting saliva stay in good proportions. Saliva is helpful in keeping our mouth watery.

Apple: Having an apple a day, especially early in the morning, not only helps in the digestion process but also helps in combating bad breath with its oxidized polyphenols properties.

Cinnamon: With its antimicrobial properties and cinnamaldehyde, cinnamon helps in keeping bad breath away.

Parsley: Munching few leaves of parsley also helps in neutralizing the nauseating smell.

Almonds: Having a few almonds everyday helps in keeping your teeth and gums healthy.

Lemon Juice: It has an antimicrobial property that kills the odor-causing bacteria. Lemon juice also helps in keeping the mouth hydrated.

Coffee without milk and cream is very helpful in tackling foul-smelling breath.

Green tea is rich in polyphenols and antioxidants which help in reducing sulfur content in the mouth and also keeps the mouth hydrated.

Ginger: Chewing this spice helps in breaking down foul-smelling substances in the mouth. Ajwain (carom seeds): These seeds help in fighting tooth decay and foul smell.

Cumin seeds: It is useful in keeping the mouth clean and aids in fresh breath. One can also prepare mouthwash with Peppermint and tea tree oil and use it to eliminate bad breath. Also, saltwater mouthwash can be of big help.

Neem: The therapeutic and anti-bacterial properties of neem kills the harmful bacteria in the mouth.

Cleaning the tongue: Cleaning the tongue regularly is important in fighting halitosis. Also, one should take whole grains like brown rice, dark green vegetables and a variety of fruits.

Prevention
Mouthwash - Over the counter mouthwashes can help kill bacteria or neutralize and temporarily mask bad breath. It's only a temporary solution, however. The longer you wait to brush and floss away food in your mouth, the more likely your breath will offend.

Clean Your Dentures
If you wear removable dentures, take them out at night, and clean them thoroughly before using them again the next morning.

Keep That Saliva Flowing -To get more saliva moving in your mouth, try eating healthy foods that require a lot of chewing, like carrots or apples. You can also try chewing sugar-free gum or sucking on sugar-free candies. Your dentist may also recommend artificial saliva antibacterial agents such as chlorhexidine, zinc, triclosan, and cetylpyridinium chloride are recommended for usage. These have different mechanisms of action. Although chlorhexidine is undoubtedly the best for inhibition of the production of VSCs, it may have an unpleasant side effect of the unsightly staining of teeth

Quit Smoking
Giving up this dangerous habit is good for your body in many ways. Not only will you have better breath, you'll have a better quality of life.

Visit Your Dentist Regularly
If you're concerned about what's causing your bad breath, make an appointment to dentist. Regular checkups allow your dentist to detect any problems such as gum disease or dry mouth and stop them before they become more serious. If your dentist determines your mouth is healthy, you may be referred to your primary care doctor.

Patient Education
It is important to educate the patient about the need for good dental hygiene. While most people would associate bad dental hygiene and resulting halitosis with toothaches and unsightly stains, a major deterrent would be to emphasize the links between bad oral hygiene and serious medical issues like cardiovascular diseases, including myocardial infarction, stroke, or endocarditis which are precipitated by periodontitis, or periodontitis.

CONCLUSION

Lots of studies show that due to the COVID-19 pandemic, the use of face masks has increased, resulting in potential health-related side-effects. The effect of wearing face masks causes dry mouth and halitosis, Still more evidence is required to confirm this study. WHO is committed to ensuring promotion of oral health and quality, essential treatment for oral health conditions for all people in all countries without individual financial hardship. An empathetic approach by the clinician is of prime importance in handling a patient with halitosis. It would be helpful if one involved a nutritionist and psychologist in the treatment protocol to prevent recurrences and to keep halitosis at bay forever.

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APPENDIX

TABLE 1
Demographic details and clinical variables in total participants

	Group I (right-handed)	*Group II (left-handed)*	*p value (Group I vs Group II)*
VSC score – *n*			
Male			
<125 ppb	513	26	–
125 ppb <	141	40	–
Female			
<125 ppb	628	42	–
125 ppb <	100	20	–
Age			
Male	32.6 ± 3.7	31.3 ± 4.8	*ns*
Female	29.8 ± 3.2	29.1 ± 3.9	*ns*
Total	30.6 ± 3.5	30.4 ± 4.1	*ns*
Daily tooth brushing (Sessions per day)			
Male	0.87 ± 0.68	1.02 ± 0.78	*ns*
Female	1.21 ± 0.82	1.29 ± 0.91	*ns*
Total	1.04 ± 0.69	1.16 ± 0.73	*ns*
Daily tongue brushing (Sessions per day)			
Male	0.04 ± 0.01	0.05 ± 0.02	*ns*
Female	0.12 ± 0.08	0.16 ± 0.09	*ns*
Total	0.08 ± 0.03	0.10 ± 0.07	*ns*
Plaque index			
Male	1.78 ± 0.54^{a}	1.32 ± 0.29^{b}	<.01*
Female	1.08 ± 0.32^{c}	0.74 ± 0.11^{d}	<.01*
Tongue surface index			
Male	1.62 ± 0.33^{a}	1.23 ± 0.18^{b}	<.01*
Female	1.01 ± 0.16^{c}	0.89 ± 0.13^{d}	<.01*

ns = not statistically significant.
*Statistically significant differences within the groups ($p < .01$).

TABLE 2
Differences between men and women according to oral hygiene practices and clinical oral conditions

	Male	*Female*	*p value (male vs female)*
Daily tooth brushing	0.97 ± 0.70^{x}	1.25 ± 0.86^{y}	<.01
Daily tongue brushing	0.04 ± 0.01^{x}	0.14 ± 0.06^{y}	<.01
Plaque index	1.41 ± 0.37^{x}	0.93 ± 0.14^{y}	<.01
Tongue surface index	1.57 ± 0.26^{x}	0.89 ± 0.16^{y}	<.01

[x,y]Statistically significant differences within the groups ($p < .01$).

TABLE 3
Relationship between VSC scores and oral hygiene procedures (daily tooth and tongue brushing activity) and tongue surface

	VSC scores	*PI*	*TSI*
Tooth brushing	−419**	−815**	–
Tongue brushing	−709**	–	−827**
TSI	783**	–	–
PI	589**	–	–

**Correlation is significant at the .01 level (Spearman rank correlation). PI = Plaque index; TSI = Tongue surface index.

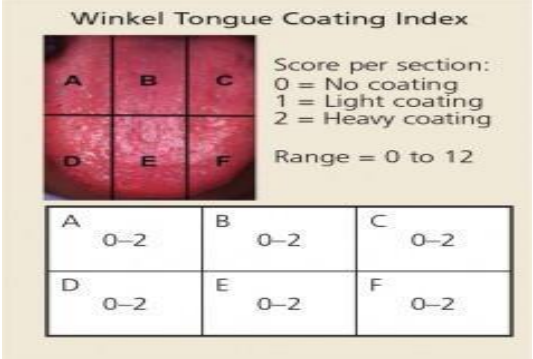

TABLE 1. Categories of Oral Malodor

Temporary Breath Malodor
Smoking
Diet (garlic, spicy foods, dairy)
Intraoral Malodor
Oral bacteria
• Chronic gingivitis
• Periodontitis
• Tongue coating
Acute Infections
• Abscess
• Necrotizing ulcerative periodontitis
• Pericoronitis
Dry mouth
• Sjögren's syndrome
• Medications
Extraoral Malodor
Nasal, paranasal, or laryngeal origins
• Acute viral or bacterial infection, tonsillitis, deep tonsillar crypts, tonsilloliths, chronic sinusitis, postnasal drip, foreign body in nasal cavity or sinus
Pulmonary tract or upper gastrointestinal tract origins
• Bronchi and lungs: chronic bronchitis, bronchial carcinoma, bronchiectasis
• Gastrointestinal: regurgitation, hiatus hernia, *Helicobacter pylori* infection, achalasia, steatorrhea, and other malabsorption conditions
Bloodborne and emitted via the lungs
• Liver cirrhosis
• Kidney insufficiency
• Systemic metabolic disorders, including diabetes, trimethylaminuria and starvation
• Internal bleeding
• Menstrual cycle
Pseudohalitosis
Oral malodor does not exist, but the patient believes he or she has halitosis
Halitophobia
After treatment for genuine breath malodor or pseudohalitosis, the patient continues to believe he or she has breath malodor

TABLE 2.
Volatile Contributors To Oral Malodor

Volatile Sulfur Compounds
Methylmercaptan
Hydrogen sulfide
Dimethyl sulfide
Diamines
Putrascine
Cadaverine
Short chain fatty acids
Butyric acid
Proprionic acid
Phenol Compounds
Indole
Skatole
Pyridine