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Review Article

Halitosis- Literature Review

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Abstract

Breath malodour is a condition that has health and social implications. The origin of breath malodour problems is related to tooth systemic and oral conditions. The advice of dental professionals for the treatment of this condition occurs with regularity since 90% of breath odour problems emanate from the oral cavity. This article reveals a review of aetiology of breath odour and its prevalence diagnosis and treatment strategies for oral malodour.

Keywords: Breath Malodour; Oral Malodour; Halitosis; Oral Halitosis; High Volatile Compounds; Halimeter; Organoleptic; Pseudo Halitosis; Halitophobia

Introduction

The definition of bad breath is not a bad smell, except that it is a foul or unpleasant odor emanating from the oral cavity [1]. It is one of the most common complaints that patients present to the dentist, after tooth decay and other diseases [2]. Fetor ex-ore, fetor oris, oral malodor, and bad breath all refer to unpleasant odors in the air of the expiration [3]. The patient generally cannot identify his/her halitosis, which is identified by his/her partner, family member, or friends. Another way could be pathways between inhaled and exhaled air diverge because the exhaled air from the mouth travels horizontally, whereas the air breathed is travels primarily vertically, there is a lowered chance of detecting the smell from the exhaled air [4]. Our reluctance to notify even those close to us that they suffer from this condition serves to further exacerbate the situation. Therefore, many people suffer from bad breath throughout their lives, without even realizing it yet [5]. The social and psychological effects of bad breath are widely considered, but they are of great concern to those affected.

Studies have shown that personal discomfort and social embarrassment were the main concerns for individuals affected by halitosis and also the primary reason why patients sought professional assistance [6,7]. Scientific research on the smell of unpleasant odors in the mouth is not sufficient to help it. It is still one of the major deprivations, but it is completely underestimated. The reasons for the inconsistency of scientific data are the difference in cultural and ethnic assessment of the smells between patients and researchers, and there is an absence of uniformity in evaluating methods, whether in relation to sensory or mechanical measurements [8]. Moreover, there are no universally accepted standard criteria, objective or subjective, that define a halitosis patient. There are few studies confirming the prevalence of halitosis in residential or community samples.

Prevalence of halitosis

The prevalence of halitosis differs across the globe due to variations in the perception of odors among people of different races and cultures, absence of uniformity in evaluation as well as a disparity between self-perceived and clinically detected halitosis reports [9,10,11]. A study of 962 patients was seen in the ENT Department, out of which a total of 65 children had complaints of halitosis. The prevalence of halitosis was common in the preschool age group (1-5years). Authors reported a gradual decrease in prevalence of halitosis with age and final peak at 16-18 years. The orodental factors were the least while naso pharyngeal and psychogenic was the most [12]. It has been reported that dental students exhibit a lower prevalence of halitosis than the general population [13]. Halitosis has been found to be greater intensity in older people [14]. However, a self-administered questionnaire in India indicated that female students had better oral hygiene practices which resulted in a lower proportion of self reported halitosis [15]. Sex ratio and age are among the factors in published studies, and there are many other factors such as oral hygiene habit and dental health, smoking, food, and medicine and health condition can also have an impact, The prevalence of halitosis has been reported up to 50% in the literature. There are different prevalence values due to differences in evaluation methods [16].

Classification

Halitosis can be either primary or secondary [17].

- Primary halitosis: Refers to respiration exhaled by the tongue.
- Secondary halitosis: Originates either in the mouth or upper airways.

The classification of halitosis generally includes genuine halitosis (physiologic and pathologic halitosis), pseudo-halitosis, and halitophobia [18]. Genuine halitosis is an obvious oral malodour, with intensity beyond a socially acceptable level. Physiologic halitosis is described as malodour that arises through putrefactive processes within the oral cavity, without any specific disease or pathologic condition. The origin of physiologic halitosis is mainly the posterior 1/3rd region of the tongue. Pathologic halitosis is subclassified into oral pathologic halitosis (caused by oral Problems) and extra-oral pathologic halitosis (e.g., originated from nasal, paranasal, laryngeal regions, pulmonary tract, and upper digestive tract). Pseudo-halitosis is a condition in which patients complain of oral malodor but it is not perceived by others. Usually, the condition is improved by counseling and simple oral hygiene measures. Halitophobia is the condition where patients persist in believing that they have halitosis even after the treatment, without any physical or social evidence suggesting the presence of halitosis.

Etiology

Halitosis is formed by volatile molecules which are caused because of pathological or nonpathological reasons, and it originates from an oral or an non-oral source which is mentioned in table1 [19,20] below

Categories	Compounds
Volatile sulphur compounds	Methyl mercaptan: CH3SH Hydrogen sulphide: H2S Dimethyl sulphide: (CH3)2S
Diamines	Putrescine: NH2(CH2)4 NH2 Cadaverine: NH2(CH2)5NH2 Butyric acid: CH3CH2CH2COOH Propionic acid: CH3CH2COOH Valeric acid: C5H10O2
Phenyl compounds	Indole: C8H7N Skatole: C9H9N Pyridine: C5H5N
Alcohols	1-propoxy 2-propanol
Alkalines	2-methyl-propane
Nitrogen-containing compounds	Urea: (NH2)2CO Ammonia: NH3
Ketones	

Table 1

Volatile sulfur compounds (VSCs) are mainly responsible for intra-oral halitosis. These compounds are mainly hydrogen sulfide and methyl mercaptan. They produce bacteria by enzymatic reactions of sulfur-containing amino acids which are L-cysteine and L-methionine [21]. In addition, some of the bacteria produce hydrogen sulfide (H2S), and methyl mercaptan (CH3SCH3) from serum. The bacteria which are the most active VSC producers are shown in table 2 [22].

Hydrogen sulfide from cysteine	mercaptan from methionine	Hydrogen sulfide from serum	Methyl Methyl mercaptan from serum
Peptosteptococcus anaerobius	Fusobacterium nucleatum	Prevotella intermedia	Treponema denticola
Microsprevotii Eubacteriumlimosum	Fusobacterium periodonticm	Prevotella loescheii	Porphyromonas gingivalis
Bacteroides spp.	Eubacterium species	Prophyromonas gingivalis	Porphyromonas endodontalis
Centipedia periodontii Selenomonas artermidis	Bacteroides species	Treponema denticola	

Table 2

Extra oral sources

The liver is one of the important extraoral sources of bad breath, with its chronic infection affecting approximately 400 million people around the world. The term fetor hepaticus, referring to a slightly sweet, musty, and fecal breath is directly correlated with hepatitis and liver failure. An important consideration of fetor hepaticus is the VSC (methyl mercaptan), and its association especially when combined with other factors such as periodontitis, xerostomia, and smoking [23]. Extra-oral halitosis caused by respiratory tract infections causing nasal or sinus secretions passing into the pharynx, gastrointestinal disease, and hematological or endocrine system disorders [24]. The main VSC associated with extra-oral halitosis is dimethyl sulphide whereas the main VSCs contributing to intra-oral halitosis are methyl mercaptan and hydrogen sulphide [22]. Metabolic diseases that can cause halitosis include diabetes, kidney failure, liver failure, trimethylaminuria, hypernatremia, and cystinosis [25]. Khozeimeh., *et al*. [26] compared the concentration of urea and uric acid in patients with halitosis and without halitosis and found that salivary urea and uric acid concentrations greater in halitosis group than the control group.

Intra oral sources

In oral cavity, temperatures may be reached up to 37°C (and changed between 34 and 37°C). During exhaling also humidity may be reached up to 96% in oral exhalations [27,28]. These conditions may provide a suitable environment for bacterial growth and

most of them are capable of producing odors compounds which can cause halitosis. These bacteria include Gr-negative species and proteolytic obligate anaerobes and they are mainly retained in tongue coating and periodontal pockets [29-31]. The association between halitosis and tongue coating is particularly strong in the region posterior to the circumvallate papillae, These surfaces have been shown to carry the highest load of the Gram-negative bacteria that contribute to oral malodour [32]. Other studies states that it was totally based on com [position not about how much area of spread [33]. For example, halitosis has been related simply to the presence of Porphyromonas gingivalis on the dorsum of the tongue, rather than the thickness of the coating [33]. In addition to the important role of Gram-negative bacteria in VSC production, the b-galactosidase of Grampositive bacteria is also considered to play a role, especially in tongue-coating-associated malodor [34]. A proposed microbiological link between halitosis and periodontal disease is through a property of the main microbially generated VSCs, whereby hydrogen sulphide and methyl mercaptan facilitate the penetration of lipopolysaccharide into the gingival epithelium, inducing inflammation [30]. It has also been suggested that saliva from patients who suffer from periodontal disease might produce increased amounts of VSCs [35]. A number of acute conditions can also cause oral malodor through the production of a characteristic fetor oris. Pericoronal infections, oral ulcerations, and acute necrotizing ulcerative gingivitis are such examples but intra-oral halitosis still mostly arises through the action of bacteria on the dorsum of the tongue and bacteria associated with periodontal disease [35]. There are also cases of temporary halitosis that lasts for only several hours. For example, the period after someone has eaten foods containing VSCs like garlic or fast food [6].

Halitosis diagnosis

Direct measurement techniques

Organoleptic measurement

Organoleptic measurement, which involves using the human nose to score the intensity of odors from the patient's mouth at varying distances, is considered the gold standard for halitosis measurement [15,19]. Testing should be undertaken in the morning before eating and hygiene procedures are performed to obtain the correct measurement [36]. The patient should also count aloud from 1 to 10 before measurement commences to promote drying of the palate and tongue mucosa and facilitate the release of VSCs [37]. In the most commonly used scoring system, the odor is classified between 0 and 5. (0: Odor cannot be detected. 1: Questionable malodor, barely detectable, 2: Slight malodor exceeds the threshold of malodor recognition. 3: Malodor is definitely detected, 4: Strong malodor, 5: Very strong malodor) [38].

Gas chromatography

The quantitative analysis of VSCs causing the odor (dimethyl sulfide, methyl mercaptan, and hydrogen sulfide gases) is performed by this method [39]. With this method, even low concentrations of gases can be measured separately and their quantities can be determined [40]. In this method, samples are analyzed by a detector, and mass spectra of existing compounds are compared and determined by a computer-based database. An automated aspiration system in gas chromatography has been developed to remove the differences caused by sampling or exhaling techniques [41], Although gas chromatography is an objective method; there are some disadvantages such as being expensive, having a non-transportable size and requiring specialist personnel to use it. High correlations were found between organoleptic measurement and gas chromatography in the studies performed [39].

Portable sulfide monitor

The sulfide monitor is a portable device that allows easy measurement of the VSCs found in the expiration air outside the laboratory environment. The device was developed over time and presented to the market under the name of 'Halimeter' (Interscan Corp., Chatsworth, CA, USA). With this method, the measurement is made as follows: The patient keeps his mouth closed for 5 minutes. Then, the patient inserts a single-use tube connected to the sulfide monitor into his mouth while breathing from the nose. The electrochemical reaction that takes place in the compounds containing sulfur in the breath brings the electric current in proportion to the levels of the compounds [42].

Indirect Measurement Techniques

BANA (Benzoyl-DL-arginine- α-Naphthylamide) Test

Proteolytic gram-negative anaerobic bacteria and short-chain volatile fatty acids, colonized in the subgingival plaque and the dorsum of the tongue, turn into a colored compound in the presence of the reducing enzyme, BANA, the synthetic trypsin substrate, and can be detected [43]. It is especially important to identify 3 major bacteria such as Treponema denticola, Porphyromonas gingivalis, and Tannerella forsythia, When these proteolytic bacteria are treated with a synthetic trypsin substrate BANA, the arginine hydrolase enzyme which is a colored compound is released. Thus, the presence of bacteria is proved. This test can easily be done with a 5-10 minutes period (BANA Test, Ora Tec, Manassas, VA/USA) [43].

Quantifying beta-galactosidase activity

beta-galactosidase enzyme levels found to correlate with oral malodor. The first step in the formation of halitosis is the glycosylation of glycoproteins. The activity of β-galactosidase, the most important enzyme of deglycosylation, can be assessed by impregnating the chromogenic substrate onto chromatography paper. When saliva flows in the paper disc, a color change is detected on the paper according to the amount of enzymatic activity [36].

Salivary Incubation Test:

In this method, the saliva is collected in a glass tube and incubated at 37 °C; for several hours in an anaerobic medium containing 80% nitrogen, 10% carbon dioxide, and 10% hydrogen. Then

the odor is evaluated by the researcher. Saliva incubation test is less affected by external factors such as scented food eaten, fragrant cosmetic use, and cigarette consumption than by organoleptic measurements [36].

Ammonia Monitoring

It is a method based on the detection of ammonia released by oral bacteria which causes halitosis. The device consists of a pump that draws the expiratory air into the ammonia gas detector and a disposable tube that is inserted into the patient's mouth. In this method, the patients rinse their mouths with urea and then blow into the tube and the amount of ammonia is read by the gas detectors. The ammonia concentration produced by the bacteria can be read directly from the scale [44].

Ninhydrin method

Ninhydrin method based on the detection of low molecular weight amines and polyamines that cannot be detected using the sulfur monitor. With this method, isopropanol is mixed with the sample taken from the patient and centrifuged and then read according to its light permeability using a spectrometer. Ninhydrin calorimetric reaction is fast, easy to apply, and inexpensive [36].

Polymerase chain reaction (PCR)

Polymerase Chain Reaction (PCR) is rapid, sensitive and specific diagnostic technique which was introduced in recent years. With using PCR, quantitative analysis of the microorganisms causing VSCs from oral specimens such as saliva, tongue coating, and subgingival plaque can be performed. Qualitative analysis methods are unsuitable for the accurate evaluation of bacteria causing oral malodor [45].

Treatment of halitosis

First, the etiology must be correctly diagnosed. This includes a thorough medical history complete with dietary analysis and identification of personal habits [46]. The available methods can be divided into mechanical reduction of microorganisms, chemical reduction of microorganisms, usage of masking products, and chemical neutralization of VSC [46]. The available methods can be divided into mechanical reduction of microorganisms, chemical reduction of microorganisms, usage of masking products, and chemical neutralization of VSC [47]. The authors have designed an investigative protocol for the diagnosis of oral malodor that can be used in clinical practice and is of significance to family healthcare practitioners' figure 1.

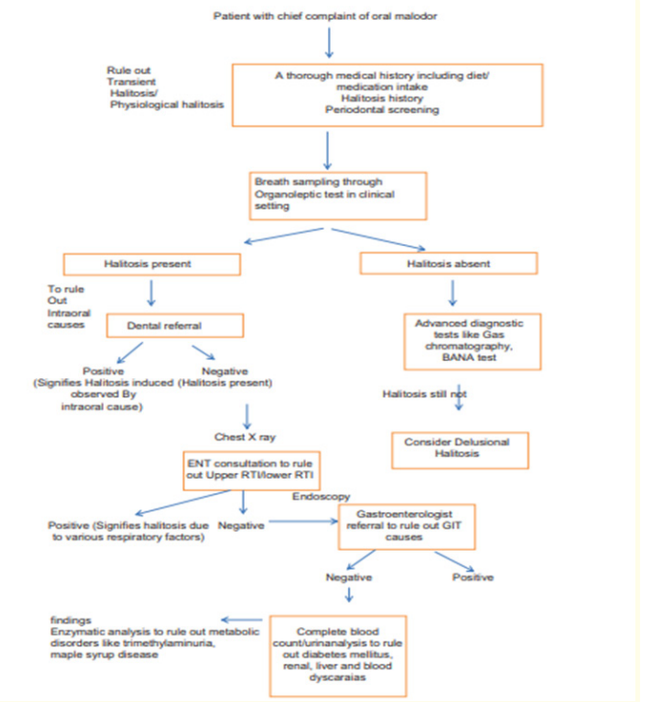

Figure 1: An Investigative Protocol Workup in A Clinical Setting for A Patient Who Presents to Primary Care Practitioner.

Good oral hygiene is another important issue for oral-caused halitosis. Proper brush, dental floss, and inter-dental brush usage are very important in the management of halitosis. However, even if the periodontal health is perfect, tongue coating can be an important source of halitosis. The tongue dorsum can be a shelter for these bacteria. If a patient has a geographic or fissured tongue, the coating will be more. Due to these reasons, cleaning of tongue dorsum by brushing, tongue scraper or tongue cleaner is important. Mechanical removal of the tongue coating can reduce VSCs concentration by 52% in the mouth air of a periodontally healthy individual [48]. Existing and necessary restorative conditions of a patient must be reviewed. Unsuitable prosthetics and conservative restorations, such as causing food impactions, food retention, create a reservoir area for bacteria. Replacement of old restorations with proper restoration provides prevention of these reservoir areas. Also existing of non-treated cavity of decayed teeth, nonvital teeth with fistula or exposed tooth pulps may create a reservoir area for bacteria, so treatments of these teeth with proper restoration are important. The other conditions that cause halitosis such as xerostomia, oral ulceration, or malignancy which must be diagnosed and treated well, require transfer of the patient to a specialized center and collaboration with the experts. According to a Cochrane review, tongue brushing in any form only conveys relief from halitosis for a period of up to 30 min, with no significant long-term effects [49]. In fact, there is little evidence for the long-term efficacy of any halitosis treatment method, although tongue brushing does appear to be the best option at the present time. Peppermint mouth rinses are safe formulation to use at home and have been shown to be successful in improving halitosis measures over a 1-week observation period [50,51]. Chlorhexidine and cetylpyridinium chloride are both compounds effective in reducing halitosis. A Cochrane review has found that mouthwashes with formulations of both compounds attained the best results in reducing the concentrations of VSCs found in expelled air and salivary bacte-

rial counts [52]. Triclosan, which is present in some toothpastes is another compound shown to have broad-spectrum effects on Gram-negative bacteria. Its effects on both soft and hard tissues are known to last up to 12 h from the time of application [53]. The use of probiotics has also been shown to reduce the counts of bacteria that lead to caries and periodontal disease. For example, daily consumption of tablets containing probiotic Lactobacillus salivarius WB21 was shown to help in controlling oral malodor [54]. In another study, the consumption of two tablets per day of probiotic Streptococcus salivarius M18 for 1 month by patients wearing orthodontic brackets decreased VSC levels at the 3-month follow-up significantly [55]. Odour masking agents like generic rinsing products, flavoured toothpastes and mint tablets from the supermarket have also shown promise in reducing halitosis symptoms but only have a very restricted short-term effect [56]. Patients with oral malodour but showing no oral cause of halitosis (e.g., periodontal disease, abnormal tongue coating and poor oral health) are usually classified as having extra-oral halitosis, and they should be referred to medical specialists. Patients with pseudo-halitosis need to be counselled, with an explanation of the examination results. Overall, there are many home treatment measures available to fight halitosis but professional advice should always be consulted to avoid misdiagnosis and unwanted side effects.

Conclusion

Halitosis is an extremely unappealing characteristic of sociocultural interactions and may have longterm detrimental aftereffects on psychosocial relationships. It is significant to highlight the necessity of an interdisciplinary method for the treatment of halitosis to prevent misdiagnosis or unnecessary treatment. It is important for health care professionals, including general physicians and dental professionals, to understand its aetiology and risk factors in order to diagnose and treat patients appropriately.

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