An intra-oral infection Halitosis and its Causes, Diagnosis, and Treatment Strategies – A Systematic Review

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Abstract

Halitosis, commonly known as foul breath, affects a substantial portion of the population and often goes unaddressed for an extended period before individuals seek help from specialized clinics. This condition can have significant social and psychological implications. While halitosis can stem from various underlying causes, the oral cavity is responsible for the majority of cases (about 90%). Factors such as bacterial buildup on the tongue and inflammation of the gums or surrounding tissues contribute significantly to oral halitosis. Dentists frequently encounter patients with halitosis in their practice and must possess effective strategies to manage it. Utilizing established methodologies, dentists can achieve considerable therapeutic efficacy. Despite the prevalence of halitosis, many individuals endure its effects for prolonged periods before seeking assistance from dedicated clinics. The literature provides numerous recognized methods for diagnosing and treating halitosis, and this article comprehensively explores these aspects.

Significance | Halitosis, a prevalent issue, often remains untreated, causing social discomfort. Oral causes, especially bacterial buildup, necessitate effective dental management strategies.

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Introduction

Halitosis is a common problem that affects a large number of people. Due to increased media coverage in recent years, halitosis has gained attention and awareness among both patients and dentists. Nevertheless, it continues to be a subject that is regarded as socially inappropriate or prohibited to talk about. Quirynen et al. (2009) found that the mouth is typically the primary source of halitosis. Therefore, it is recommended to seek the advice of a dentist as the first step. Before seeking professional help at a halitosis clinic, the majority of patients try to treat halitosis on their own (Zürcher and Filippi, 2012). Chewing gum, candies, and mouth rinse are the most often used products for treating bad breath. However, it is well accepted that these methods only offer temporary relief by hiding the symptoms of bad breath, and hence they cannot solve the root issue (Quirynen et al., 2002).

More than half of the patients at the halitosis clinic have already sought therapy from one or multiple general practitioners or medical specialists. Patients often suffer from a long-lasting period of bad breath, which causes considerable social and psychological discomfort (Zürcher and Filippi, 2012). This review comprehensively analyzes the diagnosis, frequency, and contemporary therapies for oral halitosis. Both genders experience distress in similar amounts; however, women tend to promptly seek professional help more often than men (Rosenberg et al., 1991). Miyazaki's research revealed a distinct association between age and

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oral malodor: as individuals grow older, the intensity of the smell increases (Miyazaki et al., 1995).

Approximately 90% of individuals with halitosis have oral odors. The scents typically arise from bacteria located below the gumline and on the posterior region of the tongue (Zalewska et al., 2012). Other ailments, such as abnormalities in the nose, sinuses, throat, lungs, esophagus, stomach, or other regions of the body, account for the remaining 10% of the total (Bollen and Beikler, 2012). Halitosis, considered a social stigma, often results in psychological or social problems such as anxiety, depression, diminished self-worth, and other mood disorders. The diagnosis of halitosis entails using subjective techniques, such as the examiner's olfactory perception, and objective methodologies, such as the analysis of specific chemical compounds in the breath using tools. The utilization of a direct and personal evaluation is regarded as the pinnacle of clinical treatment. It is crucial to determine the exact cause while addressing pathological halitosis. It usually takes a team effort to find and treat the root cause of halitosis that doesn't go away even after all oral problems have been treated or eliminated (Zalewska et al., 2012).

The tongue's uneven dorsum, which has a surface area of 25 cm2, offers an ideal environment for oral bacteria to thrive (Collins and Dawes, 1987). Putrefaction occurs due to the presence of shedding epithelial cells and leftover meals. Thus, the tongue's surface plays a crucial role in the colonization of bacteria on the tooth surfaces (Faveri et al., 2006). Poor oral hygiene, the presence of dental plaque, tooth decay, the accumulation and breakdown of food particles, and inadequate cleaning or care of acrylic dentures (especially those worn overnight or with rough surfaces) all contribute to the occurrence of unpleasant odors (de Souza et al., 2009). Tooth decay happens in the mouth when sulfur-containing amino acids in food and saliva are broken down by Gram-negative bacteria that do well in places with little oxygen (Bollen and Beikler, 2012).

Halitosis, originating from the Latin term "halitus," which means breath or vapor, is the presence of a noxious and disagreeable smell coming from the breath, independent of its root cause. The terms halitosis, foetor ex ore, foul breath, breath odor, offensive breath, and oral malodor are used interchangeably in the scientific literature (Scully et al., 1997; Goldberg et al., 1994; McDowell and Kassebaum, 1993; Tessier and Kulkarniare, 1991). The worldwide consensus committee recommends using the term 'halitosis' and differentiating between intra-oral halitosis and extra-oral halitosis. According to Seemann et al. (2014), this definition covers all instances of genuine halitosis. Authentic halitosis refers to a noticeable, unpleasant breath that exceeds the socially acceptable level. Intraoral halitosis refers to bad breath that originates within the mouth, while extra-oral halitosis refers to bad breath that arises outside of the mouth (Seemann et al., 2014).

The diagnosis of psychogenic halitosis, together with real halitosis, can be determined (Yaegaki and Coil, 2000). Despite acquiring substantial knowledge and education, individuals with halitophobia persist in holding the assumption that they have terrible breath. Momentary or transient halitosis is the condition of having unpleasant breath from eating specific foods like garlic and onions (Seemann et al., 2014). Based on the International Classification of Intraoral Halitosis by Yaegaki and Coil (2000), Coil et al. (2002), and Miyazaki et al. (1999), this classification has been slightly simplified.

1.1 Bacterial infection and relationship of malodor

A typical oral cavity harbors around 600 identified types of microorganisms. The odors mostly originate from the breakdown of proteins into individual amino acids, which are subsequently further degraded to produce identifiable unpleasant gases. Other chemicals involved in this bacterial degradation process include diamines such as indole and skatole and polyamines like cadaverine and putrescine. Their role in causing bad breath seems to have decreased in importance. The creation of skatole and indole primarily relies on the utilization of tryptophan, whereas the production of putrescine and cadaverine is reliant on the utilization of lysine and ornithine (Bollen and Beikler, 2012). The main bacteria responsible for causing bad breath are associated with periodontitis. Calil et al. (2009) established a causal relationship between halitosis and periodontitis. There may be a link between the microbial makeup in the mouth and excessive bacterial growth in the stomach and/or upper intestine, especially in people with gastroesophageal reflux disease (GERD). There is a well-established connection between a long-term reduction of stomach acid, an elevated likelihood of bacterial growth, and a greater presence of microorganisms commonly found in feces (Sandeanu et al., 2001). Proton pump inhibitors (PPIs) are widely utilized medications worldwide and are the most potent inhibitors of stomach acid production currently available. Long-term usage of acid-suppressant medications heightens the probability of Helicobacter pylori infection in patients. Infection of the stomach mucosa by H. pylori can result in the formation of peptic ulcers. Research conducted by Werdmuller et al. (2000) and Moshkowitz et al. (2007) has not found any definitive connection between these ulcers and halitosis. In laboratory studies, H. pylori has been observed to generate a significant quantity of volatile sulfur compounds (VSC) (Hoshi et al., 2002). Moreover, there is compelling data indicating the presence of H. pylori in people suffering from periodontitis. This implies that the progression of periodontal pockets and inflammation can produce favorable circumstances for the colonization of H. pylori. It is also thought that an H. pylori infection may be connected to developing oral pathological halitosis after periodontitis (Suzuki et al., 2008).

1.2 Intra-Oral Causes

Several research articles have shown that the oral cavity is the main source of bad breath in 85–90% of those with halitosis. In the mouth, high humidity and temperatures of up to 37 °C help bacteria grow and make it easier for them to break down L-cysteine and L-methionine, which are sulfur-containing amino acids, to make hydrogen sulfide and methyl mercaptan (Lopes et al., 2014; Loesche and Kazor, 2002). Proteins from dead human epithelial cells and white blood cells break down into sulfur-containing and non-sulfur-containing amino acids. These are the main things that cause bad breath. Amino acids are found in plaque, saliva, blood, and the lingual epithelium. The subgingival periodontal biofilm is mainly composed of gram-negative anaerobic bacteria that have the capacity to break down proteins. Some species can break down sulfur-containing compounds on different surfaces in the mouth, like periodontal pockets. This mechanism leads to the release of volatile sulfur compounds (VSCs). An empirical study has demonstrated that volatile sulfur compounds (VSCs) significantly impact the occurrence of halitosis. Hydrogen sulfide, methyl mercaptan, and, to a lesser degree, dimethyl sulfide make up 90% of the volatile sulfur compounds (VSC) responsible for causing bad breath (Bornstein et al., 2009; Setia et al., 2014). The breakdown of proteins obtained from deceased human epithelial cells and white blood cells produces sulfur-containing amino acids and non-sulfur-containing amino acids. The primary culprits behind malodorous breath are predominantly these amino acids. Amino acids are found in plaque, saliva, blood, and the lingual epithelium. The subgingival periodontal biofilm consists mainly of gram-negative anaerobic bacteria that can break down proteins.

1.2.1 **Odontogenic Halitosis**

The main factors contributing to odontogenic halitosis include inadequate oral hygiene, the accumulation of plaque, dental caries, food impaction, and inadequate maintenance of acrylic dentures, which are not regularly cleaned or have rough surfaces. The dentist should proactively identify these causes and thereafter offer the appropriate treatment for each issue.

1.2.2 Tongue Coating

The upper surface of the tongue has been identified as the main area where microorganisms decompose and generate volatile sulfur compounds (VSC), which are the main source of unpleasant breath within the mouth. The dorsal surface of the tongue features a complex array of tiny projections called papillae, which aid in the accumulation of microorganisms. Microorganisms, specifically Veillonella and Actinomyces, notably the Gram-negative and proteolytic nitrate-producing anaerobes, have the ability to produce foul-smelling chemicals from residual food and waste from epithelial cells. There is a belief that multiple bacterial species engage in interactions with each other on the tongue's surface rather than a small number of dominant species. It is hypothesized that these interactions have a role in the formation of bad breath. Kojima devised the score-based classification system for evaluating tongue coating. A direct correlation exists between halitosis and the existence of a bacterial coating on the surface of the tongue. A strong link exists between bad breath and the presence of Gram-negative bacteria, especially in the area below the circumvallate papillae, where there are a lot of these bacteria (Bicak, 2018). The strategies for maintaining oral hygiene are the least efficient in accessing this specific area, leading to the maximum accumulation of bacteria in this region. Removing the tongue's protective layer is a difficult task. Engaging in daily tongue scraping or brushing aids in reducing the accumulation of decay-causing substances, the number of bacteria, and the capacity to perceive flavor. Various factors in the vicinity can lead to an increase in the levels of VSC (volatile sulfur compound) precursors such as cystine and methionine. These elements include the saliva's pH level, the amount of oxygen in the air, the level of bacterial activity, and the presence of substances that bacteria can use for their metabolic processes. The production and release of these volatile molecules result in the eventual detection of these unpleasant compounds in the mouth. Salivary secretion is diminished, resulting in the accumulation of stagnant saliva. The availability of carbohydrates for bacterial consumption has diminished. Furthermore, the pH level in the mouth becomes more alkaline, which is the main cause of the unpleasant odor. These elements contribute to a conducive environment for the shift from gram-positive to gram-negative bacteria (Khaira et al., 2008).

1.2.3 **Periodontal Disease**

Gingivitis and periodontitis are the primary oral inflammatory conditions frequently leading to halitosis. Releasing a particularly noticeable, unpleasant, or foul odor distinguishes these conditions. Necrotizing gingivitis or periodontitis causes foul odors. Individuals with active periodontitis exhibit a markedly increased occurrence of impaired epithelial cells, leukocytes, and bacteria in their saliva compared to individuals without the disease. Multiple studies offer compelling evidence of a clear and direct correlation between periodontal disease and halitosis. Additional research further confirms a strong association between the depth of the pockets and the presence of sulfur compounds (Yaegaki and Sanada, 1992). The proposed microbiological link between halitosis and periodontal disease is based on three fundamental assumptions: Periodontal patients exhibit a greater occurrence of bacteria within the mouth (such as bacterial plaque and tongue coating) and a reduced pH level. This lower pH level is essential for breaking amino acids and producing volatile sulfur compounds (VSCs).

Microorganisms make volatile sulfur compounds (VSCs), mainly hydrogen sulfide and methyl mercaptan. These VSCs help lipopolysaccharides get into the gingival epithelium, which causes inflammation.

Volatile sulfur compounds (VSCs) facilitate bacterial infiltration into connective tissue through their cytotoxic impact on epithelial cells, whereas methyl mercaptan inhibits the growth and proliferation of epithelial cells.

The widening of the periodontal pocket increases this mechanism by causing acidification and oxygen depletion. The reduction in pH is crucial for breaking the amino acids that generate volatile sulfur compounds (VSCs). However, several studies have not demonstrated a correlation between periodontal disease and halitosis. This is because the periodontal pocket, which is a closed space, does not play a major role in releasing foul-smelling gases that can spread into the mouth (Hughes and McNab, 2008).

1.2.4 Oral Candidiasis

People who receive prolonged courses of antibiotics or corticosteroids, as well as those with weakened immune systems due to HIV, diabetes mellitus, or ongoing chemotherapy or radiotherapy, are at risk of developing fungal infections in their mouth. Oral candidiasis is a common infection that causes many clinical manifestations in the oral mucosa. Oral candidiasis is mostly diagnosed by evaluating clinical symptoms, such as the findings from a physical examination and the patient's medical history. Additional diagnostic tests can be employed to validate the diagnosis, particularly in cases where the clinical examination is inconclusive or the patient does not show improvement with antifungal treatment. Confirmation of the diagnosis can be achieved by doing exfoliative cytology to obtain a smear. Candida infections emit a unique, pleasant aroma reminiscent of sweet, fruity scents. Antifungal drugs, such as nystatin, topical ketoconazole, clotrimazole, and miconazole, have been proven to effectively treat and remove halitosis (Rosenberg, 1990).

1.2.3 Oral Cancer

Primary oral tumors, whether they are cancerous or not, create an environment that promotes more decay and the production of volatile sulfur compounds (VSCs). This is because there is a lot of necrotic tissue, blood leakage, opportunistic infections, and food waste. Cancer patients undergoing therapy are highly susceptible to tissue damage, many infections, and bleeding. Several factors contribute to the growth of anaerobic bacteria and the release of foul-smelling gases (Karban et al., 2016).

1.2.4 Other Oral Sources

Additional factors contributing to halitosis within the oral cavity include necrotic teeth, exposed dental pulps, healing wounds, oral inflammation, abnormal oral growths, post-extraction wounds with blood clots or pus, dental overcrowding leading to food entrapment, and the presence of braces or other orthodontic appliances. Furthermore, herpetic gingivitis, peri-implantitis, pericoronitis, and recurrent oral ulcerations are all factors that might cause poor smell. These variables play a crucial role in developing a website that stores and displays food, sometimes called plaque. This plaque facilitates the enzymatic degradation of amino acids, resulting in malodorous breath, commonly known as halitosis. Oral malodor can be caused by acute clinical diseases such as pericoronal infections, oral ulcerations, and necrotizing ulcerative gingivitis. This leads to a detectable and unpleasant odor in the mouth. Transient halitosis, which is short-lived, can be attributed to consuming foods that contain volatile sulfur compounds (VSCs), such as garlic or fast food. Conversely, ingesting a diet rich in fiber, including vegetables, fruit, and green tea, expedites gastric emptying. Over time, there is a gradual decrease in the amounts of volatile sulfur compounds (VSCs) (Rosenberg, 1990).

2. **Measurement of halitosis**

Various techniques exist for quantifying halitosis. Organoleptic measurement, which relies on the human sense of smell to assess the strength of odors coming from the patient's mouth at different distances, is widely regarded as the most accurate method for measuring halitosis (bad breath) (Nakano et al., 2002). (Setia et al., 2014). It is recommended to conduct testing in the morning, prior to eating and doing hygiene procedures, in order to achieve an accurate measurement of the condition (Van der et al., 2007). Prior to the measurement, it is recommended for the patient to audibly count from 1 to 10. This will help in drying the palate and tongue mucosa and aid in the release of volatile sulfur compounds (VSCs) (Kapoor et al., 2016). Employing a panel of judges is also suggested to enhance the dependability of the outcomes; however, this may lead to higher expenses for the test and pose challenges in a practical environment. The primary deterrent for the utilization of this method is the unattractive measurement technique for the examiner(s) and the socially awkward posture in which the patient is situated. Additionally, it is necessary for the patient to refrain from ingesting any strongly scented meals or liquids for a period of 48 hours before the assessment. This precaution is important to assure the accuracy of the data obtained using the organoleptic score method (Yaegaki and Coil, 2000). An electrochemical meter or gas chromatography can be used to acquire objective measures of halitosis. The Halimeter (Interscan Corp., Chatsworth, LA, USA) and BreathtronTM (New Cosmos Electric, Osaka, Japan) are electrochemical meters that directly quantify the concentration of volatile sulfur compounds (VSCs) in breath samples (Setia et al., 2014). The halimeter has been shown to have a sensitivity of 92.2% and a specificity of 91.7% (Bolepalli et al., 2015). An electrochemical process involving sulfur-containing substances produces an electric current that is directly proportional to the concentration of volatile sulfur compounds (VSCs). The use of these portable sulfide monitors is widespread in clinical procedures due to their convenient ability to generate a quantitative estimate of VSCs chairside (Rosenberg et al., 1991). However, it is important to highlight that this approach to monitoring sulfides has a significant drawback in its inability to reliably quantify dimethyl sulfide (Van der et al., 2007).

Furthermore, the existence of substances such as alcohols, phenyl compounds, and polyamines can disrupt measurements (Armstrong et al., 2010). In recent times, there has been an emergence of portable gas chromatographs such as the OralChromaTM (Abilit Corporation, Osaka, Japan) and the Twin-BreasorTM (GC, Tokyo, Japan), which have proven to be comparable to regular GC machines (Yoneda et al., 2015). Chemical sensors are currently the most favorable alternative approach for both research and clinical reasons. These methods directly assess substances within the periodontal pockets and dorsum of the tongue. They have been shown to produce results that are highly similar to readings obtained from organoleptic analysis and gas chromatography measurements (Tanaka et al., 2004). Additionally, there are several indirect techniques for quantifying halitosis. An instance of this is the benzoyl-DL-arginine-naphthylamide (BANA) test, which involves a test strip that contains the synthetic trypsin substrate benzoyl-DL-arginine-2-naphthylamide. This allows for the identification of proteolytic obligatory Gram-negative anaerobic bacteria, such as Treponema denticola, Porphyromonas gingivalis, or Bacteroides forsythus. These bacteria release enzymes that break down the substrate and create a blue color (Aylikci et al., 2013). Test findings have shown a significant positive association with the activity of periodontal disease. Nevertheless, the precise function of the various bacterial kinds that are present cannot be completely ascertained (Armstrong et al., 2010). Salivary incubation is an alternative indirect technique for assessing halitosis. Saliva samples are placed in airtight containers and kept at a temperature of 37 °C. The air inside the containers is then examined for volatile sulfur compounds (VSCs) using either chemical detection or organoleptic scoring (Quirynen, et al., 2003). The method has been proven to yield highly precise findings when compared to the established organoleptic method, which is considered the gold standard (Quirynen, et al., 2009).

3. Treatment of halitosis

Halitosis is a notable medical issue that dentists should recognize and address in their regular practice. Prior to initiating treatment, it is essential to accurately identify the underlying cause of the condition by conducting a thorough clinical examination. This will enable the customization of an appropriate treatment plan for the patient. This involves a comprehensive examination of the patient's medical history, including a detailed investigation of their food and identification of personal habits, in order to ensure that any potential causes outside of the mouth are not overlooked (Armstrong et al., 2010). When dental problems are determined to be the primary cause of bad breath, proper treatment typically leads to complete resolution (Al-Ansari et al., 2006; Setia et al., 2014). Mechanical dental treatment techniques encompass scaling, root planing, and comprehensive oral hygiene instructions (Aylikci and Colak, 2013). It is important to repair any plaque and food traps, such as poor restorations or open cavitated lesions, as well as infections such as pericoronitis. Individualized therapy treatment strategies are essential for addressing halitosis, as there is no universal treatment available (Kapoor et al., 2016). An essential concern in the treatment planning of an individual suffering from halitosis centers around their dietary choices. According to Kapoor et al. (2016), it has been suggested to follow instructions for quitting smoking and to use toothpastes containing baking soda. A home care method widely endorsed in the literature is tongue brushing using specialized tongue scrapers (Han et al., 2014; Sukontapatipark et al., 2001). These tools are believed to be more efficient in decreasing the biofilm on the top surface of the tongue compared to basic toothbrush bristles. Nevertheless, a study utilizing a Halimeter showed that the results achieved by employing a tongue scraper were similar to those obtained by scrubbing the tongue with tongue cleansing devices located on the back of a toothbrush (Casemiro et al., 2008). Furthermore, there is ongoing discussion regarding the duration of the effects of tongue scraping. Based on a Cochrane review, tongue brushing in any manner provides temporary relief from halitosis for a maximum duration of 30 minutes, without any notable long-term effects (Outhouse, et al., 2006). Currently, there is limited evidence supporting the long-term effectiveness of any halitosis treatment procedure. However, tongue brushing seems to be the most favorable choice at the moment. The dentist might suggest various chemotherapeutic procedures in addition to mechanical therapy as part of the treatment. Peppermint mouth rinses are a safe and effective formulation that may be used at home to improve halitosis measures. Studies have shown that using peppermint mouth rinses for a week can lead to significant improvements in halitosis (Haghgoo et al., 2013; Hur et al., 2007). Research has demonstrated that the zinc element included in mouthwash is useful in lowering halitosis. It achieves this by preventing bacteria from breaking down proteins, reducing the generation of volatile sulfur compounds (VSC) (Winkel et al., 2003). Chlorhexidine is an effective antiseptic that can inhibit a broad range of microorganisms, prevent the buildup of plaque, and hence eliminate bad breath. The mechanism of action involves the penetration of the cell membrane of oral bacteria, resulting in cell leakage and disruption of bacterial metabolism, hence preventing cell development (Kim et al., 2008). Despite its effectiveness, this treatment does have some drawbacks, including the potential for altering taste perception. Prolonged use of this treatment can also lead to

temporary discoloration of teeth and mucosal surfaces, which can be reversed. A study conducted using a dog model demonstrated that cetylpyridinium chloride has the potential to be a successful means of managing plaque and calculus. However, it is important to exercise caution when interpreting these findings, as human tolerance to chemicals may vary from that of animals (Kim et al., 2008). Probiotics have demonstrated the ability to decrease the bacteria levels responsible for tooth decay and gum disease. A study conducted by Suzuki et al. in 2014 demonstrated that regularly taking tablets containing the probiotic Lactobacillus salivarius Halitosis WB21 can effectively manage oral malodor. Further research conducted by Benic et al. (2019) found that individuals who wore orthodontic brackets and took two tablets daily of the probiotic Streptococcus salivarius M18 for one month experienced a substantial drop in VSC levels at the 3-month follow-up. Although probiotic treatment has potential benefits, there is currently insufficient high-quality evidence to support its therapeutic effectiveness in humans or determine any long-term effects (Bosch et al., 2012; Burton et al., 2006). Odor-masking substances, such as generic rinse solutions, flavored toothpastes, and mint tablets from the supermarket, have demonstrated potential for lowering symptoms of halitosis. However, their effectiveness is limited and only lasts for a short period of time (Laleman et al., 2014). Patients with bad breath but no oral conditions that often cause halitosis, such as periodontal disease, atypical tongue coating, or poor oral health, are typically categorized as having extra-oral halitosis. These patients should be sent to medical professionals. Patients exhibiting pseudo-halitosis should get counseling, which includes a thorough explanation of the examination findings. In general, numerous home remedies may be used to combat halitosis. However, it is advisable to get expert guidance to prevent incorrect diagnoses and potential adverse reactions.

4. Discussion

A combination of internal and external factors contribute to oral malodor. Extrinsic factors encompass smoke, alcohol, and specific food items such as onions, garlic, and spices. Substances entering the circulatory system can be released as volatile odoriferous molecules in pulmonary air or saliva, obtained from foods. To effectively manage extrinsic sources of oral malodor, it is crucial to eliminate the consumption of substances that contribute to the foul smell. The reasons for poor breath can be categorized as either oral or systemic. According to Dowell and Kassebaum (1993), systemic factors typically account for 10% of these cases while mouth-related factors account for 90%. Despite extensive research on the microbiology of the human oral cavity, the composition of the oral microflora is still not fully understood. Most research has primarily examined cultivable microorganisms, which comprise only a small portion, ranging from 1 to 10 percent, of all microbial species (Al-Rassam and Shareef, 2006; Al-Ubaidy and Sharif, 2008). As a result, much research has exhibited a bias towards examining the factors that promote growth while neglecting those that hinder it. The non-cultivable species necessitate more advanced methods for isolation, such as the BANA assay and PCR process.

Nevertheless, there appears to be no correlation between halitosis and a particular bacterial infection. These findings indicate that halitosis results from intricate interactions among many types of oral bacteria. Bacterial interactions are mainly detected in the gingival fissures and periodontal pockets, although oral malodor can also come from the posterior dorsal tongue. This explains why people who maintain good oral hygiene may still feel oral malodor (Porter and Scully, 2006). The tongue plays a crucial role in the development of halitosis, but periodontal disease and other factors seem to contribute only to a certain extent to the overall problem. The papillary structure of the dorsum in the mouth functions as a unique ecological habitat, offering a large surface area that encourages the accumulation of oral debris and bacteria. Although the bacteria on the tongue are known to be a major contributor to foul breath in those with halitosis, the exact types of bacteria found on the tongue are not thoroughly comprehended. The intricate composition of the tongue's biofilm microbiota and its correlation with oral malodor remain uncertain (Cortelli et al., 2008). Given the absence of research measuring awareness of halitosis, it is reasonable to infer that other communities have greater awareness. Halitosis centers in those areas support this inference, while our society lacks such facilities.

Furthermore, the absence of prevalence studies in our community and the existence of such research in other communities may also reinforce the hypothesis of greater awareness of halitosis in those communities (Karban et al., 2016). A comprehensive, cross-sectional study demonstrated that smoking is a significant contributing factor to the occurrence of oral lesions. These lesions include precancerous and cancerous lesions and various other oral conditions such as leukoedema, lichen planus, smoker's palate, and smoker's melanosis (Sever et al., 2023).

5. Conclusions

Bad breath, also known as halitosis, is a common condition with many potential causes. It has a substantial impact on a person's social relationships and self-esteem. Halitosis, a malodorous breath condition, arises from various origins and harms individuals' social interactions and overall well-being. In order to diagnose and treat patients effectively, it is crucial for healthcare professionals, both general physicians and dental experts, to have a comprehensive understanding of the causes and risk factors of a certain condition.

The presence of biofilm on the tongue is strongly associated with the occurrence of halitosis in the oral cavity.

Additionally, it impacts the efficacy of periodontitis therapies since it serves as a reservoir for periodontal infections. To effectively cure halitosis, it is necessary to diagnose the condition and provide professional therapy accurately. Additionally, mechanical plaque control methods such as brushing teeth and cleaning the tongue should be used. In some cases, a potent antibacterial mouth rinse may also be recommended. The halitosis treatment plan is determined after a thorough oral clinical assessment, which involves assessing the state of the teeth, soft tissues, and periodontal health. Identifying, diagnosing, and treating any present dental caries, recurrent caries, conditions affecting the dental pulp, chronic ulcerative disorders, oral candidiasis, and xerostomia is imperative. Moreover, it is imperative to precisely diagnose and efficiently treat periodontal conditions such as gingivitis, periodontitis, or necrotizing periodontal diseases. These factors greatly contribute to the existence of oral volatile sulfur compounds (VSC).

Author contributions

N.A.N., S.A.H., S.K.A.A., H.M., S.S.M. wrote, drafted, reviewed, and edited the paper. All authors have read and agreed to the published version of the manuscript.

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