

Halitosis as an Issue of Social and Psychological Significance

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ABSTRACT

Halitosis or bad breath often occurs a barrier in social contact and might lead to the development of psychological complications. Patients suffering from this condition commonly seek the aid of different specialists for the diagnosis and proper treatment. Effective treatment can be achieved only under the conditions of accurate diagnosis and clarification of etiology. It should be noted, that solution to the problem requires interdisciplinary approach involving medical specialists in different fields in order to avoid misdiagnosis and inappropriate treatment. Difference and controversy in etiological factors and approaches to the treatment of halitosis, mentioned in the literature necessitate further investigation and analysis. Taking into consideration an individual's social and psychological manifestations which are conditioned by halitosis, the objective of the study is to analyze the causative factors, diagnostic methods and treatment options aimed to maintain oral health as well as to restore an individual's mental health, self-confidence and social status.

Key words: Halitosis, Oral malodor, Bad breath, Social manifestation, Psychological manifestations

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INTRODUCTION

Halitosis, otherwise known as bad breath or sometimes named oral malodor is a serious problem for many people which needs treatment [1-3]. The name of the condition 'halitosis' originates from Latin word 'halitus', which means 'breath' and Greek suffix '-ossis' meaning 'pathological process' [4]. The interest towards the problem of fighting bad breath has especially increased in the society over the last years [5]. Thus, people suffering from halitosis more frequently seek primary care practitioners for the diagnosis and treatment [6]. Halitosis might have an impact on social communication resulting in psychological alterations which eventually lead to social and personal isolation [7].

Many physicians are not enough aware of the origin and approaches to the bad breath elimination. Halitosis and alterations in taste perception are frequently induced by a group of anaerobic sulfur-producing bacteria (*Fusobacterium*, *Actinomyces*), which flourish on the tongue and frequently thrive in the throat and tonsils. Production of odorous and unpleasant-tasting Volatile Sulfur Compounds (VSCs) is the reaction of the bacteria to any changes in the environment they exist. These VSCs include hydrogen sulfide (scent of rotten eggs), methyl mercaptan (smells like rotten cabbage), Putrescine and

Cadaverine (odor of decomposition) and some other chemicals [8]. Halitosis is observed in all age groups; however, the intensity of bad breath rises with age which might be conditioned by the developing xerostomia [9-12]. Occasional halitosis occurring during the day is common for approximately two-thirds of the population, while 5% of the population suffers from severe halitosis, which requires immediate intervention [13]. The objective of the study is to analyze the causative factors, diagnostic methods and treatment options aimed to maintain oral health as well as to restore an individual's mental health, self-confidence and social status.

Etiology and pathogenesis

Despite various etiological agents of halitosis, the main cause of bad breath is the of organic compound decomposition induced by proteolytic anaerobic bacteria in oral cavity [14,15]. Clarifying the cause of bad breath is crucial, since multidisciplinary therapy is usually needed to eliminate the etiological factor.

By origin, halitosis is classified as Genuine halitosis and Delusional halitosis. Genuine Halitosis is further divided into two subgroups - Physiological halitosis (morning halitosis) and Pathological halitosis. Decomposition of food remnants and exfoliated epithelial cells as well as saliva stagnation are the factors which contribute to the occurrence of physiological halitosis leading to the bacterial accumulation on the dorsal surface of the tongue which is clinically manifested by the tongue coating [16].

The role of gender in this condition is also not clear, though particularly women present higher levels of VSC than that observed in men in the morning [17]. Delusional halitosis is subclassified into Pseudo-Halitosis and Halitophobia.

Pathological halitosis can be of intraoral and extraoral etiology. The majority of bad breath cases (80-85%) are of intraoral nature [18]. The dorsum of the tongue is a potential reservoir for bacteria and a source of malodorous gases [19]. Rough dorsal surface of the tongue constitutes 25 cm² being an excellent area for the oral bacteria to thrive [20]. Putrefaction, conditioned by desquamating epithelium and presence of food remnants occurs. Thus, bacteria recolonize from the tongue surface to the surface of the teeth [21]. Tongue coating is not easily removed. Therefore, daily practice of tongue scraping is performed in order to reduce the number of bacteria and putrefaction process [22]. Such conditions as pericoronitis and herpetic gingivitis as well as periodontal abscess and oral ulcers often bring to higher levels of VSCs. Among diamines, putrescine and cadaverine can also induce oral malodor, since deep periodontal pockets contribute to the decrease of oxygen quantity, leading to pH reduction activating the process in which amino acids decarboxylate to malodorous diamines.

Odontogenic infections include the stagnation of food remnants in deep carious cavities, wide interdental space, alveoli of extracted teeth as well as in the area of exposed necrotic pulp, misaligned teeth, defective restorations, removable dentures and ill-fitting prosthesis [23-26]. The absence or reduced salivation result in higher Gramnegative microbial volume, which in its turn leads to VSCs increase, a common cause of halitosis. Gingivitis and periodontitis are the most important causative factors of halitosis, since in these conditions the number of Gramnegative bacteria also significantly increases [27,28]. Extremely disagreeable odors occur due to necrotizing gingivitis or periodontitis. These types of lesions are typical of opportunistic bacterial infections which occur in people suffering from stress and malnutrition. Other factors which lead to the oral malodor include malnutrition, insufficient oral hygiene, stress, smoking as well as systemic diseases. The observed lesions of the mucous membrane occurring in tuberculosis, syphilis, stomatitis, intraoral neoplasia and periimplantitis, promote the accumulation of microorganisms which secrete large number of malodorous compounds [29].

Oral health is greatly conditioned by saliva. Saliva performs the following 3 important functions: it provides digestive enzymes which help to digest food, stabilizes acids essential for maintaining pH and supplies proper oxygen levels in order to maintain healthy and fresh condition of oral tissues. Increased amount of plaque on the teeth and the tongue is observed in patients with xerostomia [30]. Decreased salivary flow affects negatively upon the saliva self-cleaning effect. Thus, volatile compounds are released inducing halitosis [31,32]. Decreased salivation results in the reduction of

its antimicrobial activity and Gram-positive species transition to Gram-negative. Hyposalivation might be conditioned by diabetes, Sjogren's syndrome, long-term stress, depression, use of medication, mouth breathing habit and alcohol abuse. There is a distinct association between mouth dryness and intensity of halitosis [33-35]. Though xerostomia is related to senescence, a number of studies have revealed that healthy elderly people maintain non-impaired function of salivary gland. With the age, saliva undergoes chemical alterations as well. Thick and viscous saliva is characteristic of low quantity of ptyalin and high level of mucin, presenting certain problems for the aged population. Various medications, such as anticholinergics, antidepressants, antihistamines, diuretics etc. can induce dryness of the mouth. Other factors which contribute to the dryness of the oral cavity include mouth breathing, radiation therapy, dehydration of the organism. Xerostomia can lead to a number of diseases, such as glossodynia, dysgeusia, sialadenitis, cracking and fissuring of the oral mucosa, and halitosis. Symptom of dry mouth can be cured by means of hydration and sialagogues as well as with artificial saliva substitutes.

There are 4 dietary factors which lead to higher sulfur production and stimulate the production of bacteria. These categories are:

1. Drying Agents. The most common drying agent is alcohol. Unfortunately, mouthwash liquids also contain alcohol, where it only aggravates the condition. As a desiccant, alcohol is applied in laboratories to "dry out" hard-to-reach areas of containers, e.g. test tubes and beakers. Similar phenomenon occurs in the oral cavity. The mouthwashes of previous generation contained alcohol which was supposed to ensure a nice marketable look rather than to kill bacteria, since artificial flavoring and coloring chemicals are not water-soluble but solve in alcohol. Alcohol is the second factor which contributes to the dryness of the mouth, while smoking is the first.
2. High-protein foods. Lactose protein is known to cause halitosis. Millions of people all over the world have problem with the digestion of dairy foods such as milk, cheese, yogurt, ice cream etc. It results in the production of amino acids, that are further transformed into volatile sulfur compounds through the action of anaerobic bacteria, flourishing on the surface of the tongue and throat. There are fewer people who suffer from the same problem digesting dense protein foods, for example fish, chicken and beef.
3. Sugars. Glycan strands can be produced by bacteria from sugar, and thus thick layers of enamel plaque is formed, also affecting the gums. As a result, such causative factors of halitosis as tooth decay and gum disease occur.
4. Acidic Foods. These include coffee – both decaf and regular, tomato juice, citrus juices. Acidic foods give a cause for concern as bacteria have specific reaction to an acidic environment i.e. bacteria reproduce much faster. In addition, sour bitter metallic tastes occur due to acids, and typically the more acidic is the environment, the

worse is the taste. TheraBreath is a mouthwash with anti-acid action as it neutralizes oral acids. Other odorous products which induce temporary bad breath are onions, radish, garlic, pickles, condiments and spices.

The cause of bad breath in about 10% of cases originates from the ENT region i.e. ears, nose and throat, 3% of which originate in the tonsils. Such conditions as acute/chronic tonsillitis and tonsilloliths increases the risk of abnormally high levels of VSC by 10 times due to formation of deep tonsil crypts [36]. The presence of foreign body can become a focus for bacterial degradation and hence produce a striking breath odor. Purulent discharge from paranasal cavities occurring in regurgitation esophagitis, piles at the dorsal surface of the tongue leading to oral malodor [37]. Klebsiella ozaenae, which suppresses the self-cleaning capability of the mucous membrane in nasal cavity atrophic rhinitis, while streptococcal species induce acute pharyngitis and sinusitis which also contribute to bad breath occurrence [38]. Among the diseases causing halitosis nasopharyngeal abscess and lower respiratory tract infections such as bronchiectasis, carcinoma of the larynx, lung abscess, chronic bronchitis, asthma, cystic fibrosis, bronchiectasis, interstitial lung diseases and pneumonia should be mentioned [39]. According to some researches, halitosis can be caused by the diseases of

gastro-intestinal tract which constitute about 0.5% of cases [40,41]. Gastroesophageal reflux disease (GERD), gastric and peptic ulcers, Zenker’s diverticulum are the causative factors of halitosis [42-44], while Helicobacter pylori which is considered to be the cause of gastric and peptic ulcer has recently been found to play its role in halitosis. Another cause of unpleasant odors is liver failure inhibiting the detoxification in the organism [45]. Table 1 includes a list various types of the odor and known metabolic, systemic and endocrinological diseases, hormonal alterations which cause the smells [46-48]. Liver cirrhosis, renal failure and diabetes mellitus are well-known etiologies for non-oral malodor. Moreover, some other metabolic conditions like enzymatic and transport anomalies (e.g. trimethylaminuria) appear to bring to the systemic production of volatile malodors, manifesting in altered chemoreception and bad breath. Thus, in Trimethylaminuria the smell in the urine, sweat and expired air resembles that of rotten fish [49]. Specific odor, produced in hypermethioninemia resembles that of boiled cabbage and is emanated through breath, sweat and urine. Bad breath can be induced by some medicines [50]. Bisphosphonates which lead to the jaw bone necrosis and resulting malodor have been recently added to the list of these medicines [51,52].

Table 1: A list of systemic diseases with characteristic halitosis.

Disease	Characteristic odor
Diabetes mellitus	Acetone breath, fruity odor
Unbalanced insulin dependent diabetes	Rotten apple smell
Liver insufficiency	Sweet odor that can be described as dead mice smell; fetor hepaticus (breath of death)
Trisonemy	Cabbage odor
Kidney insufficiency, trimethylaminuria	Fish odor
Uremia, kidney failure	Ammonia or urine odor
Maple syrup urine disease	Burned sugar odor
Homocystinuria	Sweet musty odor
Isovaleriaan acidity	Sweating feet odor
Lung abscess or bronchiectasis	Odorous rotten meat smell, putrefactive smell
Putrefaction of pancreatic juices	Hunger breath smell
Portocaval venous anastomosis	Feculent “amine” odor resembling a fresh cadaver known as “fetor hepaticus” but characteristically intermittent in nature for long period of time
Blood dyscrasias	Resembling the smell of decomposed blood of a healing surgical wound
Liver cirrhosis	Resembling decayed wound odor
Weger’s granulomatosis	Necrotic putrefactive odor
Syphilis, exanthematous disease, granuloma venereum	Fetor
Azotemia	Ammonia odor

In delusional halitosis (imaginary halitosis) the individual believes he suffers from oral malodor which becomes the reason for social nuisance, though this is not confirmed either by the doctor or by other people. This is

considered to be psychosomatic disorder pertaining to dental practice [53]. Pseudohalitosis patients get convinced that they don’t have bad breath during the consultation with physician [54]. Among the patients

presenting with the complains of halitosis, 28% do not display any actual signs of bad breath. Halitophobia, observed in at least 0.5–1% of adult population, is a fear of bad breath presence. These patients need psychological consultation. Before making diagnosis of halitophobia, a doctor should exclude all the possible causes of halitosis. Another psychological disorder, characterized with a preconceived notion concerning foul body odor or offensive mouth breath is Olfactory Reference Syndrome. Serotonin reuptake inhibitors are known to show significant improvement in these disorders [55].

Diagnosis

Alongside with patient's main present complaints, their diet and habits should be of a special concern while taking general and dental medical history [56]. Issues regarding halitosis, which should be clarified include the frequency and duration of manifestation, the time it appears during the day, its being noticed by others, medicines used, smoking and other bad habits as e.g. alcohol consumption as well as symptoms such as cough, pyrexia, anosmia, discharges from the nose and weight loss.

Organoleptic assessment of halitosis is actually based on the physician's subjective perception. Doctors determines the presence of malodor in the air exhaled by the patient through the nasal and oral cavities, using their sense of smell. Organoleptic assessment is considered the "gold standard" in clinical diagnosis of halitosis [57]. There are more than 150 various components in the breath exhaled. Factors that influence the perception of these molecules are the olfactory response, the intensity of the odor and the volatility of the molecules, the threshold concentration. In organoleptic assessment, an experienced physician determines the presence of malodor in a breath sample, giving a score to the intensity in the range of 0 to 5, with 0 being no appreciable odor, 1-bearly noticeable odor, 2-slight, but clearly noticeable malodor, 3-moderate malodor, 4-strong malodor, 5-extemely strong malodor. Different breath samples are assessed in every patient. Oral odor is detected at the distance of 10 cm, while patient is breathing normally or counting out loudly from 1 to 10. This is performed to dry up the palate and tongue mucosa [58]. The odor of saliva is determined by wrist-lick test, and the sample is assessed 10 seconds after the patient licks the wrist. On the assessment of tongue coating scores debris, scraped from the dorsum of the tongue. Scrapping obtained from the tongue dorsum is taken using a non-odorous spoon as the periodontal problem is presented to the physician. To assess interdental area, a score is given to a floss odor after flossing with dental tape. Nasal odor is assessed during the nasal breathing with mouth closed and a score is given to the exhaled air. In the presence of removable denture, its odor is also assessed. To obtain the accurate test results the patients should avoid spicy foods, garlic and onions the day before the examination. At least 12 h before the consultation, teeth should not be brushed or

rinsed, perfumes should not be used and at least 6 h before the examination, food or liquid intake should be avoided. It is not allowed to smoke at least 24 h before any examination [59].

The smell coming from the oral cavity, but not from the nose is of an oral or pharyngeal origin. In case the smell comes from the nose only, the cause is located either in the nasal cavity or sinuses. Rarely, similarly intensive odor coming from both the nose and mouth can be conditioned by systemic disorders. Direct assessment of exhaled breath can be discomforting for both the patient and the physician, so the patient is offered to exhale into the paper bag and then the bag odor is examined. The advantages of organoleptic scoring are its being inexpensive, no equipment is needed and a wide range of odors is detectable. As disadvantages, the extreme subjectivity of the test, the lack of quantification, the saturation of the nose and the reproducibility can be mentioned.

There is no universal objective method for the diagnosis of a halitosis [60]. Electronic devices like Halimeter and oral chroma are used to detect volatile sulfur components in the expired air. The Halimeter can only give an idea of the total amount of VSCs, present in a sample. In the Halimeter, the total amount parts per billion of VSCs in the sample is marked.

Gas chromatography (GC) analyzes air, incubated saliva, tongue debris or crevicular fluid for any volatile component and is objective, reproducible and reliable [61]. GCis highly specific to VSCs and can detect even low concentrations of odorous molecules. However, it is expensive, bulky and requires special training. The processing of the method is time-consuming, the device is used in research rather than in daily work [62]. Portable volatile sulfide monitor is easily operable and reproducible, but they are only sensitive to sulfurcontaining compounds. Oral malodor can be worsened by the substances which are different from volatile sulfur compounds, resulting in inaccurate assessment of the source and intensity of bad breath [63].

Other objective methods of breath component assessment are rarely used in daily clinical practice, since they are costly and time-consuming. Various tests used are Darkfield or PhaseContrast Microscopy, Quantifying β galactosidase activity, Salivary incubation test, BenzoylDLarginineanaphthylamide (BANA) test, Ammonia monitoring, Ninhydrin method, polymerized chain reaction, Taqman DNA, Tongue Sulfide Probe and Zinc Oxide Thin Film Conductor Sensor [64-68].

Treatment

It should not be neglected, that people with halitosis need help, are often anxious and skeptical about any treatment [69]. An accurate diagnosis is needed to ensure proper treatment. The purpose of treatment is to eliminate the causative factor, to increase the hygienic state of the oral cavity and to stop the disagreeable odor of the mouth [70]. There are various methods of carrying

out the treatment, including both mechanical and chemical reduction of microorganisms, odor concealment as well as neutralization of VSCs with chemicals [71]. In case of periodontal disease or the presence of numerous decayed teeth, these problems should be eliminated first, as these can induce bad breath. Regardless of the type of halitosis, professional oral hygiene procedures should be carried out.

The first stage of treatment consists of mechanical removal of Biofilm and microorganisms. Cleansing the tongue reduces mouth odor and tongue coating [72]. Tongue scrapers reduce 75% of VSCs due to their unique shape, while 45% of reduction is observed in case a toothbrush is used [73]. However, there is another study which doesn't confirm the statement [74]. Cleaning the interdental space is also essential for the control of oral microorganisms and plaque, since the probability of malodor is much higher in case no floss is used [75].

Alteration in diet, the use of sugarfree chewing gum, cleansing the tongue with a toothbrush, scraping the tongue, the application of the toothpastes containing zinc brings to the clinically important findings in the treatment of intraoral halitosis [76].

Antibacterial substances in mouthwash liquids, such as triclosan, cetylpyridinium chloride (CPC) and chlorhexidine (CHX) affect bacteria which cause oral malodor. Mouth rinse liquids, which contain CPC and CHX suppress VSCs production, meanwhile those with zinc and chlorine dioxide might neutralize halitosis-inducing sulfur compounds [77].

CHX is regarded gold standard mouth rinse to treat halitosis. In combination with CPC, CHX produces greater decrease in VSCs level, where both aerobic and anaerobic bacterial counts show the lowest percentage of survival [78]. The study of Zinc and CHX combined impact revealed that Zinc (0.3%) and CHX (0.025%) in low concentration lead to 0.16% drop in H₂S levels after 1 h, 0.4% drop after 2 h and 0.75% drop after 3 h, producing synergistic effect [79]. However, long-term CHX exposure might result in reversible tooth discoloration. Usage of Listerine containing essential oils bring down the number of halitosis-inducing bacteria [80], while antimicrobial effect of Triclosan reduces dental plaque, gingivitis and halitosis [81,82].

The only scientifically proven and clinically effective method to stop halitosis is to attack the ability of bacteria to produce VSCs and to convert the VSCs into non-odorous and non-tasting organic salts. These bacteria are anaerobic, which simply means that they thrive and produce more sulfur under the condition of little or no oxygen. Little oxygen is present in case of little amount of saliva which makes an anaerobic environment, perfect for the bacteria to produce more of these odorous and sour/ bitter compounds. One of the methods to stop the bad odor and sour taste is to use Oxyd-8 based oral products. Oxyd-8 is made directly from "active" ClO₂ which is a strong oxidizing (oxygen-donating) compound, commonly used in water purification over the years. Potent zinc compounds (ZOX) with other natural

ingredients have been developed for those cases where Oxyd-8 is not applicable.

Another way to stop bad breath is to simply replace the odorous bacteria in the oral environment with non-odorous bacteria. Probiotics, such as Aktiv-K12 Probiotics, which actually reintroduce the good bacteria into oral environment (*Streptococcus salivarius* strain K12) are essential for this purpose. In case of chronic halitosis, it can even be used in conjunction with the oxygenating formulae to create a double strike.

The possible presence of extra-oral problems should be taken into consideration while managing halitosis. These might need conservative treatment with broad spectrum antibiotic coverage for pharyngitis, drugs such as proton pump inhibitors for GERD or surgical treatment, such as tonsillectomy/ adenotonsillectomy, liver/kidney transplantation [83]. When *Helicobacter pylori* infections are observed, the therapy with omeprazole, amoxicillin and clarithromycin is carried out. In the endocrinological and metabolic disorders, the underlying diseases should be detected and treated.

The application of toothpaste, sprays and rinsing liquids which contain fluoride as well as chewing gums and mint tablets have only a shortterm concealing effect [84]. Peppermint oil stimulates salivation, which is useful, as a dry mouth might result in halitosis [85]. Diet is of a great significance and should be balanced to effectively fight against oral malodor. Propolis is also applied to cure halitosis [86,87]. The patients suffering from bad breath should give up smoking, using alcohol and dentifrices containing baking soda.

Patients who have oral malodor have notably higher scores for anxiety, phobic anxiety, depression, obsessivecompulsive disorders and paranoid ideation as compared to similar patients without halitosis [88]. People with oral malodor often interpret the attitude of surrounding people towards them in a different way. Thus, the patients should be explained that the way people treat them has nothing to do with them having or not having halitosis, but the reason for their attitude is different. People suffering from halitophobia who credit their emotional condition to imaginary oral malodor, at early stages of the condition should be referred to a clinical psychologist for mental assessment and proper treatment [89]. Together with health care practitioner, the treatment of delusional halitosis requires a multidisciplinary approach of different specialists such as psychologists and psychiatrist. In the management of halitosis, the mutual understanding between the physician and patient is critical for a successful final result. Physician should show acceptance, empathy and reassurance in order ease the patient's anxiety. The life quality of the patients can be much improved by restoring their social contacts. The patient's primary healthcare practitioner as well as family and friends should provide a sustained encouragement and reassurance.

Taking into account the multifactorial nature of halitosis, an individual approach should be shown to every case

while managing the patient's treatment plan [90]. Diagnosis and management require a multidisciplinary approach with primary healthcare clinician, an ENT specialist, dentist, gastroenterologist, nutritionist, endocrinologist and clinical psychologist involved.

Conclusion

Halitosis occurs a rather serious barrier for people in building and developing social relationship which, in its turn, has a negative impact on the individual's psychological state. Therefore, the early diagnosis of the problem is crucial, and only the identification of the causative factors makes it possible to carry out proper and personalized treatment involving medical specialists in different fields since oral malodor might often be conditioned by general somatic diseases and taking various medicines. Thus, the treatment should be aimed at eliminating etiological factors and maintaining proper hygiene of the oral cavity.

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