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Letter to the editor

Managing halitosis during the SARS-CoV-2 pandemic

On December 31, 2019, the world health organization reported pneumonia of an unknown cause in Wuhan, China. Later, coronavirus was identified as a respiratory disease cause. It was announced as severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2). Due to the specific structure of spike protein, the virus has a high mutation potential. Among the virus' mutations, the last two mutations, namely Delta (B.1.617.2) and Omicron (B.1.1.529), have posed a greater challenge to global health during the pandemic. In this context, vaccination, hand disinfection, telemedicine, and particularly medical masks can disrupt the infection chain. Wearing medical masks can worsen halitosis because the exhaled air cannot escape through the mask. Consequently, individuals with halitosis are reluctant to wear masks.[1,2] This brief letter focuses on halitosis during the current coronavirus pandemic.

Halitosis is a term that refers to foul odor caused by a multifactorial etiology. This disorder can affect the quality of life due to its multiple social and psychological effects. Of several classifications proposed regarding halitosis, two ones can be highlighted during the pandemic: 1) intra-oral (i.e., blood-borne) and 2) extra-oral (i.e., non-blood borne) halitosis. The intra-oral halitosis is caused by oral diseases such as gingivitis, periodontitis, pericoronitis, dental caries, and oral ulceration. A variety of diseases, including diabetic metabolic disorders, kidney and liver diseases, specific medicines, and food, can cause blood-borne halitosis. In comparison, non-blood-borne halitosis is caused by respiratory and gastrointestinal diseases.[2,3]

In a review study, Wu et al. reported the prevalence of halitosis in different countries and age groups as follows: 1) The prevalence of halitosis was 24% among Polish university students; 2) in the USA, dentists diagnosed 41% of their patients' halitosis in the first week; 3) in Korea, Sweden, and Brazil, the prevalence of halitosis among adolescents was 25%; 4) halitosis in 12-year-old children in the USA was 37.6%. It has been reported that one in four people also suffers from halitosis. Hence, the treatment of halitosis is a priority during the pandemic.[2]

Riad et al. evaluated the prevalence of halitosis in 18 patients (14 female and 4 male) who tested positive for COVID-19 for the following reasons: travel, contact with positive patients, and individuals with mild symptoms of COVID-19. The halitosis was assessed via Halimeter Plus. The mean halitosis intensity was 203.89 $\pm$ 95.56 (100–420) ppb. Magic mouthwash and chlorhexidine were used to treat halitosis in 12 and 6 patients, respectively. The results showed a significant decrease in mean halitosis intensity (i.e., 68.75 $\pm$ 30.96 (20–120) ppb) after one month. This data indicates the outstanding role of mouthwashes in reducing halitosis. The halitosis in COVID-19 patients has been explained by possible epithelia modifications of the tongue dorsum caused by SARS-CoV-2. This change is due to angiotensin-converting enzyme 2 located in abundance around the oral mucosa. Overall, this halitosis assumption in COVID-19 patients requires further investigation.[4]

In line with previous studies, Abubakr et al. reported that 537 participating patients with mild to moderate symptoms of COVID-19 presented a variety of symptoms. Two of these symptoms were xerostomia (47.6%) and halitosis (10.5%). Mild to moderate oral symptoms of COVID-19 infection are more commonly associated with xerostomia (i.e., dry mouth), as a phenomenon that causes halitosis. Thus, the management of SARS-CoV-2 patients with halitosis should be highly considered during the pandemic.[5]

Teixeira Essenfelder et al. evaluated the role of β-glucosidase as a risk factor in the incidence of halitosis. They included 48 patients in their in vivo study and diagnosed the presence of halitosis through the organoleptic test and a portable monitor for sulfur detection. Of 48 patients, 32 exhibited different types of halitosis (i.e., 16 mild, 3 moderate, and 13 severe halitosis) through the organoleptic test, and 10 individuals had volatile sulfur compounds. The β-glucosidase was detected in fresh saliva samples of 40 patients (83.3%). In this perspective, increased salivary β-glucosidase can be associated with halitosis. Polyols such as xylitol can inhibit the β-glucosidase in human saliva. As a result, they should be considered

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during the pandemic to control the treatment of halitosis in the case of increasing salivary β-glucosidase.[6]

In addition, *Helicobacter pylori* (*H. pylori*) infection is one of the most common causes of infectious diseases, including gastric cancer, gastric lymphoma, gastric ulcer, and halitosis. Factors such as selecting appropriate antibiotics, drug dosage, duration of therapy, and proton pump inhibitors should be highlighted in the treatment and eradication of *H. pylori* during the pandemic. Concomitant therapy consists of proton pump inhibitors, clarithromycin (1000 mg per day in 2 doses), amoxicillin (2000—3000 mg per day in 2—4 doses), and nitroimidazole (tinidazole [Tindamax] or metronidazole) (1500—1600 mg per day in 3—4 doses) for 10—14 days. In the case of refractory *H. pylori* infection, bismuth therapy is recommended.[7]

The efficacy of lemon essential oil (LEO) and other mouthwashes in treating halitosis was also investigated. To this end, 48 volunteers (i.e., 20 males and 28 females without systematic diseases) with more than 180 ppb of volatile sulfur compound, detected through Halimeter and positive organoleptic test (i.e., >1), were included in the study. The results showed that LEO has satisfactory effectiveness in reducing halitosis compared to 0.1% cetylpyridinium chloride, 3% hydrogen peroxide (H_2O_2), and distilled water (H_2O) as the control group. The inhibitory effects of LEO concentration were as follows: 1) 9 mg/ml, 4.5 mg/ml, and 2.25 mg/ml had an effect against salivary bacteria; 2) 0.563 mg/ml to 4.5 mg/ml had an effect against biofilm formation of salivary bacteria; 3) 0.563 mg/ml to 2.25 mg/ml had an effect against the volatile sulfur compound. Therefore, using LEO during the pandemic can be considered to reduce the severity of halitosis.[8]

Another study evaluated the treatment of halitosis through photodynamic therapy in older patients with complete dentures. In this research, 40 patients older than 60 years with halitosis (H_2S concentration $>$112 ppb) were divided into two groups. The first and second groups ($n = 20$) were treated with a tongue scraper and antimicrobial photodynamic therapy (aPDT), respectively. The H_2S results in both groups were as follows: Group 1 (treated with a tongue scraper): 736.7 ppb (initially), 185.3 ppb (after treatment), and 218.2 ppb (a 7-day follow-up). Group 2 (treated with aPDT): 698.7 ppb (initially), 18.5 ppb (after treatment), and 39.0 (a 7-day follow-up). The aPDT showed a lower concentration of H_2S compared with tongue scraper treatment. Therefore, it can be considered for treating halitosis, particularly in the older population.[9] It was also reported that Lacer Hali™ could be used as an alternative to chlorhexidine based toothpaste and mouthwashes for the management of halitosis.[10]

Based on the information provided in this letter, individuals might abstain from wearing face masks due to halitosis. Hence, to minimize the spread of COVID-19, clinicians should highlight the etiology, diagnosis, appropriate treatment, and management of halitosis.

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Kaveh Nasiri*
Independent Researcher, Essen, Germany

Aleksandra Dimitrova
Department of Hematology, Internal Oncology & Stem Cell Transplant, Evang. Hospital Essen-Werden, Essen, Germany

Karl-Thomas Wrbas
Department of Operative Dentistry and Periodontology, Center for Dental Medicine, Oral and Maxillofacial Surgery, Medical Center, University of Freiburg, Freiburg i.Br., Germany
Division of Endodontics, Department of Dentistry, Faculty of Medicine and Dentistry, Danube Private University, 3500 Krems, Austria

*Corresponding author. Koenigraetzstrasse, Essen 45138, Germany.
E-mail address: DDS.Nasiri@web.de (K. Nasiri)

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