Medical Science

pISSN 2321–7359; eISSN 2321–7367

Role of mouthwashes in combating SARS-COV 2 COVID-19 virus: Assessment of the knowledge of Middle Eastern Dentists

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To Cite:
Ahmed S, Alotaibi SN, Abdul NS, Alotaibi MM, Sheikho MA, Alharthi AA, Alenezi BS, Al-Jamali R, Almalhan AM, Aljethaily NA, Tabassum N. Role of mouthwashes in combating SARS-COV 2 COVID-19 virus: Assessment of the knowledge of Middle Eastern Dentists. Medical Science 2022; 26:ms405e2483.
doi: https://doi.org/10.54905/disssi/v26i128/ms405e2483

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Peer-Review History
Received: 18 September 2022
Reviewed & Revised: 20/September/2022 to 05/October/2022
Accepted: 09 October 2022
Published: 11 October 2022

Peer-review Method
External peer-review was done through double-blind method.

URL: https://www.discoveryjournals.org/medicalscience

ABSTRACT

Background: Mouthwashes are deemed an effective measure in mitigating the risk of coronavirus contraction in dental clinics through limiting aerosol spread during procedures. This study aimed to evaluate the attitude, knowledge, and practices of Middle Eastern dental professionals regarding the use of mouthwash for combatting the coronavirus. *Methods:* This cross-sectional study was conducted online between the 1st and 15th of September 2021 where a random sample of dental practitioners were enrolled from Saudi Arabia, Qatar, Oman, UAE, Egypt, Turkey, Bahrain, and Kuwait. The survey included questions about the participants' demographics, degree of knowledge and use of mouthwashes for coronavirus. *Results:* Of the 880 participants filling the questionnaire, the majority were males 500 (56.8%), consultants 324 (36.8%), and based in Egypt 224 (25.5%). Only 5.6% of the enrolled dental practitioners were conscious of the presence of more than four types of medicated mouthwashes. Almost 86% of the participants were unknowledgeable of the benefit of mouthwashes for COVID 19, with an approximately similar percentage (83.2%) of dentists believing that the current literature is deficient. Notably, more than two-thirds of the dentists had a negative attitude towards the role of mouthwashes in disrupting the coronavirus. Also, 43.2% of the participants had a wrong perception of the superiority of chlorhexidine in eradicating the virus as compared to other rinses. *Conclusion:* Dental professionals based in the Middle East have inadequate knowledge and a negative perception of the role of mouthwashes in minimizing cross-transmission of coronavirus between dentists and patients in dental clinics.

Keywords: SARS-CoV-2, COVID-19, dental facility, mouthwashes, aerosol transmission.

1. INTRODUCTION

For a period exceeding seventeen months, the world has been witnessing health emergency due to the COVID-19 pandemic. Given the high transmissibility of the virus even from asymptomatic patients, clinic visits have been periodically suspended to ensure patient and staff protection (Ather et al., 2020). This behavior was further accentuated by the recommendations of the American Dental Association (ADA) and the Center for Disease Control and Prevention (CDC) to limit dental services to emergency cases only (Ren et al., 2020). This is mainly due to the high SARS-CoV-2 counts traced in salivary samples and the oral mucosal function as a primary portal of entry of the virus pertaining to the increased number of ACE2 receptors in this area (Ather et al., 2021). Presently the situation is more alarming due to the emergence of newer mutations such as the delta variant which is reported to be highly infectious. Aerosol-producing procedures cause salivary components, including the virus, if present, to be suspended in the air facilitating transmission (Ather et al., 2021). Thus, for better control over the cross-contamination of SARS-CoV-2 by COVID-19 patients, the salivary viral load should be reduced prior to any procedure (Vergara-Buenaventura et al., 2020).

Upon the return of ordinary life and the re-opening of clinics amid the pandemic, dentists must be prepared to perform such high-risk procedures in a facilitated environment and maximum control over the viral transmission. While wearing on the protective clothing (i.e., N95 masks, gloves, gowns, goggles, face shields, and head and shoe covers) or performing the Rapid Antigen test in dental offices -via salivary swabs- may be sound options, it is impractical for dentists to wear all recommended PPE equipment. In addition, the rapid test may not always provide accurate results. More recently, infection control procedures' focus has been directed to additional efficient means. Multiple organizations have recommended using pre-procedural mouthwashes to decrease the odds of SARS-CoV-2 transmission (Alharbi et al., 2020; Ather et al., 2020). In this regard, the (ADA, 2021) and (CDC, 2019) recommended particularly using a pre-procedural Povidone Iodine (PVP-I) mouthwash for this purpose. Nevertheless, to this date, the World Health Organization has not published any recommendation about using mouth rinses in this regard.

Medicated mouthwashes are available as OTC or prescription and may contain one of the active ingredients —povidone-iodine (PVP-I); chlorhexidine (CHX); oxidizing agents, e.g., hydrogen peroxide (H_2O_2); essential oils, e.g., eucalyptol oil, menthol, methyl salicylate, and thymol; fluorinated mouthwashes; and quaternary ammonium compounds, e.g., cetyl-pyridinium chloride. Regularly, mouthwashes are used as adjuncts in mucositis, gingivitis, dental caries, halitosis, and xerostomia. Recently, these compounds exhibited varying efficacy against SARS-CoV-2 in clinical trials. Given the importance and novelty of this topic, it is important that dentists be acknowledged of the latest and genuine updates. Most of the previously conducted studies aimed to assess dentists' knowledge regarding COVID 19, infection control and to evaluate their anxiety amidst this pandemic.

In these studies, dentists proved to be anxious, unprepared for working in a pandemic and lacking knowledge about the virus (Shamsoddin et al., 2021; Bastani et al., 2021; Almas et al., 2020; Sarfaraz et al., 2021). According to a survey by (Ather et al., 2021), dentists believed that mouthwashes generally can minimize microbial load and decrease bacteria's aerosolization. However, a recent study conducted by Imran et al., (2021) found a lack of knowledge amongst dental practitioners regarding the significance of mouthwash in combatting SARS-CoV-2 virus in particular. It is important to note that up until this point, a joint survey covering the knowledge of dentists regarding this topic in the Middle East has been lacking.

Thus, our research aimed to investigate the attitude and knowledge of dental practitioners based in the Middle East towards the potential of mouthwashes in confronting COVID-19 and to assess their current practice in this manner.

2. METHODS

This cross-sectional study examined the knowledge of dental practitioners based in different countries of the Middle East region regarding the use of mouthwash for COVID-19 infection control in dental clinics. Dental consultants, specialists, and general practitioners from Saudi Arabia, Qatar, Oman, UAE, Egypt, Turkey, Bahrain, and Kuwait who provided written informed consent to participate in this study were included. Data was collected in the month of September 2021.

This study was reviewed and approved by the Ethical committee and Institutional Review Board of Research center of Riyadh Elm University (FRP/2021/356). The questionnaire was supplied with a digital informed consent form to be signed by the practitioner and a declaration of the respected confidentiality and anonymous data analysis.

A previous study conducted by Sarfaraz et al., (2021) estimated that 22.6% of dentists recognized the role of Povidone-Iodine (PVP I) rinse in mitigating SARS-CoV-2 viral load during dental procedures preparation. Based on this finding, the sample size was marked down to be 758 using the Open Epi calculator with a 99.9% confidence interval. The sample size was inflated by 16% to 880 participants to make up for possible missing data. Initially, the questionnaire was translated to Arabic and then translated back to English to assure the accuracy of the translation. This was followed by questionnaire piloting on a group of 40 dentists from different Middle East countries to check for the accuracy and clarity of questions. Obtained data were then cleared out, and the data

collection process was initiated using the various online communication platforms where the questionnaire was distributed in Arabic and English as a google form document link.

The study's questionnaire was first commenced with a query about the participant's demographics— gender, job position, and location of practice to confirm the representativeness of the sample. A series of multiple-choice questions then followed to evaluate participants' knowledge, attitude, and practice regarding the role of mouthwashes in combatting COVID-19.

Statistical analysis

Data analyses were completed using SPSS version 25.0 software (IBM SPSS Inc., Armonk, NY, USA). Percentages were used to describe qualitative variables. Normality was assessed employing the Shapiro-Wilk test (p-value ≥0.05) indicates a normally distributed continuous variable and independent student t-test was used to compare responses provided by the two groups — dental specialists or consultants and general practitioners. CI was taken as 99.9%, α as .01.

3. RESULTS

Table 1 presents the dental professionals' demographic characteristics and Figure 1 shows their location of practice. Eight hundred eighty dentists were included in this study; 324 (36.8%) consultants, 267 (30.3%) specialists, and 289 (32.8%) general practitioners. 56.8% of the dentists were males where most of the participants were based in Egypt 224 (25.5%) followed by Saudi Arabia 209 (23.7%), Turkey 195 (22.2%), Kuwait 114 (12.9%), Qatar 46 (5.2%), Bahrain 33 (3.7%), UAE 31 (3.5%), and Oman 28 (3.2%).

Table 1 Characteristics of the participants' demographic make-up (N,%) (N=880 dentists)

Demographics of the participants	Frequency (%)
Gender	
Male	500 (56.8)
Professional position	
Consultant	324 (36.8)
Specialist	267 (30.3)
General practitioner	289 (32.8)

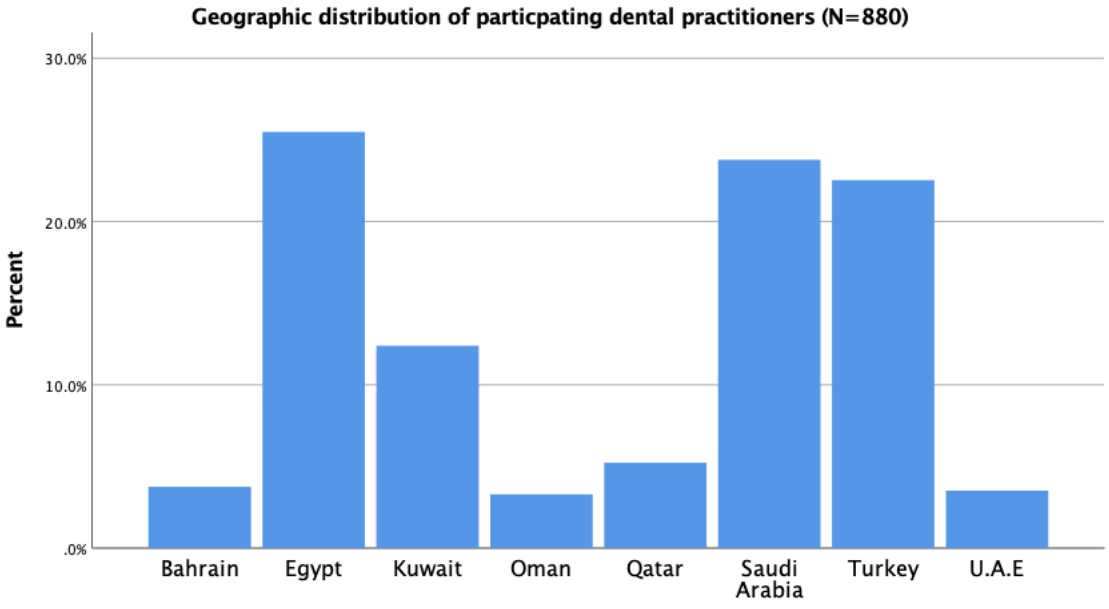

Figure 1 Geographic distribution of participating dental practitioners (n=880)

When assessing the level of participants' knowledge, the majority of participants (86.1%) knew two to three types of mouthwashes, as can be inferred from Table 2. Contrarily, only 49 participants (5.6%) were aware of four or more types of gargles. Most of the participating dentists, 564 (64.1%), have not read any research article on the impact of using mouthwash on COVID-19,

with a majority of 756 practitioners (85.9%) being oblivious to the benefit of mouthwashes in some way for coronavirus. Furthermore, only 27% of the participating dentists knew the mechanism of action of at least one of the available mouthwashes. It deserves mention that specialists and consultants had a greater degree of knowledge than general practitioners regarding the mouthwashes' different types, effectiveness against COVID-19 and mechanism of action (p-value< .001).

Table 2 Knowledge of participants about the use of mouthwashes for COVID 19 (N, %)

Knowledge item	Consultants/ specialists	General practitioners	p-value
Number of available mouthwashes			< .001
One	73 (100)	0	
Two	276 (66.7)	138 (33.3)	
Three	234 (67.8)	111 (32.2)	
Four and more	31 (64.6)	17 (35.4)	
Mouthwashes are effective against COVID 19			< .001
Yes	280 (100)	0	
No	199 (69)	89 (31)	
I do not know	135 (43.3)	177 (56.7)	
Read any research article related to the effect of mouthwash on COVID 19			.04
Yes	207 (65.5)	109 (34.5)	
No	407 (72.2)	157 (27.8)	
Determine the mode of action of each of the mouthwashes			
Yes	165 (69.3)	73 (30.7)	< .001
No	449 (69.9)	193 (30.1)	

Questions evaluating dentists' attitudes revealed that 600 dentists (68.2%) had a negative attitude towards the role of mouthwashes against COVID19, as presented in Table 3. Notably, only 16.7% of the participants opined that the current literature discussing the role of mouthwashes against coronavirus is well developed. Concomitantly, 85% of the dentists assumed that the World Health Organization should project further guidelines and evidence-based recommendations on this topic. Notably, dental professionals of different job positions agreed on the need for further recommendations (p-value= .253) and need for a more robust literature (p-value= .072). However, consultants and specialists had a better attitude towards the role of mouthwashes against COVID-19 (p-value= .002).

Table 3 Perception of participants regarding the use of mouthwashes for COVID 19 (N %)

Variable	Consultants/ specialists	General practitioners	p-value
Sufficiency of the literature on the use of mouthwashes for COVID 19			.072
Yes	112 (16.7)	35 (23.8)	
No	129 (59.4)	88 (40.6)	
I do not know	373 (72.3)	143 (27.7)	
Further WHO guidelines and recommendations are needed			.253
Yes	524 (70)	224 (30)	
No	17 (63)	10 (37)	
I prefer not to say	73 (69.5)	32 (30.5)	
Mouthwashes could affect SARS-CoV-2			.002
Yes	70 (56.5)	54 (43.5)	
No	31 (12.8)	212 (87.2)	
I do not know	513 (100)	0	

Table 4 demonstrates questions and responses about dentists' handling of mouthwashes. Generally, chlorhexidine medicated mouthwashes were deemed to be the most regularly ordered gargles by 243 (39.6%) specialists and consultants, whereas Listerine was preferred by 124 (46.4%) of the general practitioners (p-value< .001). Chlorhexidine mouthwashes were also suggested as the recommended gargles to prescribe for COVID-positive patients by 211(33.4%) of specialists and consultants compared to Listerine preferred by general practitioners (p-value< .001). Most of the dental professionals (64%) recommended that mouthwashes be used for duration of two week.

Table 4 Participants handling of mouthwashes (N,%)

Variable	Consultants/ specialists	General practitioners	p-value
The main content of the mouthwash you regularly prescribe for any patient			< .001
Betadine	171 (82.6)	36 (17.4)	
Chlorhexidine	243 (71.3)	98 (28.7)	
Listerine (essential oils)	165 (57.1)	124 (42.9)	
others	34 (79)	9 (21)	
The main content of the mouthwash you regularly prescribe for COVID positive patients			< .001
Betadine	211 (75.9)	67 (24.1)	
Chlorhexidine	311 (81.8)	69 (18.2)	
Listerine (essential oils)	57 (34.8)	107 (65.2)	
Others	53 (91.4)	5 (8.6)	
Recommended duration of mouthwash use			.002
One week	147 (66.5)	74 (33.5)	
Two weeks	380 (67.5)	183 (32.5)	
Three weeks	96 (90.6)	9 (9.4)	

4. DISCUSSION

Mouthwashes are antimicrobial rinses with a varying spectrum of activity against the different microorganisms. SARS-CoV-2 is an RNA-enveloped virus tested both in vivo and in vitro for possible susceptibility to different mouthwashes. Recently, plenty of evidence-based views and reviews on the efficacy of anti-SARS-CoV-2 mouthwashes have been supplied to the literature (Vergara-Buenaventura et al., 2020; Cavalcante et al., 2021; Martinez et al., 2020; Bernstein et al., 2021; Oliviera et al., 2021; Bidra et al., 2020; Ather et al., 2021). Based on the current literature, clinical trials have focused on the role of the three rinses — hydrogen peroxide (H_2O_2), chlorhexidine (CHX), and povidone-iodine (PVP-I). Testing of these constituents is based on the prior, non-evidence-based, recommendation to gargle for 60 seconds with 15 ml of any of the following: 1.5% or 3% H2O2; 0.12% CHX; 0.05% CPC; or 9mL of 0.2%,0.4%, or 0.5% PVP-I (Vergara-Buenaventura & Casto Ruiz, 2020).

More than four different types of active ingredients constitute mouthwashes, which were only known to 44 (5.5%) dentists enrolled in this study. Only 124 (14.1%) dental practitioners were aware of the possible benefit of mouthwashes for disrupting coronavirus, with an estimated two-thirds having a negative belief towards its possible use for COVID-19. A slightly higher percentage of dental practitioners (22.6%) in Imran et al., (2021) study knew that mouthwashes can have a positive contribution to viral spread limitation. Also, about three-quarters of the participants in our study were oblivious to the mechanism of action of any of the available mouthwashes. A total of 85% of the participants believed that the available literature is deficient. Consequently, a review of the relevant literature was necessary.

CHX is regarded as the second most potent amongst the available mouthwash with a broad spectrum of activity against fungi, bacteria, DNA, and RNA viruses — only lipid-enveloped ones (Bernstein et al., 2021); therefore, it was proposed to affect the enveloped coronavirus (Ather et al., 2021). A unique property of CHX is substantivity which is the slow release of the molecule over an extended period (Bernstein et al., 2021). The ADA routinely recommends CHX as prophylaxis before and after dental procedures given its cationic nature that targets the anionic residue of the microbe's cell membrane, ultimately resulting in the microbes' death (Ather et al., 2021). However, the current evidence regarding its use for COVID-19 is limited and inconsistent. A *recent clinical trial has shown that* pre-procedural rinsing with 15mL of 0.12% CHX for thirty seconds can decrease the titers of enveloped viruses, including coronavirus (SARS-CoV-2) (Yoon et al., 2020). However, this decrease was only transitional, returning to baseline in two to four hours after rinsing. In addition, a review performed by (Ather et al., 2020) concluded that the evidence for the use of CHX

for eradicating the SARS-CoV-2 virus is inconclusive; similar to the recommendations set by the National Health Commission of the Republic of China, in its 5th edition for the *Guidelines for the Diagnosis and Treatment of New Coronavirus Pneumonia* that negated the significance use of 0.2% chlorhexidine mouthwash in reducing SARS-CoV-2 viral titers (Peng et al., 2019).

In addition, providing that the SARS-CoV-2 virus is oxidation-susceptible, the use of the oxidizers, hydrogen peroxide, or povidone-iodine has been suggested (Bidra et al., 2020). Compared to other medicated mouthwashes, Povidone-iodine (PVP-I) rinse is generally recognized as the most potent through the oxidizing action of free iodine on the microbial nucleic acid assemblies (Ather et al., 2020). Interestingly, the viral load of SARS-CoV-2 was significantly reduced for three hours through a one-minute rinsing with 1% PVP-I in an in-vivo study conducted by (Martinez et al., 2020). In the latter study, however, PVP-I was only effective in patients with high baseline viral titers. Lately, Io Tech International (Boca Raton, FL) developed a newer formulation of iodine antiseptic "IORINSE RTU" with a 100 times greater iodine content, a higher virucidal activity, reduced side effects (e.g., irritation, staining), and an increased shelf-life. Rinsing with 30mL IORINSE RTU is recommended for 30 seconds twice daily.

Hydrogen peroxide is another example of oxidizing agents which demonstrated a tremendous virucidal activity against SARS-CoV-2 as a disinfectant, warranting the recommendation of the available H_2O_2 mouthwash use (Ather et al., 2021). H_2O_2 works by releasing nascent oxygen-free radicals that destroy the lipid membrane of anaerobic bacteria and lipid-enveloped viruses (e.g., influenza and coronavirus were the most vulnerable) (O'Donnell et al., 2020; Peng et al., 2020). Commonly, oral rinsing with H_2O_2 mouthwash is advised prior to any dental procedure by the (ADA, 2020). Unfortunately, available in vivo and invitro results do not present promising findings where it has been hypothesized that the oral catalase enzyme is inactivating the molecule (Ather et al., 2021). A study conducted by Brida et al., (2020) comparing the efficacy of PVP-I to H_2O_2 in decreasing the virulence of the virus concluded that rinsing with 1.5% and 3% H_2O_2 for 15-30 seconds had a minimal ability to inactivate the virus compared to PVP-I, which totally inactivated it. Similar findings were observed in the (Gottsauner et al., 2020) pilot study, which revealed the insignificance of the use of 1% H2O2. Notably, 3% H_2O_2 rinse and hypertonic saline nasopharyngeal wash provided favorable results in a study conducted by (Capetti et al., 2021). The type of swab and the addition of hypertonic saline may have been accountable for the differing results. Until now, there is no robust evidence to stand with or against the use of H2O2 mouthwashes for COVID 19.

Other available mouthwashes include Benzalkonium chloride, Quaternary Ammonium Compounds, and Cetyl-pyridinium chloride (CPC), which potentially eradicate fungi, yeast, and Gram-positive enveloped bacteria through disrupting the cell membrane. Additionally, Essential oils (e.g., eucalyptol oil and thymol) marketed as Listerine cool mint® are opined to interrupt the enveloping viral membrane given their potential antiviral activity towards herpes simplex virus. Till now, a few studies have tested the use of these compounds for combatting SARS-CoV-2. However, data presented by current literature seems assuring. Based on all these findings, it seems that PVP-I have the most robust evidence of use as a pre-procedural mouth rinse to inactivate the SARS-CoV-2 virus during aerosol-producing procedures. Compared to other mouthwashes, 1.5% hydrogen peroxide, 0.2% povidone, and 0.12% chlorhexidine rinsing with 100-ppm molecular iodine for as little as 30 seconds significant greater effect anti–SARS-CoV-2 efficacy. Notably, this eradication of the virus is very transient, lasting only three hours.

In this study, dental specialists, consultants, and general practitioners had a false belief regarding the favored mouthwash for COVID positive patients where the former two types of dentists believed that chlorhexidine is preferred. Whereas general practitioners assumed that Listerine (essential oils) may have a predominating impact on SARS-CoV-2 eradication compared to other mouthwashes. Different views were observed in Imran et al., (2021) study where dental specialists and consultants were better aware of the superiority of PVP-I over chlorhexidine.

Limitations

This study was filled online by participants, which may have caused a misunderstanding of the questions. However, the large sample size and the representativeness of the sample add power to the study. In addition, the current guidelines are still not developed and confusing, which may have affected the participants' initiative to read and accept data present in the available literature.

5. CONCLUSION

Overall, the chance of cross-infection, between dentists and patients, in dental clinics is high due to the nature of dental work. Based on the available literature, pre-procedural rinsing with PVP-I, at concentrations of 1 and 7%, is the most reliable means to reduce the salivary SARS-CoV-2 titers and diminish the viral virulence; despite the continued support of H_2O_2 use by dental care guidelines. In this study, dentists had poor knowledge and a negative attitude towards using mouthwashes for COVID 19. It is necessary to

educate dentists on the updated literature through continuing educational programs on this topic for best control of viral spread.

Funding

This study has not received any external funding.

Conflicts of interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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