

COVID-19 impact, knowledge and preparedness among dental hygienists in Saudi Arabia: A cross-sectional study

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Abstract

Objectives: The study investigates the impact of COVID-19 on dental hygiene professionals practising in Saudi Arabia, and measuring the knowledge and preparedness of dental hygienists to provide care during the pandemic.

Methods: A non-experimental, cross-sectional study was conducted targeting dental hygiene professionals in Saudi Arabia. The online survey consisted of 31 close-ended questions: 9-items related to demographics, and 22-items that are COVID-19 related. Data were tested at two levels; descriptive and preliminary using Chi-square test, and significance was set at the 0.05 level.

Results: One hundred and thirty-one responses were received and the final sample included one hundred and eighteen responses as it excluded unemployed dental hygienists with estimated 39.6% response rate. The stress level to return to practice was considered moderate among 65.3% of participants. Over two-thirds (73.7%) of dental hygienists were not providing any kind of care/treatment during quarantine. Generally, a moderate level of knowledge (57.8%) was demonstrated by participants. For preparedness level to practice during the pandemic, sixty-four dental hygienists (54.2%) were adequately prepared to provide care. Significant correlations were found between impact and knowledge ($p = 0.045$), impact and preparedness ($p = 0.053$), and knowledge and preparedness ($p = 0.024$).

Conclusions: Dissemination of COVID-19 protocols, guidelines and scientific literature increased the respondents' level of knowledge and preparedness to an adequate level. This study indicated that knowledgeable dental hygienists were significantly more prepared to treat patients during the pandemic and that stress positively influenced the COVID-19 knowledge acquisition. Non-practising dental hygienists during quarantine were more knowledgeable and more prepared to practice during the pandemic.

KEYWORDS

COVID-19, dental hygiene, impact, knowledge, pandemic, preparedness

1 | INTRODUCTION

On Dec 31, 2019, the World Health Organization (WHO) was officially notified by the Chinese Health Authority of 27 cases of an atypical fatal pneumonia.¹ The new strain was named by the International Committee on Taxonomy of Viruses (ICTV) as 'Severe Acute Respiratory Syndrome Corona Virus-2' (SARS-CoV-2).² The WHO named it 'COVID-19' and declared it a public health emergency on 31 Jan 2020.^{3,4} In China, soon after the fast spreading virus has already infected more than 3000 healthcare professional including dentists and had caused 22 deaths,^{5,6} the first review paper was published alerting dental professionals to the possible route of transmission of COVID-19 in dental clinics and that asymptomatic patients could spread the virus.⁷

On 2 March 2020, the first case of COVID-19 was detected in Saudi Arabia (SA)⁸ and by 11 March 2020, 118,000 cases were reported in 114 countries.⁹ The WHO declared COVID-19 a pandemic.⁹ A Day after, Meng et al¹⁰ confirmed the hidden danger of aerosolizing COVID-19 in dental practices and indicated that regular or standard Personal Protective Equipment (PPE) was not effective. However, aerosol-generating producers (AGP) and elective care in dental practices did not cease until a research study testing the virus viability in aerosol and fomites was published on 17 March 2020.¹¹ In response to the accumulating scientific evidence, the Centers for Disease Control and Prevention (CDC),¹² the American Dental Association (ADA),¹³ the American Dental Hygienists' Association (ADHA)¹⁴ and the Saudi Dental Hygiene Society (SDHS)¹⁵ issued their statements to postpone all AGP and elective dental procedures.

Results from an occupational risk exposure analysis to COVID-19 by the Occupational Safety and Health Administration (OSHA) and the Office for National Statistics (ONS) placed dental hygienists as one of the highest risk professions among all occupations for exposure to COVID-19 due to three main factors^{16,17}: First, dental hygienists have prolonged time of exposure to aerosols; secondly, they are in close proximity to patients; and lastly, they have frequent contact with others during a day. These elements earned them a 99.7 risk score to COVID-19.¹⁸ Additionally, most dental hygienists work as solo practitioners with no dental assistant who would help in the assessment of patients, control of aerosol, instrument sterilization and surface disinfection.¹⁹

The unprecedented circumstances give rise to many occupational safety and clinical questions in need of real-time evidence-based answers and clarification, before the resumption of AGP and elective dental hygiene care.²⁰ Dental hygienists are responsible and accountable for their practice, conduct and decision-making. Using the best scientific evidence in the Evidence-Based Decision-Making (EBDM) process concerning the delivery of dental hygiene care is of most importance during this period.²⁰ The aim of this study is to investigate the impact of COVID-19 on dental hygiene professionals in Saudi Arabia, and to measure the knowledge level and preparedness of dental hygienists to provide care during the pandemic.

1.1 | Operational definitions

1.1.1 | Impact

The impact of COVID-19 in this study included practice safety, financial impact, stress level and status of care provision.

1.1.2 | Knowledge

COVID-19 knowledge related to effectiveness of PPE during the pandemic, viability of COVID-19 and evidence-based dental hygiene practice.

1.1.3 | Preparedness

Preparedness to provide care during COVID-19 pandemic.

2 | METHODS AND MATERIALS

2.1 | Survey and study design

During May 2020, a non-experimental, cross-sectional study was conducted targeting a convenience sample of dental hygiene professionals in Saudi Arabia. Inclusion criteria are employed dental hygienists, senior students and interns. Unemployed dental hygienists were excluded as they would not have to resume dental hygiene care provision during the pandemic. Google Forms platform was used to develop and deliver the study survey. The Saudi Dental Hygiene Society (SDHS) was selected to distribute the survey through the society social media, targeting both members and non-members. Following approval of the King Saud University Institutional Review Board (IRB), the survey was launched on 15 May 2020 to the targeted population. A second survey distribution occurred one week after the initial launch on 22 May 2020 and was available for a total of two weeks. All responses were anonymous. Respondents' participation and return of the survey were considered voluntary consent.

The survey consisted of 31 close-ended questions: 9-items of demographics; 22-items that COVID-19 related; 4-items addressing impact; 12-items for knowledge and 6-items for preparedness. For the impact scale, responses were 'yes', 'no' or 'not applicable'; for treatment delivery, the following options were provided: front-line, regular clinical practice with the same hours, regular clinical practice with reduced hours, regular clinical practice without aerosols procedures, urgent dental hygiene care only, tele-dentistry or non-applicable.

For the knowledge scale, statements offered responses of 'true', 'false' or 'I don't know'. Knowledge questions were worded with a mixture of positive and negative responses to reduce response bias. The self-perceived preparedness scale included three levels of preparedness: fully prepared, meaning the subject had received all

required information and training; adequately prepared, meaning subjects had received some required information and training; and not prepared, meaning subjects did not receive any required information and training. Operational definitions for levels of preparedness were explained to participants within the survey.

2.2 | Survey instruments validation

Survey items were validated through a panel of the SDHS scientific committee, and validation letter was provided. Fifteen dental hygiene professionals provided feedback on the face validity of the instruments, and factor analysis was used for content validity.

2.3 | Statistical analysis

Data were tested at two levels: descriptive and preliminary. Descriptive analysis included frequencies and percentages of demographics, impact level, knowledge level and preparedness level. The baseline to determine impact and knowledge levels is less than 50% for low level, (51%–70%) for moderate level, and more than 70% for high level. The frequency count of the self-perceived preparedness scale was used to determine the level of preparedness. For preliminary analysis, relationships were tested using Chi-square between impact and knowledge, impact and preparedness, and between knowledge and preparedness. Significance was set at the 0.05 level. Statistical analysis was performed using the IBM Statistical Package for the Social Sciences (SPSS) version 25.

2.4 | Research questions

1. How did COVID-19 impact dental hygiene professionals in Saudi Arabia?
2. What are dental hygiene professionals' levels of knowledge related to COVID-19?
3. What are dental hygiene professionals' levels of preparedness to provide care during COVID-19 pandemic?

3 | RESULTS

One hundred and thirty-one responses were received. Thirteen responses were excluded as twelve respondents were unemployed and one response did not include employment data. The final sample included one hundred and eighteen responses. The most recent data regarding the total number of dental hygienists in Saudi Arabia were reported by the Saudi Commission for Health Specialties in 2017. At that time, the number of licenced Saudi dental hygienists was 298 hygienists.²¹ Accordingly, the estimated response rate of this study is 39.6%.

3.1 | Demographics

Table 1 illustrates demographic variables. Over two-thirds of the participants were female and aged 20–30 years. For undergraduate education, governmental education reported more than private dental hygiene education. According to educational level, 103 of the 118 participants hold bachelor's degrees (four years of full-time study and one-year internship), followed respectively by masters, diploma and PhD. Forty-seven participants were senior dental hygiene students and interns. For region of practice, the middle region had the most respondents, followed by west, east, south and north. For the years of clinical practice, the two highest groups were 1–5 years, followed by less than one year of experience.

3.2 | Impact of COVID-19

Table 2 shows the impact of COVID-19 on dental hygienists practising in Saudi Arabia. Twenty-seven dental hygienists out of 118 were asked to work under conditions that could jeopardize their personal safety. Some dental hygienists were directed by their employers to provide elective procedures during postponing period (quarantine) or were working without recommended PPE during the pandemic. Over two-thirds of dental hygienists were not affected financially during the current pandemic. Seventy-seven dental hygienists felt stressed going back to provide dental hygiene care. Over two-thirds of dental hygienists were not providing any kind of care/treatment during quarantine. The following clinical care was delivered during quarantine from highest to lowest percentage, respectively; regular clinical care with reduced hours, urgent dental hygiene care only, frontline, regular clinical practice with same hours, tele-dentistry, regular clinical practice without aerosolization.

3.3 | Knowledge of COVID-19

Table 3 illustrates the correct responses for knowledge questions. Overall, participants showed a moderate level of knowledge (57.8%). Almost all of respondents showed a high level of knowledge concerning dental hygiene's occupational risk classification for COVID-19. Eighty-five dental hygienists considered COVID-19 an airborne infection. Dental hygienists were knowledgeable about level of aerosols generated during ultrasonic debridement, travel distance of aerosols and the viability of COVID-19 in the air. However, a low level of knowledge was reported regarding evidence-based dental hygiene practice and effectiveness of regular personal protective equipment (PPE). For the use of masks during the COVID-19 outbreak, respondents were not knowledgeable regarding the effectiveness of surgical masks nor the usage of the (N95) respirator.

TABLE 1 Frequencies and percentages of demographic variables ($N = 118$).

Variables		Frequencies (n)	Percentage (%)
Gender	Female	87	73.7
	Male	31	26.3
Age	20–30 years	80	67.8
	31–40 years	25	21.2
	41–50 years	13	11.0
Nationality	Saudi	112	94.9
	Non-Saudi	5	4.2
Undergraduate Degree	Governmental	108	91.5
	Private	9	7.6
Level of Education	Bachelor	103	87.3
	Masters	11	9.3
	Diploma	3	2.5
	PHD	1	0.8
Employment	Employed	71	60.2
	Intern	25	21.2
	Student	22	18.6
Employment Capacity	Clinical	87	73.7
	Academic	10	8.5
	Administrative	1	0.8
Region of Practice	Middle	69	58.5
	West	18	15.3
	East	10	8.5
	South	7	5.9
	North	5	4.2
Years of Clinical Experience	Less than one year	33	28.0
	1–5 years	51	43.2
	6–10 years	14	11.9
	11–15 years	6	5.1
	More than 15 years	13	11.0

3.4 | Preparedness to practice during the pandemic

For preparedness level to practice during the pandemic, dental hygienists generally reported to be adequately prepared to provide care (see Table 4). The following shows the descending order of 'not prepared' categories: treating confirmed COVID-19 patient; joining the frontline during the COVID-19 pandemic; dealing with aerosol-generating procedures; wear/handle a respirator (N95); educating patients during COVID-19 pandemic; and treating patients during the COVID-19 pandemic with adequate infection control information/ training.

3.5 | Preliminary relationships

(Table 5) shows the significant correlations between impact and knowledge, impact and preparedness, and knowledge and

preparedness. No reported correlations were not statistically significant. Regarding impact and knowledge, stressed dental hygienists were more knowledgeable about the use of N95 masks compared with non-stressed dental hygienists; however, practising dental hygienists during quarantine were less knowledgeable about the transmission characteristics of COVID-19 and the viability of COVID-19 in the air compared with non-practising dental hygienists. Concerning impact and preparedness, non-practising dental hygienists during quarantine felt more prepared to provide care during the pandemic as compared to practising dental hygienists.

Regarding the relationship between knowledge and preparedness, dental hygienists who were knowledgeable about aerosol management were significantly more prepared to treat patients during the pandemic and more prepared to join the frontline. As well as dental hygienists who have higher knowledge in effective PPEs and usage of N95 mask were significantly more prepared to deal with aerosol-generating procedures and to treat a confirmed COVID-19 patient.

Impact of COVID-19 on Respondents	Yes	No	Not applicable
Have you been forced to work under conditions that could jeopardize your personal safety and well-being?	<i>n</i> = 27 (22.9%)	<i>n</i> = 86 (72.9%)	<i>n</i> = 4 (3.4%)
Have you been affected financially from working as dental hygienist during COVID-19 pandemic?	<i>n</i> = 17 (14.4%)	<i>n</i> = 85 (72.0%)	<i>n</i> = 15 (12.7%)
Do you feel stressed going back to work and providing dental hygiene care?	<i>n</i> = 77 (65.3%)	<i>n</i> = 32 (27.1%)	<i>n</i> = 9 (7.6%)
Are you currently providing any care during the COVID-19 pandemic?	<i>n</i> = 27 (22.9%)	<i>n</i> = 87 (73.7%)	<i>n</i> = 4 (3.4%)

TABLE 2 Impact of COVID-19 on dental hygienists in Saudi Arabia (*N* = 118)

Knowledge of COVID-19 statements	Correct responses
An Evidence Based Dental Hygiene Practice is mostly based on clinical experience and judgement	<i>n</i> = 25 (21.2%)
Dental hygiene practice is classified as a high-risk occupation for COVID-19	<i>n</i> = 116 (98.3%)
COVID-19 has not impacted the practice of dental hygiene profession	<i>n</i> = 103 (87.3%)
Regular PPE are effective in preventing COVID-19	<i>n</i> = 53 (44.9%)
COVID-19 is an airborne infection	<i>n</i> = 33 (28.0%)
COVID-19 can remain as aerosol in an active status up to 3 hours	<i>n</i> = 81 (68.6%)
Ultrasonic debridement does not have the highest capability to produce and generate aerosols	<i>n</i> = 97 (82.2%)
Aerosols generating from ultrasonic debridement could travel up to 6 feet	<i>n</i> = 80 (67.8%)
Medical conditions that could necessities non-surgical periodontal debridement are cancer, cardiac, and transplant clearance patients	<i>n</i> = 80 (67.8%)
A surgical mask can prevent aerosol transmission	<i>n</i> = 51(43.2%)
N95 masks must be used when aerosol-generating procedures are performed and could be reused	<i>n</i> = 35 (29.7%)
Hand instrumentation does not require an N95 mask	<i>n</i> = 64 (54.2%)

TABLE 3 Dental hygienists knowledge of COVID-19 including frequencies and percentages of correct responses (*N* = 118).

4 | DISCUSSION

4.1 | Impact of COVID-19

Dental professionals were concerned globally about theirs and their patients' safety and well-being during the period of the outbreak. Due to the American Dental Hygienists' Association' (ADHA) advocacy during April 2020, dental hygienists in the USA were asked to contact their governors and urge them to continue postponing elective procedures as some practitioners were told by their employers to return to their regular practice.²² The International Federation of Dental Hygienists (IFDH) also conducted a series of COVID-19 surveys. Its second survey aimed to understand the impact of the COVID-19 pandemic on global dental hygienists, dental therapists and oral health therapists.²³ Saudi Arabia was not among the responding countries, fuelling the need to evaluate the impact

of COVID-19 on dental hygienists in Saudi. As compared to global dental hygiene populations, the safety of Saudi dental hygienists may have been less threatened as the majority of practitioners work in the governmental sector where strict guidelines are followed regarding practice safety. In the current study, only a few practitioners in the private sector were asked to work under conditions that could risk their safety during the pandemic.

A study examined the employment patterns of dental hygienists in the United States during the COVID-19 pandemic.²⁴ Findings indicated that 7.9% of dental hygienists have exited the workforce with an estimated reduction of 18,000 dental hygienists from the workforce since the onset of the COVID-19 pandemic.²⁴ Analysis from the study suggested that the departure from the dental hygiene workforce is voluntary and most likely to be short-termed with reentering the workforce after vaccination or the passes of the pandemic.²⁴ Similarly, a survey was conducted by the RDH magazine evaluating the work situation and financial status of registered

TABLE 4 Preparedness of dental hygienists to provide care during COVID-19 pandemic (N = 118).

Preparedness to provide care questions	Fully prepared	Adequately prepared	Not prepared
Are you prepared with adequate infection control information/training to operate on patients during the COVID-19 pandemic?	n = 37 (31.4%)	n = 64 (54.2%)	n = 17 (14.4%)
Are you prepared with adequate information/training to treat a confirmed COVID-19 patient?	n = 20 (16.9%)	n = 56 (47.5%)	n = 41 (34.7%)
Are you prepared with adequate information/training to deal with aerosol-generating procedures during the COVID-19 pandemic?	n = 31 (26.3%)	n = 52 (44.1%)	n = 34 (28.8%)
Are you prepared with adequate information/training to wear/ handle respirator (N95) during the COVID-19 pandemic?	n = 36 (30.5%)	n = 48 (40.7%)	n = 33 (28.0%)
Are you prepared with adequate information/training to educate patients about COVID-19 during the pandemic?	n = 39 (33.1%)	n = 54 (45.8%)	n = 24 (20.3%)
Are you prepared with adequate information/training to join the frontline during the COVID-19 pandemic?	n = 21 (17.8%)	n = 59 (50.0%)	n = 37 (31.4%)

dental hygienists in the United States during the pandemic.²⁵ Among the 2,200 responses, 82% of RDHs had applied for unemployment, and 22% were using their savings for living expenses. Resultantly, some were evaluating changing their profession completely.²⁵ In the UK, dental hygienists reported their primary concern during the pandemic was the financial impact, as a majority of them are self-employed.²⁶ Only 14.4% of Saudi dental hygienists were financially affected by the pandemic, perhaps because majority of dental hygienists in Saudi practising in governmental sector with greater job security relative to the private sector.²⁷

According to a study conducted in Saudi Arabia, health workers showed an increased probability of becoming mildly to severely distressed due to COVID-19, based on health professionals' high exposure to the risk of contracting and spreading the disease.²⁷ The findings showed that being a health worker, a frontline health worker, a young person and a private sector employee were related to distress in Saudi Arabia.²⁷ These contributing factors may apply to participants in this study, explaining the reported stress level of dental hygienists in Saudi Arabia (65.3%), which is considerably higher than US dental hygienist (25.7%).²⁸ This difference could be due to the fact that this study was conducted early in the pandemic and before the emergence of vaccination.

Concerning the level of treatment provided during May 2020, nationally and internationally, most dental hygienists were not providing any care at that time.²³ For the small percentage of practising dental hygienists, global data differed when compared to Saudi Arabia. Globally, dental hygienists were mainly providing non-aerosolizing procedures,²³ while in Saudi Arabia, they were mainly practising routine procedures including aerosols but with reduced practice hours; thus, they were not strictly following the SDHS statement on COVID-19¹⁵ that recommends limited use of aerosolizing procedures. Accordingly, infection control practice and the rate of COVID-19 infection need to be examined among dental hygienists in Saudi during the pandemic. In the United States, a low rate of COVID-19 infection was reported among dental hygienists,²⁸ which might reflect a high level of infection control practice.

4.2 | Knowledge of COVID-19

Before COVID-19, studies conducted among dental professionals in SA and the USA showed a low level of knowledge regarding standard PPE.^{29,30} Post-COVID-19, an increased level of knowledge of standard PPE was observed in several studies.^{31,32} This change in

Impact of COVID-19	Knowledge of COVID-19	Pearson Chi-square significance
Psychological impact of feeling Stressed going back to work	Knowledge of N95 mask usage in aerosol-generating procedures	0.045
Occupation status of providing care during the pandemic	Knowledge of COVID-19 being airborne disease	0.026
Occupation Status of providing care during the pandemic	Knowledge of the viability of COVID-19 in the air	0.035
Occupation Status of providing care during the pandemic	Knowledge of aerosol transmission using surgical mask	0.017
Impact of COVID-19	Preparedness to Provide Care	Pearson Chi-Square Significance
Occupation Status of providing care during the pandemic	Preparedness to deal with aerosol-generating procedures	0.053
Knowledge of COVID-19	Preparedness to Provide Care	Pearson Chi-Square Significance
Knowledge of effectiveness of regular PPE in preventing COVID-19	Preparedness to deal with aerosol-generating procedures	0.024
Knowledge of the capability of ultrasonic debridement in generating aerosols	Preparedness to join the frontline during COVID-19 pandemic	0.023
Knowledge of travel distance of aerosols generated from ultrasonic debridement	Preparedness to operate on patients during COVID-19 pandemic	0.000
Knowledge of the usage of N95 mask during aerosols generating procedures	Preparedness to treat a confirmed COVID-19 patient	0.008

TABLE 5 Significant correlations between impact, knowledge and preparedness among dental hygienists in Saudi Arabia during COVID-19 pandemic

knowledge post-COVID-19 can be explained by Maslow's Hierarchy of Human Needs. Maslow prioritized certain basic human needs according to their strength and power to motivate and influence behaviors.³³ He indicated that in times of danger and uncertainty or when being confronted with a health threat such as COVID-19, the need to ensure safety becomes paramount.³³ The feeling of stress could have encouraged the scientific inquiry of standard PPE and COVID-19 mitigation,³⁴ as stressed dental hygienists in the study demonstrated a higher level of knowledge compared with non-stressed dental hygienists. Estrich CG et al. supported that finding as consistent adherence to PPE guidance was highest among dental hygienists who were most concerned about COVID-19.²⁸

Although an increase in the level of knowledge among Saudi dental hygienists was observed post-COVID-19, the majority of participants felt that EBDM practice depends mostly on clinical experience and judgement. While information learned in dental hygiene school and past clinical experience plays a role in EBDM, scientific research using a hierarchy of evidence is a key element of EBDM in dental hygiene practice for more than 20 years.³⁵ The EBDM model was developed to ensure precise and up to date best practice treatment interventions and to answer real-time clinical questions and situations that arise, such as COVID-19.³⁶ Having the ability to navigate and critically appraise recent, relevant, and reliable scientific knowledge are required skills for dental hygienists.

Although findings revealed an overall moderate level of knowledge about COVID-19, deficits were noted in knowledge of effectiveness of regular personal protective equipment (PPE), the usage of masks during the COVID-19 outbreak, and the effectiveness of surgical masks, and the usage of the (N95) respirator. Conversely, USA dental hygienists showed low level of knowledge regards coronavirus incubation periods, disease transmission, actions in dealing with positive cases and precautionary measures.²⁸ Constantly changing information about COVID-19 could have influenced this difference in knowledge.

4.3 | Preparedness to practice during the pandemic

Preparedness can be influenced by a variety of factors. It is not always possible to demonstrate a complete preparedness in all aspects of practice, especially when dealing with an evolving pandemic.³⁷ Preparedness evaluation is essential to determine areas of weaknesses, which can then address by appropriate education, training and consolidation.³⁷ In the light of COVID-19, dental hygienists globally face a significant uncertainty regarding their safety of practice. This uncertainty may impact their confidence and preparedness to provide care. Few United States dental professionals felt fully prepared to reenter their dental practices after a three-month

slowdown and to comply with OSHA and CDC regulations.³⁸ Dental hygienists in this study reported adequate levels of preparedness; similarly, Al-Khalifa et al.³⁷ reported acceptable levels of preparedness to practice among dental practitioners in Saudi Arabia during COVID-19. Interestingly, as with knowledge levels, non-practising dental hygienists during quarantine showed a higher level of preparedness as opposed to practising dental hygienists. Non-practising dental hygienists may have been less stressed and had more time to attend educational webinars and thus be better prepared to confront COVID-19.³⁷ Decision-makers in Saudi Arabia, such as the SDHS, dental hygiene departments and educational programmes, play a vital role in preparedness evaluation, and recognizing professionals' concerns. One third of sampled dentists in Saudi Arabia reported no modified work plans for COVID-19 in their practices³⁷; however, thirty-five per cent of dental practices in the USA have started creating strategic plans to confront the virus and practice effectively.³⁹ Leaders and decision-makers in Saudi Arabia should establish both immediate- and long-term strategic plans to fully prepare dental professionals for pandemics.

4.4 | Preparedness in relation to knowledge

This study shows that preparedness and knowledge are interdependent and mutually reinforcing. During this exceptional time, national and international efforts have been made to disseminate knowledge and awareness about COVID-19.¹²⁻¹⁶ Knowledge evaluation and intervention are needed regularly during the pandemic as guidelines are being updated to ensure proper preparation and safe practice. This study indicated that dental hygienists with high level of knowledge were significantly more prepared to treat patients during the pandemic, to join the frontline, and to deal with aerosol-generating procedures. In Canada, a knowledge exchange coalition detailing the augmentation of standard practices was developed to provide a return-to-work guidelines and ensure safety for patients, oral healthcare providers (OHPs) and the community. This was a multiorganizational effort that included government, academia, hospitals, oral health professions and regulators. This knowledge exchange coalition offered a series of open-access education webinars resulting in increased confidence and preparedness of OHPs from 26% to 93% confirming that the higher level of knowledge appears to increase the level of preparedness.⁴⁰ This experience could be a benchmark for other countries to establish COVID-19 strategies for dental professionals.

4.5 | Limitation

Since this is a cross-sectional study, only a single point in time was measured, which was the beginning of COVID-19 pandemic. Ongoing evaluation is needed to analyse change over time with different peaks and evolving guidelines. Self-reporting and voluntary participation may introduce bias. However, using online surveys was

the ideal option during the pandemic. Therefore, this study's participants had to have access to Internet and specifically social media. When not available, the generalizability of study findings could be threatened. Using social media may have limited the opportunity to participate in this study affecting the sample size. The target group was employed dental hygienists, senior students and interns. During the pandemic, the total number of the target population was not available; hence, the response rate was calculated according to the most recent report of total number of dental hygienists in Saudi Arabia during 2017. This approach may have affected the response rate reported in this study.

5 | CLINICAL RELEVANCE

5.1 | Scientific rationale for study

Dental hygienists are concerned globally about the safety of practice during the pandemic as they have a prolonged time of exposure to aerosols, frequent contact with others during a workday and practice in close proximity to patients.

5.2 | Principal findings

This study indicated that dental hygienists with high level of knowledge were significantly more prepared to treat patients during the pandemic; and that stress played a positive role in COVID-19 knowledge acquisition. Non-practising dental hygienists during quarantine were more knowledgeable and more prepared to practice during the pandemic.

5.3 | Practical implications

A scale measuring dental hygienists' COVID-19 preparedness and knowledge would be useful to evaluate the need for educational and clinical training. The COVID-19 training should be customized for dental hygiene professionals to ensure the optimum gain of knowledge and preparedness.

6 | CONCLUSION

Knowledge levels, preparedness and impacts of COVID-19 varied among dental hygienists in Saudi Arabia. Like their global counterparts, constantly changing information, practice inconsistencies and stress levels were influencers. Periodic knowledge evaluation is crucial due to rapidly evolving science as the study showed a significant relationship between knowledge and preparedness. Stress related to COVID-19 has positively influenced the knowledge acquisition, yet reported stress level among Saudi dental hygienists is a concern. Non-practising dental hygienists during quarantine were

significantly more knowledgeable and prepared to provide care. As the first national assessment of dental hygiene professionals and COVID-19, this study establishes a baseline reference for dental hygiene practice in Saudi Arabia. This baseline will help decision-makers create strategic plans to address dental hygiene practice amid the current pandemic and potential future outbreaks.

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AUTHOR CONTRIBUTIONS

Futun N. Alkhalifah, BSDH and MSDH involved in conceptualization, methodology, data analysis and interpretation, visualization, writing- original draft and final approval of the version to be published. **Ayoub Y. Tobbal, RDH, BSDH, MSDH and MPA** involved in conceptualization, writing the original draft, and writing, reviewing and editing. **Jacquelyn L. Fried, RDH and MS** involved in conceptualization, supervision, and writing, reviewing and editing.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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