

Knowledge, attitudes and practices regarding COVID-19 among dental health care professionals: a cross-sectional study in Saudi Arabia

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Abstract

Objectives: With the increasing severity of the coronavirus disease (COVID-19) pandemic, it is essential that dental health care professionals (DHCPs) are prepared. The study aim was to

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assess the knowledge, attitudes and practices (KAP) regarding COVID-19 among DHCPs in Saudi Arabia.

Methods: A cross-sectional study using a web-based survey was conducted. A validated and reliable questionnaire was developed that comprised 44 questions. Using Qualtrics survey software, DHCPs working in different settings were approached across five geographical regions of Saudi Arabia.

Results: A total of 318 respondents voluntarily participated in the survey. Most DHCPs showed a moderate level of knowledge (51.6%), a positive attitude (92.1%) and adequate practice standards (86.5%). We found that 94.7% of DHCPs had an adequate overall level of KAP. DHCPs with a doctorate significantly outscored DHCPs with other educational levels with respect to knowledge and practice. Older (51–60 years) DHCPs reported significantly more knowledge than younger DHCPs.

Conclusion: DHCPs displayed an average level of knowledge that needs to be enhanced through continuing education programmes. However, they showed a positive attitude and an acceptable level of practice, as they were abiding by guidelines issued from various international and national health agencies.

Keywords

COVID-19, KAP study, infection control, dental professionals, coronavirus prevention, Saudi Arabia, knowledge, attitude, practice

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Introduction

In the last few decades, there have been several global viral epidemics. Recently, coronavirus disease (COVID-19) has become a viral pandemic. In December 2019, people in Wuhan, in China's Hubei Province, reported many linked cases of unexplained pneumonia-like symptoms.¹ The etiological agent of this pneumonia was later discovered to be a virus, and was named 2019-nCoV.² This virus belongs to the same family of β -coronaviruses that caused the severe acute respiratory syndrome (SARS) outbreak in 2003 and the Middle East respiratory syndrome (MERS) outbreak in 2012.^{3,4} To date, six human coronaviruses have been identified. The International Committee on Taxonomy of Viruses has named the latest virus SARS-CoV-2

(severe acute respiratory syndrome coronavirus-2). The disease caused by this virus was named COVID-19 in February 2020 by the World Health Organization (WHO).¹

Owing to the contagious nature of COVID-19, it has spread widely across the world. In January 2020, the National Health Commission of China categorized COVID-19 as a Group B infectious disease (along with influenza and SARS). Despite this categorization, health care workers (HCWs) were instructed to follow the same infection control and prevention protocols as for Group A diseases such as cholera and plague.^{2,5} The WHO later declared COVID-19 to be a public health emergency of international concern.¹

The Kingdom of Saudi Arabia (KSA) reported its first case of COVID-19 on 2

March 2020. The number of infections increased until June, when a nationwide lockdown was imposed. From June 21, the country started reopening in sequential phases as the recovery rate increased.⁶ However, the risk from asymptomatic cases cannot be ruled out. Additionally, the highly contagious nature and rapidly mutating viral genome that characterizes COVID-19 are of great concern for society generally and for HCWs.⁷ It is therefore essential that the authorities, HCWs and the public are aware of the nature of the disease and ways to prevent its spread.

HCWs are the frontline workers in any pandemic. Along with elderly people and individuals with comorbidities such as cardiovascular disease, respiratory disease, diabetes and cancer, HCWs are at an increased risk of acquiring COVID-19.^{8,9} Dental health care professionals (DHCPs) are no exception^{10,11} As dental treatment requires close proximity to patients, DHCPs are constantly exposed to infectious oral fluids, which can play a pivotal role in the dissemination of infection.⁸ Furthermore, DHCPs experience fear and psychological stress because of considerable work overload and low self-efficacy.^{12,13} Thus, it is important that DHCPs are kept abreast of the latest guidelines and recommendations to effectively treat patients and simultaneously protect themselves from disease. To address these issues, studies on DHCPs of different nationalities¹⁴⁻²⁰ have been carried out to assess their knowledge, attitudes and practices (KAP) regarding COVID-19. To the best of our knowledge, there are no studies assessing practice standards of DHCPs across KSA, although Khan et al.²⁰ assessed practice standards in the dental faculties of a single government university. Another study by Quadri et al.¹⁹ assessed COVID-19 awareness levels across the nation. Along with international agencies such as the WHO and the Centers for Disease Control and Prevention (CDC), the

KSA Ministry of Health (MOH) issued guidelines for conducting various dental procedures in the categories of emergent, urgent and regular dental care.²¹⁻²³ It is imperative that DHCPs strictly adhere to the guidelines to mitigate the spread of COVID-19. Thus, the primary aim of this study was to evaluate and compare the KAP regarding COVID-19 of DHCPs working in different health care sectors in various regions of KSA.

Material and methods

Study characteristics

Given the objectives, a nationwide observational study was planned and a hospital/institutional-based cross-sectional study design developed. Ethical approval (14-07/41; dated 22 March 2020) was obtained from the Local Committee of Bioethics. Written informed consent for participation was obtained in accordance with the national legislation and institutional requirements. The study was conducted within the framework of the STrengthening the Reporting of OBservational Studies in Epidemiology (STROBE) guidelines²⁴ during the last week of March (23 March to 30 March 2020).

Sample characteristics

This survey was carried out to assess KAP regarding COVID-19 among DHCPs in KSA. The study excluded medical professionals (e.g. physicians, surgeons, auxiliaries and allied HCWs). Students enrolled in any health care-related course, and health care professionals not licensed to work/practice in KSA were also excluded. To obtain a representative sample from the heterogeneous study population of DHCPs, a multistage sampling technique was used. In the first stage of sampling, based on geographical boundaries, the entire population of DHCPs in KSA was divided into five

clusters (north, east, west, central, and south). Using a simple random method, one academic and non-academic centre each was subsequently selected from each geographical cluster. Thus, a total of 400 DHCPs from 10 randomly selected clusters were approached via WhatsApp groups.

Study tool

A questionnaire was used to assess different aspects of COVID-19-related KAP among DHCPs. An expert committee was formed that comprised members from various disciplines, including dental public health, respiratory medicine, oral medicine and biostatistics, and several translators with expertise in both English and Arabic. The committee developed the questionnaire based on the available guidelines and information about COVID-19.^{5,14,25,26} As a large portion of the study population comprises Arabic speakers, forward and backward translation of the questionnaire was conducted by two independent groups of bilingual translators. Construct and content validity was assessed and suggestions were incorporated into the final version of the questionnaire. Reliability was assessed by distributing the questionnaire to 20 subjects at an interval of 1 week. The reliability coefficient was 0.85, which indicates an acceptable level of consistency. The questionnaire comprised 44 closed questions with 15, 14 and 15 questions, respectively, on knowledge, attitudes and practices. The knowledge and practice domain response options were 'yes', 'no' and 'I don't know'. For the attitude domain, a 5-point Likert scale was used.

Study protocol

The questionnaire was developed using Qualtrics survey software and circulated via an electronic portal. The first part of the questionnaire informed participants about the study and explained that

participation was voluntary. The identity of participants who filled in the questionnaire was kept anonymous.

Data analysis

The responses to the three KAP domains were collated and entered into a Microsoft Excel spreadsheet. Prior to the analysis, all correct item responses were given a value of 1 and inappropriate/incorrect responses received 0. These values were summed to produce an outcome total score for every respondent. In addition, individual scores on each KAP domain were combined to obtain an overall score. Following Alduraywish et al. (2020),²⁷ cutoff values were created to code each KAP domain score and the overall score using an ordinal scale with three categories. Correspondingly, the knowledge and practice scores were categorized as 'adequate' (11–15), 'average' (6–10) and 'inadequate' (0–5). For the attitude domain, the categories were 'positive' (52–70), 'neutral' (33–51) and 'negative' (14–32). Similarly, the overall KAP score was categorized as 'adequate' (72–100), 'average' (43–71) and 'inadequate' (14–42).

Data are presented as numbers and percentages. Inferential analysis was carried out using the chi-square test and 95% confidence interval. Significant associations were subjected to Spearman's correlation and ordinal logistic regression. All analysis was carried out using IBM SPSS Statistics for Windows, version 21.0 (IBM Corp., Armonk, NY, USA). Results were considered significant at $P < 0.05$.

Results

Sample characteristics

A total of 318 DHCPs responded with completed questionnaires, a response rate of 79.5%.

The sample comprised mainly young (20–30 years; 44.3%) male (66%) professionals. Although, this was a nationwide survey, most (44.7%) of the responses were from the northern region of KSA and the fewest from the eastern region. Regarding educational background, most respondents (55.7%) had a bachelor's degree with work experience of 1 to 3 years (45%). In terms of work setting, more than half (62.6%) of the DHCPs were employed in the government sector, and 38.1% worked in academic-based institutions (Table 1). The MOH website was the most popular source of information (79.2%), compared with the other available options of professional colleagues (16.4%), social media (56.9%) and specialty journals (24.2%) (Table 1).

Analysis of knowledge scores

We found that 94.7% of DHCPs had an adequate overall level of KAP. Most (51.6%) respondents had an average level of knowledge; only 2.2% had inadequate knowledge. Most respondents provided correct answers, except to the questions on the WHO guidelines for hand hygiene (correct response: 7.9%). DHCPs showed adequate knowledge of the COVID-19 incubation period (95.3% correct responses) and symptoms (97.5%) (Table 2). A significant positive correlation ($r = 0.131$; $P = 0.020$) was observed between the total knowledge score and age. Respondents aged 51 to 60 years were more likely to have adequate knowledge than their younger counterparts (Table 3). A positive correlation ($r = 0.207$; $P < 0.001$) was also observed between knowledge and educational level. DHCPs holding a diploma degree were the least likely to have an adequate level of knowledge compared with DHCPs with a doctorate (Table 3).

Analysis of attitude scores

Most (92.1%) DHCPs had a positive work attitude; only 1.3% had a negative attitude. Correct responses to infection control protocol questions ranged from 33.6% to 87.2%. Respondents showed the best attitude toward one set of particular infection control scenarios, which asked about the importance of personal protective equipment (PPE) (correct response 84.9%) in general and when transferring patients (87.2%). In contrast, most respondents replied incorrectly (5% correct response) to a question about the importance of the N95 mask (Table 4). A total of 71.1% of DHCPs did not agree with the statement that standard precautions should be followed, especially during an outbreak (Table 4).

Analysis of practice scores

Adequate standards of practice were reported by a large number (86.5%) of respondents, with only 0.6% having inadequate standards. Practice aspects related to awareness of infection (98.4%), associated risk factors (96.9%), infectious nature of patients (97.8%) and the procedures to be followed during COVID-19 infection (96.5%) showed extremely good standards (Table 5). However, 36.5% of respondents answered incorrectly that PPEs should be used only during an outbreak. Total practice scores were significantly ($P = 0.001$) associated with educational level (Table 1); however, there was no significant correlation between total KAP scores and educational level.

Discussion

Cases of COVID-19 in KSA are increasing daily. COVID-19 is a rapidly spreading and contagious disease that has surpassed SARS and MERS in mortality and rate of transmission.^{6,28} A game changer that could

Table 1. Frequency distribution showing descriptive and inferential analysis of baseline variables and knowledge, attitude, practice and overall scores.

Variable	Responses	Frequency - n (%)	Knowledge	Attitude	Practice	Overall
Sample size (n)		318				
Demographic & biographical data			P-value			
Age (years)	20–30	141 (44.3)	0.040 [†]	0.659	0.208	0.886
	31–40	113 (35.5)				
	41–50	53 (16.7)				
	51–60	11 (3.5)				
Gender	Male	210 (66)	0.373	0.632	0.486	0.739
	Female	108 (34)				
Nationality	Saudi	182 (57.2)	0.033 [†]	0.366	0.005 [†]	0.686
	Non-Saudi	136 (42.8)				
Region of Saudi Arabia	Central region (Riyadh, Qassim)	79 (28.4)	0.278	0.392	0.208	0.715
	Eastern region (Dammam, Jubail, Hassa & others)	19 (6)				
	Western region (Makkah, Jeddah, Taif & Madinah)	54 (17)				
	Northern region (Hail, Aljouf, Tabouk & Arar)	142 (44.7)				
	Southern region (Assir, Jazan, Najran & Baha)	24 (7.5)				
Education and work-related data						
Educational level	Intern	30 (9.4)	0.001 [‡]	0.144	0.001 [‡]	0.238
	Diploma degree/Associate college	19 (6)				
	Bachelor's degree	177 (55.7)				
	Master's degree	66 (20.8)				
	Doctorate/PhD	26 (8.2)				
Work experience (years)	1–3	143 (45)	0.113	0.431	0.372	0.909
	4–6	51 (16)				
	7–10	44 (13.8)				
	> 10	80 (25.2)				
Nature of organization	Government	199 (62.6)	0.357	0.802	0.384	0.421
	Private	119 (37.4)				

(continued)

Table 1. Continued.

Variable	Responses	Frequency - n (%)	Knowledge	Attitude	Practice	Overall
Work setting	Non-academic	60 (18.9)	0.380	0.947	0.513	0.990
	Private clinic	42 (13.2)				
	Primary health care centre	27 (8.5)				
	Regional/Public hospital	31 (9.7)				
	Specialized hospital/Referral centre	34 (10.7)				
Source of knowledge	Private hospital or medical complex	3 (0.9)				
	Military hospital/Medical clinic	121 (38.1)				
	University hospital/Clinic	181 (56.9)	0.648	0.701	0.657	0.584
	Social media	52 (16.4)	0.018 [†]	0.205	0.816	0.825
	Professional colleague	252 (79.2)	0.332	0.207	0.579	0.055
Overall score	Ministry of Health website	77 (24.2)	<0.001 [‡]	0.998	0.047 [†]	0.450
	Journals	Inadequate 1 (0.3)		Average 16 (5)		Adequate 301 (94.7)

Note: [†]P < 0.05; [‡]P < 0.01.

Table 2. Descriptive analysis of responses related to knowledge domain.

Category of information	Question (Correct response)	Response N (%)		
		Yes	No	I Don't Know
Nomenclature/Identification of causative organism	*COVID-19 is known as SARS-CoV-2. Coronavirus is the causative organism responsible for Middle East respiratory syndrome (MERS), severe acute respiratory syndrome (SARS) and coronavirus disease 2019 (COVID-19). The Chinese horseshoe bat is the most probable origin of COVID-19.	108 (34)	119 (37.4)	91 (28.6)
		219 (68.9)	43 (13.5)	56 (17.6)
Origin of infection	*The main source of the COVID-19 virus is a plant. Has COVID-19 any intermediate host? COVID-19 is transmitted by close contact with an infected person or animal. COVID-19 can be transmitted from respiratory droplets and contact.	2 (0.6)	267 (84)	49 (15.4)
Transmission	The virus incubation time is 1–14 days. Fever, dry cough and shortness of breath are the hallmark symptoms of COVID-19. People with comorbidity (diabetes mellitus and other chronic diseases) are more likely to be infected with COVID-19.	114 (35.8)	94 (29.6)	110 (34.6)
		261 (82.1)	38 (11.9)	19 (6)
Symptoms of infection	The virus incubation time is 1–14 days. Fever, dry cough and shortness of breath are the hallmark symptoms of COVID-19. People with comorbidity (diabetes mellitus and other chronic diseases) are more likely to be infected with COVID-19.	312 (98.1)	3 (0.9)	3 (0.9)
		303 (95.3)	5 (1.6)	10 (3.1)
High-risk group	The virus incubation time is 1–14 days. Fever, dry cough and shortness of breath are the hallmark symptoms of COVID-19. People with comorbidity (diabetes mellitus and other chronic diseases) are more likely to be infected with COVID-19.	310 (97.5)	5 (1.6)	3 (0.9)
		252 (79.2)	40 (12.6)	26 (8.2)
Prognosis	COVID-19 has a lower fatality rate than MERS-CoV. The PCR test can be used to diagnose COVID-19. *Antibiotics are the first-line treatment for COVID-19. *As per the guidelines issued from the health authorities, washing hands with soap and water for at least 30 seconds can help to prevent COVID-19. *A COVID-19 vaccination is available on the market.	173 (54.4)	67 (21.1)	78 (24.5)
		155 (48.7)	27 (8.5)	136 (42.8)
Investigation	*Antibiotics are the first-line treatment for COVID-19. *As per the guidelines issued from the health authorities, washing hands with soap and water for at least 30 seconds can help to prevent COVID-19. *A COVID-19 vaccination is available on the market.	45 (14.2)	214 (67.3)	59 (18.6)
		285 (89.6)	25 (7.9)	8 (2.5)
Prevention	*As per the guidelines issued from the health authorities, washing hands with soap and water for at least 30 seconds can help to prevent COVID-19. *A COVID-19 vaccination is available on the market.	2 (0.6)	299 (94)	17 (5.3)
		Inadequate 7 (2.2)	Average 164 (51.6)	Adequate 147 (46.2)

*Negatively worded question.

Table 3. Correlation and ordinal logistic regression analysis of age and professional level with knowledge domain scores.

Variable	Response	Spearman correlation: Knowledge score with age and educational level		Ordinal logistic regression: Knowledge score with age and educational level				
		P-value	(Spearman correlation coefficient)	Estimate	P-value	Lower bound	Upper bound	Pseudo R square
Age (years)	20–30		0.020[†] (0.131)	-2.653	0.013 [†]	-4.736	-0.569	0.026
	31–40	-2.529		0.018 [†]	-4.619	-0.440		
	41–50	-2.161		0.046 [†]	-4.287	-0.035		
	51–60	Reference: 51–60 years						
Education level	Intern		<0.001* (0.207)	-1.245	0.030 [†]	-2.367	-0.123	0.039
	High School Diploma	-2.256		0.001 [‡]	-3.583	-0.929		
	Bachelor's degree	-1.397		0.003 [‡]	-2.314	-0.480		
	Master's degree	-0.645		0.204	-1.641	0.350		
	Doctorate/PhD	Reference: Doctorate/PhD						

[†]P < 0.05; [‡]P < 0.01; *P < 0.001.

Table 4. Descriptive analysis of responses related to attitude domain.

Category of information	Question	Response N (%)				
		SD	D	N	A	SA
Awareness of COVID-19	Health care professionals must acquaint themselves with all the available information about COVID-19.	8 (2.5)	0	9 (2.8)	77 (24.2)	224 (70.4)
	Any information related to COVID-19 should be disseminated among peers and other health care workers.	5 (1.6)	6 (1.9)	18 (5.7)	85 (26.7)	204 (64.2)
Precipitating factor	Compliance with any local restrictions on travel, movements or large gatherings is an important means of prevention.	5 (1.6)	2 (0.6)	6 (1.9)	41 (12.9)	264 (83)
Symptoms	People with fever, cough and difficulty breathing should seek medical attention.	4 (1.3)	3 (0.9)	4 (1.3)	78 (24.5)	229 (72)
	The prevalence of COVID-19 can be reduced by active participation of health care workers in hospital infection control programmes.	7 (2.2)	10 (3.1)	23 (7.2)	109 (34.3)	169 (53.1)
Infection control protocol	Transmission of COVID-19 infection can be prevented by following the universal precautions issued by the CDC & WHO.	6 (1.9)	7 (2.2)	16 (5)	115 (36.2)	174 (54.7)
	*Use of N95 masks by undiagnosed patients is critically important.	16 (5)	36 (11.3)	65 (20.4)	94 (29.6)	107 (33.6)
	Gowns, gloves, masks and goggles must be used when dealing with COVID-19 patients.	5 (1.6)	1 (0.3)	0	42 (13.2)	270 (84.9)
	*Particularly during a COVID-19 outbreak, every patient coming to the hospital should be considered infectious and all standard protocols should be followed.	6 (1.9)	8 (2.5)	14 (4.4)	64 (20.1)	226 (71.1)
	The receiving area should be notified of the patient's diagnosis and necessary precautions should be taken as soon as possible before the patient's arrival.	6 (1.9)	1 (0.3)	7 (2.2)	71 (22.3)	233 (73.3)

(continued)

Table 4. Continued.

Category of information	Question	Response N (%)				
		SD	D	N	A	SA
Prevention	Health care professionals who are transporting patients should wear appropriate personal protective equipment and perform hand hygiene afterward.	7 (2.2)	2 (0.6)	3 (0.9)	43 (13.5)	263 (87.2)
	It is important to stay more than 1 meter (3 feet) away from a person who is sick.	6 (1.9)	3 (0.9)	7 (2.2)	82 (25.8)	220 (69.2)
Treatment	Only patients suspected of COVID-19 should be kept in isolation.	14 (4.4)	30 (9.4)	17 (5.3)	95 (29.9)	162 (50.9)
	Intensive and emergency treatment should be given to diagnosed patients.	8 (2.5)	11 (3.5)	20 (6.3)	84 (26.4)	195 (61.3)
Attitude score		Negative 4 (1.3)	Neutral 21 (6.6)		Positive 293 (92.1)	

*Negatively worded question.
SD, strongly disagree; D, disagree; N, neutral; A, agree; SA, strongly agree.

Table 5. Descriptive analysis of responses related to practice domain.

Category of information	Question	Response N (%)		
		Yes	No	I Don't Know
Awareness	Dental health care professionals (DHCPs) must keep up to date with all the information about COVID-19.	313 (98.4)	2 (0.6)	3 (0.9)
Screening	During a COVID-19 outbreak, it is advisable to have pre-check triage for staff and patients. *Persons accompanying the patient are exempt from temperature checks once they enter our hospital.	268 (84.3)	17 (5.3)	33 (10.4)
Risk factors	Ask patients questions about their health status and history of contact or travel.	83 (26.1)	224 (70.4)	11 (3.5)
Referral	Dental patients with COVID-19 can spread infection in dental clinics. Patients with fever should be registered and referred to designated hospitals.	308 (96.9)	7 (2.2)	3 (0.9)
Infection control	*DHCPs should use personal protective equipment only during the COVID-19 outbreak. It is better to wear goggles or face shields for protection during procedures using high or low speed with water spray.	311 (97.8)	4 (1.3)	3 (0.9)
Clinical procedure	Patients with fever should be registered and referred to designated hospitals. *DHCPs should use personal protective equipment only during the COVID-19 outbreak. It is better to wear goggles or face shields for protection during procedures using high or low speed with water spray. In case of a COVID-19 outbreak, non-emergency dental treatment can be postponed. A patient diagnosed with COVID-19 can be treated in a well-ventilated room or a negative pressure room. During a COVID-19 outbreak, DHCPs should perform only those dental procedures with minimal droplet and aerosol production. Extra oral radiography should be advised instead of intraoral radiography during an outbreak.	282 (88.7)	20 (6.3)	16 (5)
		116 (36.5)	174 (54.7)	28 (8.8)
		307 (96.5)	6 (1.9)	5 (1.6)
		307 (96.5)	6 (1.9)	5 (1.6)
		150 (47.2)	43 (13.5)	125 (39.3)
		258 (81.1)	34 (10.7)	26 (8.2)
		241 (75.8)	31 (9.7)	46 (14.5)

(continued)

Table 5. Continued.

Category of information	Question	Response N (%)		
		Yes	No	I Don't Know
Practice score	In oral examinations, procedures that can induce coughing should be avoided.	273 (85.8)	24 (7.5)	21 (6.6)
	Rubber dams and high-volume saliva ejectors help to reduce aerosol production.	285 (89.6)	8 (2.5)	25 (7.9)
	During a COVID 19 outbreak, the four-handed technique is beneficial for controlling infection.	209 (65.7)	40 (12.6)	69 (21.7)
		Inadequate 2 (0.6)	Average 41 (12.9)	Adequate 275 (86.5)

*Negatively worded question.

help to prevent the spread of COVID-19 is to increase the awareness of the population in general and health care professionals in particular. Therefore, it is essential to determine the preparedness of HCWs to withstand the pandemic. Thus, the current study used a validated questionnaire with good reliability to assess a randomly drawn representative sample of DHCPs working in KSA. A large number of DHCPs showed a positive attitude and an adequate level of practice regarding COVID-19, indicating that practitioners are showing an appropriate response to the present pandemic. However, only about half of DHCPs showed an adequate level of knowledge. It is noteworthy that no significant variations in KAP levels were observed across the five regions of KSA, although age and educational level showed positive correlations with knowledge.

DHCPs' knowledge about COVID-19

We found that most DHCPs depended on the KSA MOH website to obtain information, which reflects the positive role of the Saudi government in addressing the current situation. This could be attributed to KSA having experienced the MERS epidemic in 2013.^{25,29} Hence, the Saudi government's understanding of the disease and preparedness may have played a pivotal role in the prevention of disease transmission. Similarly, previous KSA-based studies of DHCWs,¹⁹ dental faculty²⁰ and HCWs²⁷ have also praised the efforts and role of the Saudi Arabian government in timely dissemination of information. Contrary to the present findings, some studies indicate that more COVID-19-related information is obtained from physician websites or social media.¹⁷ However, instant access of information through social networking sites in this digital era is a double-edged sword; the rapid propagation of misinformation through social media can mislead both the

public and HCWs.³⁰ Because of this, the KSA MOH has issued advisory information warning DHCPs about the propagation of fake news and advising them to focus on reliable sources.²⁰

The DHCPs were well aware that COVID-19 can be transmitted by an infected person, and through respiratory droplets or contact. Our results were comparable with those of other studies.^{14,16} As per the WHO, CDC and MOH guidelines, respiratory and cough etiquette should be followed to prevent the transmission of the disease.^{5,31-34} Regarding the COVID-19 incubation period and symptoms, DHCPs showed good knowledge (95.3% and 97.5%, respectively). The COVID-19 incubation period ranges from 2 to 14 days, with an average of 5 to 6 days.^{5,35} During this period, the disease is infectious and the patient will show initial symptoms of fever, dry cough and shortness of breath. As the disease progresses, symptoms such as fatigue, diarrhoea and pneumonia may develop.³⁶ Recent reports have identified loss of taste and smell as additional symptoms of COVID-19.²⁷ HCWs are a potential source of disease transmission from patients to themselves and subsequently to their friends and family,¹⁷ and may experience stress and fear of transmitting the disease. DHCP awareness of the initial symptoms may play a pivotal role in mitigating the disease. In our study, DHCPs showed adequate knowledge of the initial symptoms of the disease and the knowledge level was much higher than reported in previous studies.¹⁴ This may be because DHCPs actively obtained timely information from the MOH website.

When DHCPs were asked about the stipulated duration of hand hygiene (with soap and water), 89.6% gave incorrect responses. As mentioned in the WHO guidelines, hand hygiene should be maintained either by washing hands with soap and water for at least 40 s (20 s is sufficient if alcohol-based

hand rub is used).²⁶ This shows a lacuna in DHCPs' knowledge of the duration of hand hygiene protocol, which needs to be emphasized. However, during the SARS and MERS epidemics, the WHO recommended washing visibly soiled hands with soap and water for 20 s, followed by the use of an alcohol-based hand rub technique.³⁷ Regarding COVID-19 treatment, most participants responded that antibiotics are not the first-line treatment. Similar responses were reported in a few previous studies.^{15,16} Although various drugs for COVID-19 are being tested, none have been approved as first-line treatment. Hence, the current treatment modality is supportive rather than imperative.⁴ DHCPs were well aware that a COVID-19 vaccine remains to be developed. To date, no vaccines are available on the market, although many countries are engaged in the development of vaccines and multiple trials are in various phases.

In this study, age and educational level were significant influencing factors for the knowledge domain. Older DHCPs and those with doctorates had adequate knowledge compared with their counterparts. These findings support the widespread assumption that greater age and years of experience lead practitioners to adopt a rational and evidence-based approach to tackle any situation.²⁷ These practitioners are more likely to keep up-to-date with current knowledge, which was probably reflected in our observations. These findings suggest that substantial measures are needed to increase the level of knowledge among young DHCPs. Implementation of mandatory continuing education programmes, with verifiable points in key areas such as infection control, is highly recommended. To foster a positive approach toward infection control protocols, such topics should be incorporated into dental education curricula.

DHCPs' attitudes toward COVID-19

DHCPs strongly agreed that they should obtain and disseminate up-to-date information about COVID-19. As the disease progresses, the rate of change in relevant information and guidelines has increased. Therefore, it is a positive sign that DHCPs are showing a keen interest in acquiring knowledge. Contrary to this finding, some studies have found that DHCPs' attendance of continuing professional development programmes is lower than expected.¹⁷ Although continuing education programmes about COVID-19 could increase anxiety in DHCPs, they could also inform and motivate them to fight the pandemic in a rational way. Many DHCPs responded correctly to the question about patient referral. As COVID-19 is rapidly and easily transmitted, it is important that DHCPs can immediately recognize its symptoms and refer patients to medical experts for management. DHCPs showed an appropriate attitude toward the importance of restrictions in travel, general movement and large mass gatherings. These norms have been well explicated in advisories and guidelines issued by the WHO^{1,31} and MOH.^{33,34}

Correct responses to questions about the infection control protocol ranged from 33.6% to 87.2%. The use of an N95 respirator by an undiagnosed patient is currently emphasized. Some reports have pointed out that dentists face a shortage of PPE, including masks.^{14,17} The CDC and WHO have recommended the use of surgical masks for undiagnosed patients; however, the N95 respirator should be worn by HCWs. The appropriate use of such devices could reduce the shortage of PPE and ensure that HCWs are protected; this in turn would help the community to obtain better treatment.^{32,38} In the present survey, 71.1% of DHCPs had negative attitudes to the assertion that standard precautions should be

followed, especially during an outbreak. However, CDC guidelines recommend that all patients, at all times, should be considered potentially infectious and standard precautions should be practiced.^{5,26} The rationale for such a practice is based on the fact that COVID-19 can be transmitted during the recovery phase or carrier state, even if the patient shows no obvious symptoms or signs. Consequently, in these phases, both HCWs and patients have a risk of transmitting the disease to each other.³⁹⁻⁴¹

DHCPs' practice standards during COVID-19

As per recent recommendations,⁵ a screening triage should be established to obtain information related to symptoms, medical history, travel history and close contact with suspected cases of COVID-19.⁴² Despite a screening protocol, a recent travel history may place a patient in the high-risk category. Kamate et al.¹⁶ found that 92.6% of DHCPs record travel history as a screening protocol to aid in the diagnosis and prevention of disease transmission. Telephone triage has also been recommended to avoid unnecessary travelling and to prioritize cases.⁴² Our respondents scored well on questions related to the referral protocol, identification of risk factors and screening protocol, indicating that they practiced the above-mentioned guidelines.

DHCPs scored well when questioned about infection control protocols to be followed during COVID-19 outbreaks. To a negatively worded question regarding the use of PPE, 36.5% of respondents answered incorrectly by agreeing to the statement that PPEs should be used only during an outbreak. However, they performed well on questions about the indications of PPEs in aerosol-generating clinical procedures. These conflicting responses may reflect the effect of negatively worded

questions. Few studies have reported a consensus of proper PPE usage among dentists.^{14,15} As per the CDC guidelines on infection control protocols, universal precautions should be taken at all times irrespective of the pandemic or epidemic status. The highly contagious nature of COVID-19 warrants proper infection control protocols. The use of PPE, including N95 or FFP2/FFP3 masks, gloves, gowns, protective glasses, visors and headgear caps, is of the utmost importance during any dental procedures.^{20,43}

DHCPs demonstrated good practice management regarding clinical procedures. They agreed that during the COVID-19 pandemic, rubber dams, four-handed dentistry and saliva ejectors should be used along with minimal aerosol-producing procedures.⁴⁴ The presence of saliva in the oral cavity is a potential source of infection^{10,28} that can be exacerbated by various aerosol-generating procedures. Thus, wearing goggles and shields can prevent the virus from coming into contact with the conjunctiva epithelium.^{42,44} Therefore, DHCPs should focus on procedures that produce fewer aerosols,^{5,10,45} which could help to reduce disease transmission. This is in consensus with the guidelines of the CDC, the WHO and various dental societies. DHCPs had a good level of awareness of the WHO guidelines posted on 21 March, which state that treatment should be provided only for emergency cases and treatment of non-emergency cases should be postponed.³¹ Similar responses have been noted in other studies showing that only emergency dental care is being provided to patients, and procedures that can reduce aerosol production and salivary contamination are prioritized.^{14,15}

Limitations and future prospects

The study was conducted during the period when the spread of COVID-19 was

accelerating, and when DHCPs were stressed and acclimatizing to disruptions in their social, economic and professional life. Owing to the lockdown across KSA, the only feasible option for data collection was a web-based survey. For these reasons, the response rate was relatively low and the chances of response bias cannot be completely ruled out.

The current study assessed the present state of COVID-19-related KAP among DHCPs. Future studies should be conducted at intervals using quasi-experimental designs to provide a comparative analysis. This would also help to evaluate the effect of continuing education programmes during the pandemic phase. The results of such future studies could help in planning and developing supportive policies and programmes.

Conclusion

The successful management of any pandemic requires adequate knowledge, a positive attitude and evidence-based practice protocols. Although no variation in KAP was observed between the five geographical regions of KSA, DHCPs' levels of attitudes and practice standards were higher than their knowledge. Therefore, efforts should be made to enhance the knowledge of DHCPs across the nation, particularly younger professionals. This could be achieved through the collaborative efforts of global health agencies and government. Indeed, the effect of such efforts is apparent in KSA, where the MOH has played a significant role in enhancing the KAP of DHCPs.

Author contributions

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