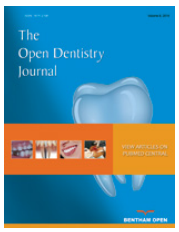

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RESEARCH ARTICLE

Perception of Fomite Route of Transmission, Usage of Masks and Role of Saliva in coronavirus Disease-19 Infections: A Cross-sectional Survey among Dental Health Care Professionals in Saudi Arabia

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Abstract:

Background:

Coronavirus Disease-19 has been spreading globally with the rise of many variants after being declared as a pandemic on 11th March 2020. There is a lack of scientific literature focused on fomite transmission of COVID-19, especially the potential of saliva as a contributing factor in the spread and diagnosis of COVID-19 in dental healthcare practice. Hence, the aim was to comprehend the level of awareness of dental health care professionals/practitioners (DHCPs) about the role of fomite route of transmission and the role of saliva in Coronavirus Disease-19 (COVID-19) infections.

Methods:

An electronic questionnaire using Google Forms was circulated online after ethical approval and validation to dental health practitioners in Saudi Arabia, *via* emails and social media platforms.

Results:

Three hundred and eighty-nine responses were recorded. The female DHCPs had statistically significant awareness of the fomite route of transmission among various dental health professionals ($p=0.04$) and dental students, and dental interns had the maximum awareness ($p<0.05$). The DHCPS preferred to learn and collect nasopharyngeal specimens by themselves for COVID-19 testing. Doctoral DHCPs had maximum awareness about WHO guidelines for social distancing, while dental nurses were more informed about infection control methods against COVID-19.

Conclusion:

DHCPs have adequate information about the fomite route of transmission and the role of saliva in COVID-19. Saliva specimen collection is specifically preferred for COVID-19 testing by dental assistants and hygienists for testing in the dental health center/clinic/university. The DHCPs and dental hygienists were less aware of the fomite route of transmission through asymptomatic COVID-19 infected patients.

Keywords: Fomite, Dentistry, COVID-19, SARS CoV-2, Infection control, Saliva, Masks.

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1. INTRODUCTION

COVID-19 infection first surfaced in the global community when it was found in Wuhan City, China in December 2019. From there the virus came along a long path to spread globally resulting in one of the greatest pandemics in the history of pandemics. The novel coronavirus was identified as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2 was announced by WHO as a global pandemic on 11th March 2020 [1]. The emergence of variants that posed a high risk to global transmission were categorized as variance of concern (VOC) and variants of interest (VOI) to give priority to the monitoring at the global level and for research, thus tracking ongoing pandemic updates and responses [2]. There are six variants of concern of SARS CoV 2 identified as Alpha

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(identified from UK), Beta (identified from South Africa), Gamma (identified from Brazil), Delta (identified from India), and Omicron (identified from multiple countries) [2, 3]. Whereas the variants of interest are two namely, Lambda (identified from Peru) and Mu (identified from Columbia) [2].

COVID-19 spreads by both direct and indirect modes of transmission. While direct droplets can be spread mostly through respiratory and salivary fluids; indirect spread can be through fomite transmission by surface contamination *via* clothing, and objects [4].

Dental settings and procedures can also contribute to fomite transmission. There is a lack of scientific literature on awareness of the fomite mode of transmission in dental settings and the role of saliva in the transmission and detection of COVID-19, which directed the rationale of conducting this study. Hence, the aim was to comprehend the level of awareness of dental healthcare practitioners/professionals (DHCPs) about the role of surface contamination and saliva in Coronavirus Disease-19 (COVID-19) infections.

2. METHODS

An electronic questionnaire using Google Forms was created online in English after ethical approval (FRP/2021/350/509/488) and validation. The online questionnaire was distributed to dental healthcare practitioners in Saudi Arabia, *via* emails and social media platforms, from June 2022 to July 2022, after obtaining their consent for voluntary participation in this study. The data collection used nonrandom volunteer response sampling from 21-70 years of age. Dental healthcare professionals included in the study were dental students and interns, general dental practitioners, dental specialists and consultants, dental nurses, dental assistants and dental hygienists. The research hypothesis questioned, 'Do dental healthcare professionals have adequate information about the fomite route of transmission and the role of saliva in COVID-19?'

The questionnaire was framed with 25 questions seeking demographic details, and professional details and focused on questions about COVID-19 virus, routes of spread and fomite transmission, infection control steps to prevent fomite transmission, role of saliva in fomite transmission and the diagnostic test preferred for COVID-19 testing by the respondents. To avoid duplication bias, the response was set as default to be entered only once. The sample size was calculated using Raosoft software with a 5% margin of error and 95% confidence as 385. Using a non-random volunteer response sampling method, the data was collected from the target group.

3. RESULTS

Data was analyzed using SPSS version 26.0 for descriptive statistics with a p-value of < 0.05 considered for statistical significance. Three hundred and eighty-nine respondents attempted the questionnaire.

3.1. Demographic Data

The maximum responses were achieved from Saudi nationals 267(68.6%), while the non-Saudi respondents were 122 (31.4%). The female respondents attempted the questionnaire more (62.2%) than the male respondents (37.8%) and 60.2% of responses were from the 21-30 years of age group. The job sector segregation of DHCPs revealed Bachelor's dental degree holders were 71% among the responders, followed by Dental students and Interns 15.4%, Master's degree 14.7%, Doctorate (PhD) holders 10.5% and Diploma holders 3.8%. The details of the professional status of the respondents are given in Fig. (**1**). The dental students and interns contributed 30.8% in the professional category. Responses from job sectors were as follows: private universities 30.3%, government hospital-based dental practice 23.7%, Private Hospital-based dental practice 9.5%, Private dental clinic 8.5%, Government Universities 8.2% and non-practicing dental health care professionals 4.4%.

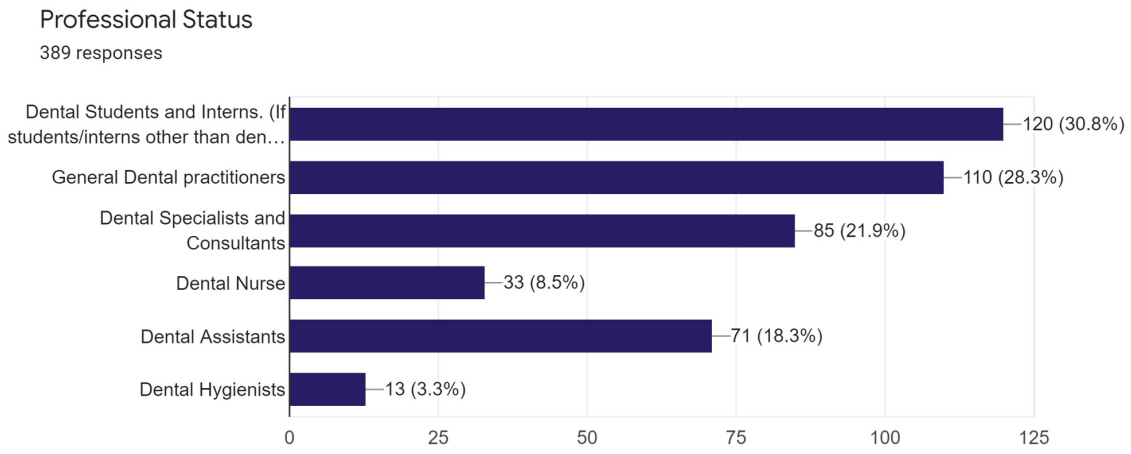

Fig. (1). Professional status of the participants.

3.2. SARS- CoV-2 and Modes of Transmission

There were 50.8% responses were received for SARS-CoV-2 as the virus causing COVID-19 disease, followed by SARS- CoV-9 with 35.7%, SARS- CoV-3 with 10.3% and SARS- CoV-3 with 3.1%. DHCPs were well informed that COVID-19 can spread *via* symptomatic and asymptomatic individuals (82.8%) while 12.1% DHCPs assumed that COVID-19 spreads through symptomatic individuals only and 5.1% did not have the information on spread through asymptomatic individuals. DHCPs were aware of the major routes of transmission of COVID-19 (Fig. **2**). However, the fecal-oral route (34.4%), mother to child and transmission (29%) and transmission *via* other body fluids and secretions (41.1%) were less known to the DHCPs.

3.3. Fomite Route of Transmission

The majority of DHCPs (68.1%) were aware of the fomite-based transmission of COVID-19. The DHCPs in a majority (60.8%) had knowledge on fomite transmission of COVID-19, that it was through materials or surfaces carrying the infection. Whereas 32.9% of DHCPs believed that fomite transmission of infection is *via* body fluids and secretions and a minority (3.2%) of DHCPs were of the opinion that such transmission is *via* mother-to-child intrauterine infection. The DHCPs were well informed (89.5%) that dental practice is a potential source for working and non-working surface area contamination in the clinic or practicing space if a patient is asymptomatic and exposed to COVID-19 infection. The awareness of DHCPs about the dental procedures that can cause risk of surface contamination (Fig. **3**) was remarkable (> 50%) with the lowest awareness 63.2% on the risk of transmission of COVID-19 *via* radiographic procedures.

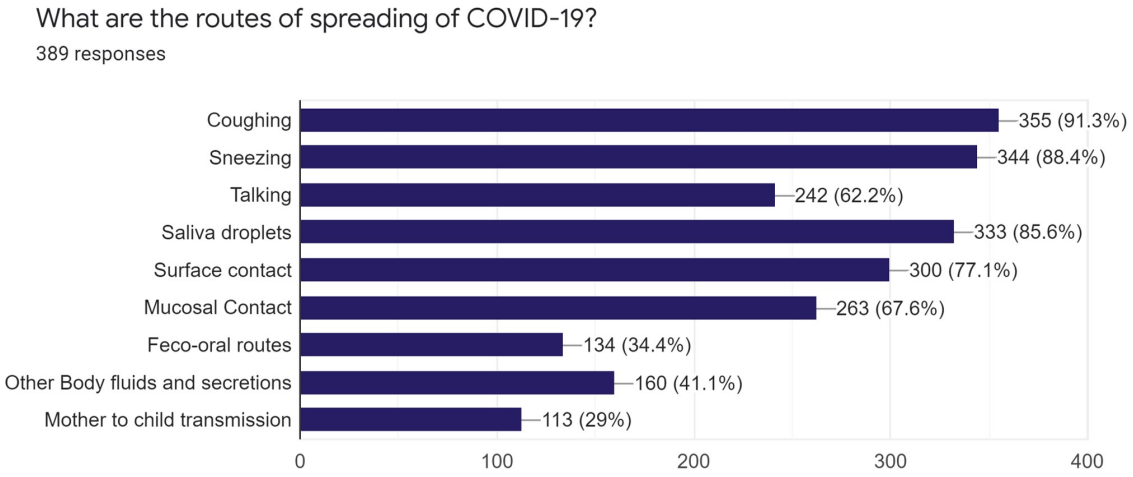

Fig. (2). Routes of COVID-19 infection.

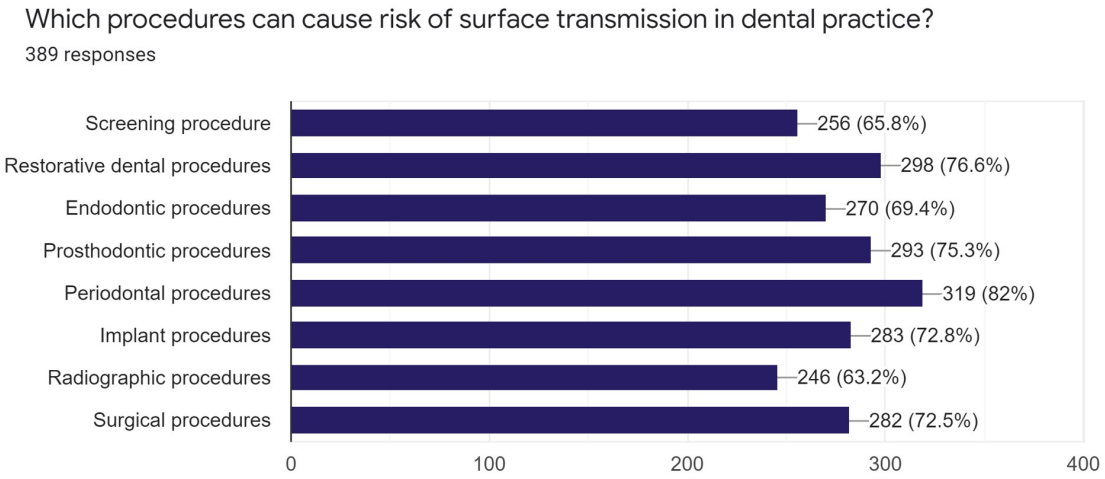

Fig. (3). Dental procedures with risk of transmission of COVID-19.

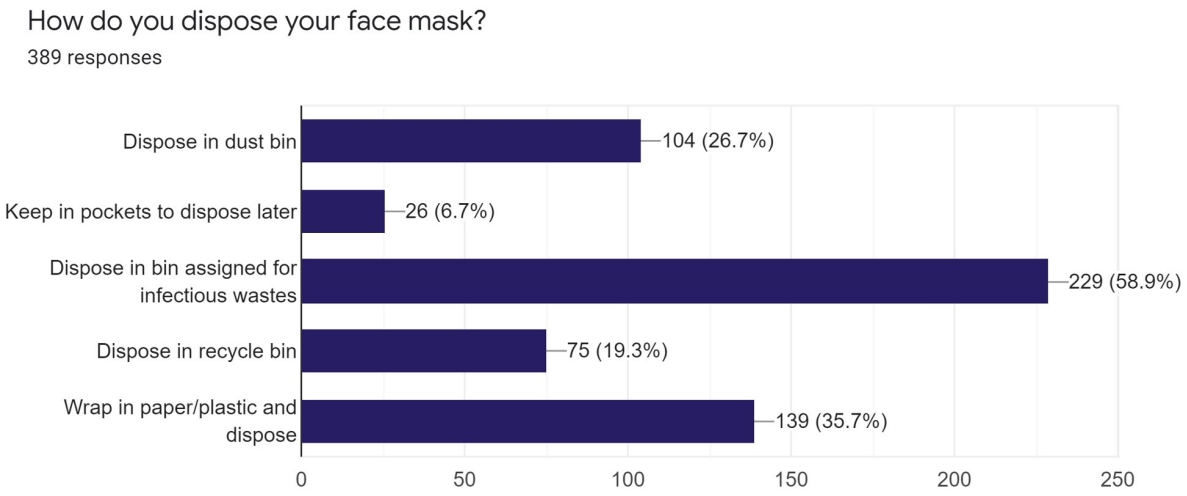

Fig. (4). Disposal of face masks by dental healthcare professionals.

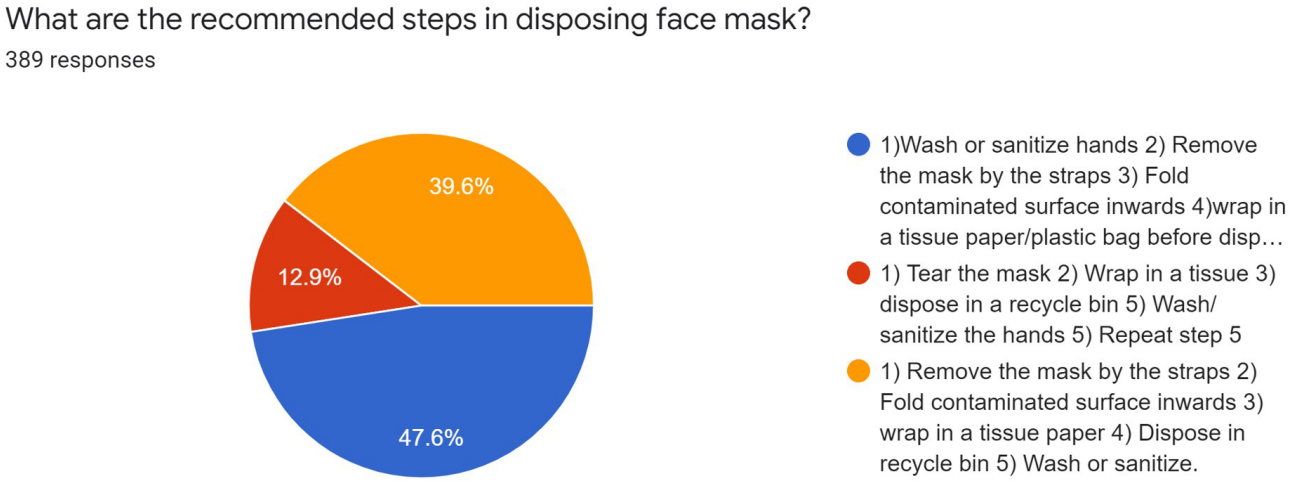

Fig. (5). Dental healthcare professionals awareness on recommended steps for disposal of face masks.

3.4. Infection Control *via* Fomite Transmission

A higher rate of respondents (79.9%) was of the opinion that handwashing followed by sanitization is the best method to prevent disease transmission through surface contamination (fomite transmission). Whereas handwashing alone was opted for by 13.4% of DHCPs and 6.7% of respondents believed that only sanitization can prevent fomite transmission. Among the DHCPs, 36.2% believed that the World Health Organization (WHO) guidelines for minimum social distancing are 2 meters (m), 43.4% opted for 1.5m and 20.3% were of the opinion of 1m of minimum social distancing. The most accurate reason for social distancing as a precaution against COVID-19 spread was opted by 84.3% as a reason to prevent direct and indirect routes of transmission, 11.1% for preventing severity of symptoms after direct exposure to the virus and 4.6% were under the impression that social distancing is to prevent breathing difficulties in elderly patients due to indirect contact transmission. More than half of the DHCPs (86.1%) were of the opinion that personal protective equipment (PPE) should be worn for all dental procedures, while 7.5% encouraged procedures having saliva contamination, 3.5% for surface contamination and 3.1% opted to use of PPE for blood contamination related procedures. The proper disposal of face masks was chosen by only 35.7% of DHCPs with 58.9% responses for disposing of the facemask in a dust bin for infectious wastes (Fig. **4**). A higher number of DHCPs / (77.9%) were aware of the proper folding for disposal of face masks with contaminated surfaces folded inwards whereas only 47.6% correctly opted for the recommended steps in disposing of face masks (Fig. **5**).

3.5. Role of Saliva in COVID-19

There was a difference in opinion with regard to the role of saliva in COVID-19. It was stated as one of the direct routes of transmission by 42.2%, as an indirect route of transmission by 10.5%, both routes of transmission by 39.3%, and 8% of

DHCPs were not aware of the correct route of transmission of saliva. As many as 72.2% of DHCPs believed that saliva can help in COVID-19 diagnosis. About more than a half (53.2%) of DHCP preferred to learn and do efficient nasopharyngeal swabs, 37.3% wanted to perform saliva collection as it was easier and 9.3% were competent enough to collect blood for serum samples if it was required to be done on a patient in their dental health center/clinic/university. As a dental healthcare practitioner, the best diagnostic test they would like to use in their dental health center/clinic/university was 63% for Nasopharyngeal swabs, 23.3% for saliva and 8.7% in favor of serum-based analysis. An estimated 89.7% of DHCPs found the questionnaire to be helpful to refresh or add beneficial information on COVID-19.

The female gender had a statistically significant difference from males in the awareness of the fomite route of transmission among various dental health professionals (p=0.04). Male gender had a statistically significant difference (p=0.027) in the awareness of dental practice-related contamination of working and non-working surface areas, if a patient is asymptomatic and exposed to Covid 19 infection. A significant difference of opinion on the salivary-based diagnostic test was seen with more females preferring to use saliva-based diagnostic tests by themselves if required in the dental setup and opting for nasopharyngeal swab test (p=0.006) (Table **1**).

Table 1. Gender and variation of response to the questionnaire.

-	Gender		P- value
	Male	**Female**	
What is the name of the virus causing COVID-19? • SARS- CoV-3 • SARS- CoV-2 • SARS- CoV-8 • SARS- CoV-9	12% 50% 3% 35%	9% 52% 3% 36%	0.785
What is your understanding about COVID-19 infection spreading based on symptoms? • Spreads through asymptomatic individuals • Spreads through symptomatic individuals • Both of the above options are correct	5% 10% 84%	5% 13% 82%	0.669
Are you aware about fomite transmission? • Yes • No	62% 38%	**72%** 28%	0.040
According to your understanding, what do you think 'Fomite transmission' could be through…..? • Materials or surfaces carrying infection • Mother to child intrauterine infection • Infection *via* body fluids and secretions	58% 5% 37%	63% 7% 31%	0.443
Do you think dental practice can contaminate working and non-working surface areas in the clinic or practicing space if a patient is asymptomatic and exposed to Covid 19 infection? • Yes • No	**94%** 6%	87% 13%	0.027
Which is the best method to prevent disease transmission through surface contamination? • Handwashing • Sanitizing •Handwashing followed by sanitising	14% 9% 77%	13% 5% 82%	0.354
How much is the minimum social distancing advised by WHO? • Atleast 1 meter • Atleast 0.5 meter • Atleast 1.5 meter	21% 48% 31%	20% 40% 40%	0.181
According to your understanding, which is the most accurate reason for social distancing as COVID-19 precaution? • Prevents direct and indirect routes of transmission among people • Prevents severity of symptoms after direct exposure to virus • Prevents breathing difficulties in elderly patients due to indirect contact	86% 12% 3%	83% 11% 6%	0.374
For which dental procedures do you wear Personal Protective Equipment's? • Involving surface contamination • Blood contamination • Saliva contamination • All dental procedures	4% 3% 11% 82%	3% 3% 5% 88%	0.202
How should you fold a face mask after use? • Fold the contaminated part inwards • Fold the contaminated part outwards	74% 26%	80% 20%	0.166
What are the recommended steps in disposing face mask? • 1)Wash or sanitize hands 2) Remove the mask by the straps 3) Fold contaminated surface inwards 4)wrap in a tissue paper/plastic bag before disposing 5) Repeat step 1 • 1) Tear the mask 2) Wrap in a tissue 3) dispose in a recycle bin 5) Wash/sanitize the hands 5) Repeat step 5 • 1) Remove the mask by the straps 2) Fold contaminated surface inwards 3) wrap in a tissue paper 4) Dispose in recycle bin 5) Wash or sanitize.	46% 17% 37%	48% 10% 41%	0.154

(Table 1) contd.....

-	Gender		P- value
	Male	Female	
According to your understanding, what is the role of saliva in COVID-19 • It is one of the direct routes of transmission • It is an indirect route of transmission • Both routes of transmission are applicable • Not aware about the correct route of transmission of saliva	43% 10% 38% 9%	42% 11% 40% 7%	0.946
Can saliva help in covid 19 diagnosis? • Yes • No	76% 24%	81% 19%	0.258
As a dental health practitioner, which type of diagnostic test would you prefer to do by yourself if it is required on a patient in your dental health center/clinic/university • I am competent enough to do blood sample for serum • Saliva collection is easier for me to do perform • I can learn and do efficient nasopharyngeal swabs	14% 30% 56%	6% 42% 52%	0.006
According to your opinion as a dental health practitioner, which is the best diagnostic test you would like to use in your dental health center/clinic/university • Saliva based analysis • Serum based analysis • Nasopharyngeal swab	22% 11% 67%	32% 7% 61%	0.101
Was this survey beneficial to refresh or add additional information? • Yes • No	89% 11%	90% 10%	0.761

Age of the DHCPs played a significant role in correctly identifying the COVID-19 virus as SARS-CoV-2 (p=0.042) with 100% accurate responses in the age range of 61 to 70 years and also the direct and indirect role of saliva in disease transmission (p=0.029), with maximum correct responses in 61-to-70-year age group (Table **2**). There were highly significant differences in the impact of educational levels on the information about fomite transmission (p=0.000) among DHCPs. The dental students and interns had statistically significant awareness of the fomite route of transmission (p<0.05). Bachelor dental students had more information on the methods to prevent infection by handwashing and sanitizing (p=0.016) and the most accurate reason for social distancing (p=0.043). Doctoral dental healthcare professionals had maximum awareness about WHO guidelines for social distancing of 1m (p=0.016). Diploma students preferred to collect saliva by themselves if required to perform tests in the dental center (p=0.028), while master students preferred to advice saliva as a diagnostic test (p=0.001) in their dental setup (Table **3**).

Table 2. Age of the participants and perception on fomites and role of saliva in COVID-19.

-	Age Groups					P- value
	21-30 Years	31-40 Years	41-50 Years	51-60 Years	61-70 Years	
What is the name of the virus causing COVID-19? • SARS- CoV-3 • SARS- CoV-2 • SARS- CoV-8 • SARS- CoV-9	12% 42% 4% 41%	5% 64% 1% 30%	12% 60% 5% 24%	5% 71% 0% 24%	0% 100% 0% 0%	0.042
What is your understanding about COVID-19 infection spreading based on symptoms? • Spreads through asymptomatic individuals • Spreads through symptomatic individuals • Both of the above options are correct	6% 14% 80%	4% 13% 82%	2% 5% 93%	0% 5% 95%	0% 0% 100%	0.509
Are you aware about fomite transmission? • Yes • No	65% 35%	73% 27%	69% 31%	81% 19%	100% 0%	0.410
According to your understanding, what do you think 'Fomite transmission' could be through…..? • Materials or surfaces carrying infection • Mother to child intrauterine infection • Infection *via* body fluids and secretions	57% 8% 35%	65% 4% 31%	71% 0% 29%	67% 5% 29%	100% 0% 0%	0.457
Do you think dental practice can contaminate working and non-working surface areas in the clinic or practicing space if a patient is asymptomatic and exposed to Covid 19 infection? • Yes • No	86% 14%	93% 7%	98% 2%	90% 10%	100% 0%	0.133

(Table 2) contd.....

-	Age Groups					P- value
	21-30 Years	31-40 Years	41-50 Years	51-60 Years	61-70 Years	
Which is the best method to prevent disease transmission through surface contamination? • Handwashing • Sanitizing •Handwashing followed by sanitising	12% 8% 79%	14% 5% 80%	19% 5% 76%	10% 0% 90%	0% 0% 100%	0.795
How much is the minimum social distancing advised by WHO? • Atleast 1 meter • Atleast 0.5 meter • Atleast 1.5 meter	18% 41% 41%	24% 46% 30%	24% 43% 33%	24% 52% 24%	0% 100% 0%	0.531
According to your understanding, which is the most accurate reason for social distancing as COVID-19 precaution? • Prevents direct and indirect routes of transmission among people • Prevents severity of symptoms after direct exposure to virus • Prevents breathing difficulties in elderly patients due to indirect contact	81% 14% 6%	90% 5% 4%	83% 14% 2%	100% 0% 0%	100% 0% 0%	0.258
For which dental procedures do you wear Personal Protective Equipment's? • Involving surface contamination • Blood contamination • Saliva contamination • All dental procedures	4% 5% 8% 84%	3% 0% 5% 91%	2% 2% 14% 81%	0% 0% 0% 100%	0% 0% 0% 100%	0.471
How should you fold a face mask after use? • Fold the contaminated part inwards • Fold the contaminated part outwards	74% 26%	88% 12%	76% 24%	86% 14%	100% 0%	0.061
What are the recommended steps in disposing face mask? • 1)Wash or sanitize hands 2) Remove the mask by the straps 3) Fold contaminated surface inwards 4)wrap in a tissue paper/plastic bag before disposing 5) Repeat step 1 • 1) Tear the mask 2) Wrap in a tissue 3) dispose in a recycle bin 5) Wash/sanitize the hands 5) Repeat step 5 • 1) Remove the mask by the straps 2) Fold contaminated surface inwards 3) wrap in a tissue paper 4) Dispose in recycle bin 5) Wash or sanitize.	45% 16% 39%	51% 4% 45%	55% 17% 29%	48% 5% 48%	100% 0% 0%	0.107
According to your understanding, what is the role of saliva in COVID-19 • It is one of the direct routes of transmission • It is an indirect route of transmission • Both routes of transmission are applicable • Not aware about the correct route of transmission of saliva	43% 8% 37% 12%	44% 10% 45% 1%	38% 19% 40% 2%	38% 24% 33% 5%	0% 0% 100% 0%	0.029
Can saliva help in covid 19 diagnosis? • Yes • No	78% 22%	82% 18%	76% 24%	81% 19%	100% 0%	0.871
As a dental health practitioner, which type of diagnostic test would you prefer to do by yourself if it is required on a patient in your dental health center/clinic/university • I am competent enough to do blood sample for serum • Saliva collection is easier for me to do perform • I can learn and do efficient nasopharyngeal swabs	11% 36% 53%	7% 40% 54%	7% 45% 48%	5% 29% 67%	0% 0% 100%	0.714
According to your opinion as a dental health practitioner, which is the best diagnostic test you would like to use in your dental health center/clinic/university • Saliva based analysis • Serum based analysis • Nasopharyngeal swab	27% 10% 63%	27% 9% 64%	40% 7% 52%	24% 0% 76%	0% 0% 100%	0.565
Was this survey beneficial to refresh or add additional information? • Yes • No	89% 11%	92% 8%	81% 19%	100% 0%	100% 0%	0.151

Table 3. Perception of fomite transmission and role of saliva in COVID-19 and its significance toEducational level.

-	Education Level				P- value
	Bachelors	Masters	PhD	Diploma	
What is the name of the virus causing COVID-19? • SARS- CoV-3 • SARS- CoV-2 • SARS- CoV-8 • SARS- CoV-9	8% 53% 2% 37%	14% 47% 7% 32%	20% 39% 5% 37%	7% 60% 7% 27%	0.153

(Table 3) contd.....

-	Education Level				P- value
	Bachelors	**Masters**	**PhD**	**Diploma**	
What is your understanding about COVID-19 infection spreading based on symptoms? • Spreads through asymptomatic individuals • Spreads through symptomatic individuals • Both of the above options are correct	4% 11% 85%	9% 16% 75%	5% 17% 78%	20% 0% 80%	0.039
Are you aware about fomite transmission? • Yes • No	69% 31%	67% 33%	66% 34%	67% 33%	0.972
According to your understanding, what do you think 'Fomite transmission' could be through…..? • Materials or surfaces carrying infection • Mother to child intrauterine infection • Infection *via* body fluids and secretions	65% 3% 32%	56% 9% 35%	41% 24% 34%	60% 7% 33%	0.000
Do you think dental practice can contaminate working and non-working surface areas in the clinic or practicing space if a patient is asymptomatic and exposed to Covid 19 infection? • Yes • No	91% 9%	94% 16%	88% 12%	87% 13%	0.466
Which is the best method to prevent disease transmission through surface contamination? • Handwashing • Sanitizing •Handwashing followed by sanitising	12% 5% 83%	16% 9% 75%	24% 10% 66%	0% 20% 80%	0.031
How much is the minimum social distancing advised by WHO? • Atleast 1 meter • Atleast 0.5 meter • Atleast 1.5 meter	20% 40% 40%	12% 63% 25%	34% 37% 29%	20% 47% 33%	0.016
According to your understanding, which is the most accurate reason for social distancing as COVID-19 precaution? • Prevents direct and indirect routes of transmission among people • Prevents severity of symptoms after direct exposure to virus • Prevents breathing difficulties in elderly patients due to indirect contact	88% 8% 4%	79% 18% 4%	71% 20% 10%	80% 20% 0%	0.043
For which dental procedures do you wear Personal Protective Equipment's? • Involving surface contamination • Blood contamination • Saliva contamination • All dental procedures	2% 4% 5% 89%	5% 0% 14% 81%	7% 5% 12% 76%	7% 0% 13% 80%	0.078
How should you fold a face mask after use? • Fold the contaminated part inwards • Fold the contaminated part outwards	78% 22%	84% 16%	68% 32%	73% 27%	0.294
What are the recommended steps in disposing face mask? • 1)Wash or sanitize hands 2) Remove the mask by the straps 3) Fold contaminated surface inwards 4)wrap in a tissue paper/plastic bag before disposing 5) Repeat step 1 • 1) Tear the mask 2) Wrap in a tissue 3) dispose in a recycle bin 5) Wash/sanitize the hands 5) Repeat step 5 • 1) Remove the mask by the straps 2) Fold contaminated surface inwards 3) wrap in a tissue paper 4) Dispose in recycle bin 5) Wash or sanitize.	47% 13% 39%	51% 18% 32%	44% 10% 46%	47% 0% 53%	0.472
According to your understanding, what is the role of saliva in COVID-19 • It is one of the direct routes of transmission • It is an indirect route of transmission • Both routes of transmission are applicable • Not aware about the correct route of transmission of saliva	44% 7% 39% 9%	37% 16% 46% 2%	37% 20% 37% 7%	40% 27% 27% 7%	0.050
Can saliva help in covid 19 diagnosis? • Yes • No	79% 21%	79% 21%	83% 17%	80% 20%	0.938
As a dental health practitioner, which type of diagnostic test would you prefer to do by yourself if it is required on a patient in your dental health center/clinic/university • I am competent enough to do blood sample for serum • Saliva collection is easier for me to do perform • I can learn and do efficient nasopharyngeal swabs	9% 34% 57%	5% 40% 54%	20% 46% 34%	7% 60% 33%	0.028
According to your opinion as a dental health practitioner, which is the best diagnostic test you would like to use in your dental health center/clinic/university • Saliva based analysis • Serum based analysis • Nasopharyngeal swab	25% 7% 69%	28% 14% 58%	44% 17% 39%	53% 7% 40%	0.001
Was this survey beneficial to refresh or add additional information? • Yes • No	91% 9%	84% 16%	88% 12%	93% 7%	0.441

Dental nurses were more informed than any other professional category about the virus causing COVID-19 (p=0.002), about symptomatic and asymptomatic spread of COVID-19 (p=0.018), awareness of fomite transmission (p=0.000), the understanding of what fomite transmission means (p=0.004), infection control methods against fomite transmission of COVID-19 (p=0.048) and recommended steps to dispose face mask (p=0.011) (Table **4**).

Table 4. Dental Health Care Professional's perception on Covid-19 related fomite transmissionand significance of role of saliva.

-	Profession						P-value
	Dental Students and Interns	**General Dental practitioners**	**Dental Specialists and Consultants**	**Dental Nurse**	**Dental Assistants**	**Dental Hygienists**	
What is the name of the virus causing COVID-19? • SARS- CoV-3 • SARS- CoV-2 • SARS- CoV-8 • SARS- CoV-9	9% 46% 3% 42%	17% 39% 1% 43%	11% 51% 4% 34%	4% 85% 0% 11%	3% 63% 6% 28%	18% 45% 9% 27%	0.002
What is your understanding about COVID-19 infection spreading based on symptoms? • Spreads through asymptomatic individuals • Spreads through symptomatic individuals • Both of the above options are correct	8% 16% 76%	3% 10% 87%	3% 15% 83%	0% 11% 89%	6% 6% 88%	27% 9% 64%	0.018
Are you aware about fomite transmission? • Yes • No	69% 31%	56% 44%	60% 40%	96% 4%	81% 19%	82% 18%	0.000
According to your understanding, what do you think 'Fomite transmission' could be through…..? • Materials or surfaces carrying infection • Mother to child intrauterine infection • Infection *via* body fluids and secretions	57% 4% 39%	59% 10% 31%	54% 4% 43%	78% 7% 15%	72% 3% 25%	64% 27% 9%	0.004
Do you think dental practice can contaminate working and non-working surface areas in the clinic or practicing space if a patient is asymptomatic and exposed to Covid 19 infection? • Yes • No	89% 11%	87% 13%	94% 6%	93% 7%	90% 10%	73% 27%	0.331
Which is the best method to prevent disease transmission through surface contamination? • Handwashing • Sanitizing •Handwashing followed by sanitising	11% 5% 85%	15% 8% 77%	19% 6% 75%	4% 7% 89%	7% 7% 85%	45% 9% 45%	0.048
How much is the minimum social distancing advised by WHO? • Atleast 1 meter • Atleast 0.5 meter • Atleast 1.5 meter	17% 37% 46%	21% 39% 40%	20% 54% 26%	30% 56% 15%	21% 45% 34%	18% 36% 45%	0.116
According to your understanding, which is the most accurate reason for social distancing as COVID-19 precaution? • Prevents direct and indirect routes of transmission among people • Prevents severity of symptoms after direct exposure to virus • Prevents breathing difficulties in elderly patients due to indirect contact	88% 6% 6%	80% 15% 5%	86% 10% 4%	93% 7% 0%	81% 15% 4%	73% 18% 9%	0.531
For which dental procedures do you wear Personal Protective Equipment's? • Involving surface contamination • Blood contamination • Saliva contamination • All dental procedures	4% 2% 5% 89%	3% 7% 9% 81%	4% 3% 9% 85%	0% 0% 15% 85%	3% 0% 4% 93%	9% 9% 9% 73%	0.310
How should you fold a face mask after use? • Fold the contaminated part inwards • Fold the contaminated part outwards	81% 19%	67% 33%	79% 21%	89% 11%	84% 16%	82% 18%	0.058

(Table 4) contd.....

-	Profession						P-value
	Dental Students and Interns	**General Dental practitioners**	**Dental Specialists and Consultants**	**Dental Nurse**	**Dental Assistants**	**Dental Hygienists**	
What are the recommended steps in disposing face mask? • 1)Wash or sanitize hands 2) Remove the mask by the straps 3) Fold contaminated surface inwards 4)wrap in a tissue paper/plastic bag before disposing 5) Repeat step 1 • 1) Tear the mask 2) Wrap in a tissue 3) dispose in a recycle bin 5) Wash/sanitize the hands 5) Repeat step 5 • 1) Remove the mask by the straps 2) Fold contaminated surface inwards 3) wrap in a tissue paper 4) Dispose in recycle bin 5) Wash or sanitize.	41% 10% 49%	53% 21% 26%	50% 11% 39%	63% 7% 30%	45% 9% 46%	18% 18% 64%	0.011
According to your understanding, what is the role of saliva in COVID-19 • It is one of the direct routes of transmission • It is an indirect route of transmission • Both routes of transmission are applicable • Not aware about the correct route of transmission of saliva	46% 7% 35% 13%	40% 11% 37% 12%	41% 14% 41% 4%	41% 4% 52% 4%	42% 13% 42% 3%	36% 18% 45% 0%	0.297
Can saliva help in covid 19 diagnosis? • Yes • No	80% 20%	78% 22%	78% 22%	78% 22%	81% 19%	91% 9%	0.937
As a dental health practitioner, which type of diagnostic test would you prefer to do by yourself if it is required on a patient in your dental health center/clinic/university • I am competent enough to do blood sample for serum • Saliva collection is easier for me to do perform • I can learn and do efficient nasopharyngeal swabs	8% 32% 61%	12% 43% 45%	9% 38% 54%	11% 48% 41%	9% 34% 57%	0% 36% 64%	0.584
According to your opinion as a dental health practitioner, which is the best diagnostic test you would like to use in your dental health center/clinic/university • Saliva based analysis • Serum based analysis • Nasopharyngeal swab	22% 11% 67%	35% 7% 58%	34% 8% 59%	15% 15% 70%	27% 6% 67%	27% 18% 55%	0.370
Was this survey beneficial to refresh or add additional information? • Yes • No	93% 7%	86% 14%	84% 16%	100% 0%	93% 7%	91% 9%	0.084

4. DISCUSSION

COVID-19 has been spreading globally with the emergence of different variants since it was first identified in December 2019 [1, 2]. Despite the fact that vaccines reduce the severity of the symptoms of COVID-19 infection, it does not completely ensure protection from being infected. Dentists are at higher risk of exposure to COVID-19 due to the direct and indirect modes of transmission due to contamination with saliva, aerosols, *etc*, which can be closely related to dental practice [5, 6]. Many DHCPs are aware and practice steps to avoid direct transmission of SARS-CoV-2. However, this study is focused on understanding the status of DHCPs on fomite transmission of COVID-19 and the role of saliva in COVID-19 in infection and diagnosis of COVID-19 in dentistry.

Dental healthcare practitioners displayed adequate knowledge of the fomite route of transmission of COVID-19 in agreement with previous studies on COVID-19 awareness among dental healthcare practitioners in Saudi Arabia [7 - 9]. The predominance of female participants in the study is in lieu of the previous study [9]. It was noted that the maximum responses were received from 21 to 30 years of age, while the accuracy of information was high among 61 to 70 years of age which is compatible with the results of a previous study of DHCPs in Saudi Arabia [8, 9].

There was a lack of knowledge of the virus causing COVID-19 among the various fields of dental healthcare practitioners [10]. The general dental practitioners were found to be less aware of the information on the SARS-CoV-2 virus itself which points to the need for continuous education programs for orientation about COVID-19 [7].

A gap was identified in the information on asymptomatic transmission of COVID-19 among DHCPs and uncertainty of whether both symptomatic and asymptomatic transmission exist. The information on the fomite route of transmission was vague among various DHCPs. Despite the fact that the DHCPs practice infection control methods, only dental nurses were well informed about the routes of fomite transmission prevention, proper use and disposal of face masks and other infection control methods [11].

The dental radiographic procedures were underestimated among DHCPs as a mode of fomite transmission and were

selected with the least responses for the dental procedures causing fomite transmission [12]. Despite many of the dental procedures being contaminated with saliva, there was a void to acknowledge the same [12]. Dental health care professionals should be well-oriented about the latest guidelines and preventive strategies for infection control in dentistry [13]. Jamal M *et al*., 2020 put forth a condensed recommendation for measures to be taken care for dental treatment during the COVID‐19 pandemic which is beneficial for current dental practice since the global remission of COVID-19 is still far side [13, 14]. Amato A *et al*., 2020 have also provided important practical advice which dentists can follow for infection control practices in dentistry [15].

Preventive measures like handwashing and sanitizing were more popular among bachelor undergraduate dental students in Saudi Arabia in alignment with the reports of the previous studies from the region [7 - 10, 12, 16, 17]. and in other countries like Brazil and Austria [18, 19]. The awareness on COVID-19 related information among DHCPs was related to the educational levels and was found to be more among post-doctoral dental health care professionals consistent with the previous studies [8]. In a survey conducted among dental hygienists alone in Saudi Arabia, it was found that the knowledge determined the confidence to practice dentistry during COVID-19 [20].

The role of saliva in COVID-19 in dentistry is well appreciated as a direct mode of droplet transmission [8, 9, 12, 16, 17]. While the DHCPs knowledge of indirect fomite transmission through saliva during dental practice and procedures was found to be insufficient [21]. There are various techniques by which saliva specimen collection can gain momentum for COVID-19 diagnosis in dental practices/hospitals/clinics [21 - 23].

COVID-19 related value-added programs in the form of continuous dental programs should be conducted in intervals to refresh, strengthen and update the current dental practice guidelines for efficient dental practice among dental healthcare professionals in COVID-19. Timely adoption of clear policies and guidelines to prevent COVID-19 transmission should be implemented in the infection-control education and training of dental healthcare professionals [24, 25]. Dental health care professionals should have adequate information that is frequently updated by the regulatory authorities of the government to combat the spread of COVID-19 through dental practice effectively.

Moreover, the fact that the viruses can survive for hours on surfaces, and fomite spread has been considered by the World Health Organization (WHO) to be of importance [26, 27]. A previous study detected more than twenty-three thousand elicited by a 'cough model'. The study found that the targeted area was spread with 5-6% of the target area covered in droplet fluid [28]. The surface contamination risk was also found to be directly proportional to the proximity of the procedural site, length of the procedure, the complexity of the procedure, where an extraoral evacuator was not used and frequency of contact [29]. Furthermore, a recent study proposed the use of fluorescein staining techniques for providing infection control [30].

The present study also had a few limitations amongst which the most important is the relatively low response rate from the dental hygienists and dental assistants in comparison to the other professional groups. The findings of the study are generalizable due to the higher sample representation of dental healthcare professionals in Saudi Arabia.

CONCLUSION

Dental healthcare professionals have adequate information about the fomite route of transmission. There is a gender predominance for awareness of COVID-19 among female DHCPs. Dental healthcare professionals are less aware of the fomite route of transmission through asymptomatic COVID-19 infected patients. Dental nurses were found to have maximum awareness about various aspects of fomite transmission, methods to control its transmission and infection control protocols to be followed. The future recommendations for the study are suggested based on a ‘coin face’ method as described by the authors, where one side of the coin ‘head’ represents increasing the awareness and changing the perception of DHCPs towards fomite route of transmission and infection control methods while the ‘tail’ side of the coin represents conducting in-vitro studies on the fomite-based contamination potential of various strains of COVID-19.

AUTHORS' CONTRIBUTIONS

All authors were part of the Project Management Group.

CS contributed to conception, design, data acquisition and interpretation, drafted and critically revised the manuscript, ADS contributed in major share for data acquisition and critically revised the manuscript and SAAR, MASH, WASB, LYSH and DNSA contributed to data acquisition and critically revised the manuscript. All authors gave their final approval and agreed to be accountable for all aspects of the work ensuring integrity and accuracy of the study.

LIST OF ABBREVIATIONS

SARS-CoV-2	=	Severe Acute Respiratory Syndrome Coronavirus 2
VOC	=	Variance of concern
VOI	=	Variants of interest
DHCPs	=	Dental healthcare practitioners/professionals

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was registered and approved by the Institutional Review Board with IRB number (FRP/2021/350/509/488).

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent was obtained from all participants.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data and supportive information is available within the article.

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None.

CONFLICT OF INTEREST

The authors declare no conflict of interest financial or otherwise.

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