Journal of Young Pharmacists, 2024; 16(2):346-354.
https://www.jyoungpharm.org

Original Article

Assessment of Knowledge of Oral Hygiene Practices during Pandemic and its Post-COVID-19 Impact: A Survey-Based Study

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ABSTRACT

Objectives: The main objective of the study was to assess Knowledge of oral hygiene practices during the pandemic and its post-COVID-19 impact among the community of Delhi and NCR region. **Materials and Methods:** A cross-sectional online survey was conducted among the local population of Delhi and NCR during April and May of 2022. Links to the survey were sent by email and several social media platforms, including WhatsApp. Before answering any questions on the questionnaire, participants were asked to read the study's information and provide their informed permission. **Results:** A total of 516 people did the survey and their responses were included in data analysis. 78 (15.12) agreed and 379 (73.455) said no access and 59(11.43%) said not always with a *p*-value<0.05. 464 (89.92%) agreed that they experienced anxiety and fear during COVID-19 related to their oral hygiene whereas 52 (10.08%) did not, with *p*-value<0.05. 406 (76.68%) agreed on receiving guidance and recommendations from a dental or a health professional to maintain or improve oral health during COVID-19 whereas 110 (21.32%) disagreed with *p*-value<0.05. **Conclusion:** Teledentistry was merely used; its use must be encouraged to provide online services to patients in such a pandemic situation. Yet people tried to change their oral hygiene habits and diet to improve their oral health.

Keywords: Oral health, Teledentistry, Oral hygiene practice, COVID-19, Delhi.

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Received: 26-01-2024;
Revised: 02-03-2024;
Accepted: 14-03-2024.

INTRODUCTION

The World Health Organization proclaimed a pandemic on March 12, 2020. Coronavirus illness (COVID-19), caused by a coronavirus strain in Wuhan, China, was first declared an international public health emergency.[1] The virus enters cells via an interaction of host cells with its "spike protein". *In vitro* testing proclaimed Angiotensin-Converting Enzyme 2 (ACE2) receptors of host cells for entry into the body. ACE2 expression is high in alveolar cells and the basal layer of the squamous epithelium of the nasal, oral, and nasopharyngeal mucosa.[2] Different tissue cells, such as mucosal tissues, gingiva, non-keratinizing squamous epithelium, and epithelial cells of the tongue and salivary glands, include the membranes linked with ACE2.[3] The oral cavity comprises the second largest microbiota in the human body and includes bacteria, fungi, and viruses. Most microorganisms present in the oral cavity are not considered beneficial to the Oral cavity.[4]

One of the first tissue areas to come into contact with the coronavirus is the oral cavity, which develops various changes.[5] Oral lesions and dental anomalies can occur as a direct result of SARS-CoV-2 infection.[6] Dysgeusia is the first oral symptom that results directly from SARS-CoV-2 infection. Additionally, hyposalivation or changes in the makeup of the saliva might cause dysgeusia or ageusia.[6] In a few cases Oral ulcers, petechiae, and reddish macules, mainly in the palate, besides desquamative gingivitis, and blisters in the lower lip and buccal mucosa have been described.[6] There is various evidence available on the correlation between oral hygiene and nonoral systemic diseases. People with oral infections are more likely to develop respiratory illnesses.[7] Sharing toothbrushes, toothpaste, and brush holders may cause an indirect spread of infection among people living together.[8] The attitude of the public toward general health has changed during COVID-19 including oral hygiene. Apart from this the prescribing pattern of health professionals for oral diseases was changed and oral health services utilization had significantly decreased due to the restrictions imposed.[9] Herbal

DOI: 10.5530/jyp.2024.16.45

plants are found to be useful in treating gum disorders, and preventing tooth decay, and have demonstrated good antifungal activity in the oral cavity.[10]

Dental care utilization specifically was less compared to general medical care utilization during the pandemic. After the pandemic, there has been a significant surge in invasive oral and dental treatments compared to preventive treatments.[11] Keeping in mind the importance of oral hygiene practices and overall oral health a study measuring the attitudes and experiences of people during a pandemic was conducted.

MATERIALS AND METHODS

Study Design and Settings

In the Delhi NCR region of India, a cross-sectional survey was carried out among the local population during April and May of 2022. There was an online survey. Links to the survey were sent by email and several social media platforms, including WhatsApp. Before answering any questions on the questionnaire, participants were asked to read the study's information and provide their informed permission.

Sample Size

We used a convenience sampling technique for selecting participants for the study. To determine the sample size, we used an online sample size calculator called Raosoft, Inc. We took Delhi's population of approximately 20.7 million as the population size. For a population of this size, we used a margin of error of 5%, a 90% response rate, and a 95% confidence interval. Based on these parameters, we calculated that 271 responses would be sufficient for this study. However, since we used an online questionnaire that was distributed via social media, we wanted to reduce sampling bias, so we increased the sample size to include 542 participants, which is roughly twice the required size. During the study period, 516 eligible respondents participated in the survey, and their responses were included in the data analysis.[12,13]

We created a questionnaire using Google Forms to collect data for our research. The questionnaire was written in English and Hindi and was reviewed by three experts to ensure its validity. We gave the survey to a small group of 10 people to test for any technical issues before distributing it to a larger sample. We assured participants that their information would only be used for medical research and that they could withdraw at any time. To avoid bias, we used an online survey that randomized the order of answer options for each participant. The questionnaire had multiple sections, including a brief description of the study's purpose, demographic information, knowledge, and attitude towards oral hygiene during the pandemic. We selected the study sample using a convenience sampling technique, and the sample size was determined using the online sample size calculator Raosoft, Inc. Only complete surveys were taken and included in the final analysis of the results while any incomplete survey responses were excluded from the final data analysis in the results.

Ethical Approval

The names, identities, and outcomes of the respondents were kept anonymous due to ethical concerns. Additionally, we made an effort to prevent bias against recipients based on their gender, colour, age, culture, etc. Before the interviews started, each respondent completed an informed consent form. The

Table 1: Distribution of the study population based on responses to questions related to oral hygiene Knowledge (*n*)=516.

Variable	Yes, n (%)	*p*-value
Have you been able to access any teledentistry or remote dental care services (connect through the internet, like video calls) during the COVID-19 pandemic?		
Yes	78(15.12)	<0.05
No	379(73.45)	
Not always	59(11.43)	
Have you experienced any anxiety or fear during the COVID-19 pandemic related to your Oral health because of the following?		
Yes	464(89.92)	<0.05
No	52(10.08)	
Have you received any guidance or recommendations from a dental or healthcare professional to maintain or improve your oral health during the COVID-19 pandemic?		
Yes	406(78.68)	<0.05
No	110(21.32)	

responders received no monetary compensation. All respondents signed an informed consent form before the commencement of the survey; study consent was available in paragraph form on the first page of the survey. Without consent survey was not available the response. However, if the researcher fills respondents fill that they want to quit the survey they can stop the response. We confirm that the research was carried out following the Helsinki Declaration's concept of human involvement in research.

Statistical Analysis

Statistical analysis was conducted by exporting the data from Google Forms (Mountain View, California, USA) and Microsoft Excel (Version 2019) and then exporting it to the Statistical Package for Social Sciences (SPSS) version 26.0 (IBM, Inc., Armonk, NY, USA). Set at <0.05 was the threshold for significance.

RESULTS

Table 1 describes the general experience of study participants regarding oral hygiene. When asked about their access to teledentistry or remote dental care services during the COVID-19 pandemic, 78 (15.12%) agreed, 379 (73.455%) said no access and 59 (11.43%) said not always with a *p*-value<0.05. 464(89.92%) agreed that they experienced anxiety and fear during COVID-19 related to their oral hygiene whereas 52(10.08%) did not, with *p*-value< 0.05. 406 (76.68%) agreed on receiving guidance and recommendations from a dental or a health professional to maintain or improve oral health during COVID-19 whereas 110 (21.32%) disagreed with *p*-value<0.05.

Table 2 shows a distribution of the study population based on responses to questions related to oral hygiene. When asked about access to routine dental care checkups during COVID-19,

Table 2: Distribution of the study population based on responses to questions related to oral hygiene practice (*n*)=516.

Variable	Response, n (%)	*p*-value
Have you been able to access routine dental care (such as check-ups and cleanings) during the COVID-19 pandemic?		
Yes	131(25.39)	< 0.05
No	347(67.25)	
Maybe	38(7.36)	
Experienced any delays or cancellations of dental appointments due to the COVID-19 pandemic.		
Yes	143(27.71)	< 0.05
No	341(66.09)	
Maybe	32(6.20)	
Experienced any changes in your oral health since delaying or canceling a wisdom tooth removal procedure during the COVID-19 pandemic.		
Yes	71(13.76)	<0.05
No	440(85.27)	
Not suffered with wisdom tooth related problem.	5(0.97)	
Were you able to consult your doctor during any emergency (sudden pain or inflammation or cracked/ broken teeth) during COVID-19 pandemic?		
Yes	184(35.66)	<0.05
No	245(47.48)	
Not always	87(16.86)	
Have you changed your oral hygiene habits during the COVID-19 pandemic?		
Yes	349(67.64)	<0.05
No	167(32.36)	
Have you changed your eating habits (your diet) during the lockdown (COVID)?		
Yes	346(67.05)	<0.05
No	170(32.95)	
Have you been able to receive any orthodontic (straightening of teeth) treatments or consultations during the COVID-19 pandemic?		
No	383(74.22)	<0.05
Often	103(19.96)	
Regularly	30(5.81)	

Table 3: Association among different groups of participants regarding responses to questions (*n*=516).

Variable	Yes, n (%)	Gender		*p*-value	Age (years)						*p*-value
		Male, n (%)	Female, n (%)		Under 18, n (%)	18-34, n (%)	35-44, n (%)	45-54, n (%)	55-64, n (%)	≥65, n (%)	
Psychological distress related to oral health during the COVID-19 pandemic, yes	157(30.43)	81(51.59)	76(48.41)	0.69	2(1.27)	102(64.97)	23(14.65)	17(10.83)	11(7.01)	2(1.27)	0.00
Have you been able to access routine dental care (such as check-ups and cleanings) during the COVID-19 pandemic?	177(34.30)	98(55.37)	79(44.63)	0.15	5(2.82)	116(65.54)	35(19.77)	17(9.60)	3(1.69)	1(0.56)	0.00
Have you experienced any delays or cancellations of dental appointments due to the COVID-19 pandemic?	175(33.91)	87(49.71)	88(50.29)	0.94	3(1.71)	117(66.86)	36(20.57)	14(8)	4(2.29)	1(0.57)	0.00
Have you experienced any changes in your oral health since delaying or canceling a wisdom tooth removal procedure during the COVID-19 pandemic?	125(24.22)	73(58.4)	52(41.6)	0.06	1(0.8)	95(76)	16(12.8)	12(9.6)	1(0.8)	0	0.00
Were you able to consult your doctor during any emergency (sudden pain or inflammation or cracked/ broken teeth) during COVID-19 pandemic?	184(35.66)	102(55.43)	82(44.57)	0.14	3(1.63)	155(84.24)	9(4.89)	14(7.61)	2(1.09)	1(0.54)	0.00
Have you been able to receive any orthodontic (straightening of teeth) treatments or consultations during the COVID-19 pandemic?	132(25.58)	75(56.82)	57(43.18)	0.00	2(1.52)	112(84.85)	10(7.58)	7(5.30)	1(0.76)	0	0.00
Have you been able to access any teledentistry or remote dental care services (connect through the internet, like video calls) during the COVID-19 pandemic?	114(22.09)	66(57.89)	48(42.11)	0.09	3(2.63)	97(85.09)	3(2.63)	9(7.89)	2(1.75)	0	0.00
Have you experienced any injuries to your mouth or teeth during the COVID-19 pandemic?	214(41.47)	112(52.34)	102(47.66)	0.49	5(2.34)	172(80.37)	19(8.88)	13(6.07)	4(1.87)	1(0.47)	0.00
Have you experienced any anxiety or fear during the COVID-19 pandemic related to your Oral health because of the following?	464(89.92)	256(55.17)	208(44.83)	0.03	8(1.72)	376(81.03)	37(7.97)	31(6.68)	10(2.16)	2(0.43)	0.00

Variable	Yes, n (%)	Gender		*p*-value	Age (years)					*p*-value
		Male, n (%)	Female, n (%)		Under 18, n (%)	18-34, n (%)	35-44, n (%)	45-54, n (%)	55-64, n (%)	≥65, n (%)	
Have you changed your eating habits (your diet) during the lockdown (COVID)?	346(67.05)	187(54.05)	159(45.95)	0.13	3(1.73)	101(58.38)	44(25.43)	14(8.09)	11(6.36)	0	0.00
Have you sought any alternative treatments or remedies for wisdom tooth problems during the pandemic?	477	261(54.72)	216(45.28)	0.04	10(2.10)	389(81.55)	40(8.39)	28(5.87)	9(1.89)	1(0.21)	0.00
Have you received any guidance or recommendations from a dental or healthcare professional to maintain or improve your oral health during the COVID-19 pandemic?	93(18.02)	52(55.91)	41(44.09)	0.25	4(4.30)	74(79.57)	8(8.60)	4(4.30)	3(3.23)	0	0.00

131 (25.39%) said yes, 347 (67.25%) said No and 38 (7.36%) were not sure with a *p*-value of <0.05,143 (27.71%) experienced delays or cancellations of dental appointments due to COVID 19, 341(66.09%) said no, whereas 32(6.20%) were not sure. when asked about changes in oral health due to cancellation or delaying wisdom tooth removal during the COVID-19 pandemic, 71 (13.76%) said yes, 440 (85.27%) said no and 5 (0.97%) did not experience any wisdom tooth-related problems with *p*-value<0.05. when asked about their access to an emergency during the COVID-19 pandemic 245 (47.48%) said they had no access, 184(35.66%) had access and 87 (16.86%) said not always with *p*-value<0.05, 349 (67.64%) had reported that they changed their oral hygiene habits during COVID-19, whereas 167 (32.365) had not, with *p*-value<0.05, 346 (67.05%) changed their eating habits during COVID-19, whereas 170 (32.95%) did not with *p*-value<0.05, 383 (74.22%) reported the unavailability of access to orthodontic treatments or consultations, whereas 103 (19.96%), reported they often available, and 30 (5.81%) had regular access, with *p*-value<0.05.

Table 3 describes the association among different demographic groups regarding the response to the questions related to oral hygiene. When asked about the psychological distress related to oral health during COVID-19, among 157 (30.43%) who agreed, the highest were males 81 (51.59%), followed by females 76 (48.42%), a *p*-value=0.69.

When compared in different age groups, the 18-34 age group was the highest who agreed 102(64.97%), and the least was under 18 years 2 (1.27%) *p*-value 0.177. Out of (34.30%) who agreed to be able to access routine dental care checkups during COVID-19, the highest were males 98 (55.37%), followed by female 79 (44.63%), *p*-value 0.15. when compared in different age groups, the 18-34 age group was the highest who agreed 116 (65.54%), and the least were 55-64 years, 3(1.69%) *p*-value 0.175. Out of 33.91% who experienced delay or cancellation of dental appointments, the highest were females 88 (50.29%), followed by males 87 (49.71%), *p*-value 0.94. when compared in different age groups, the 18-34 years age group was the highest who agreed 117(66.86%), and the least was under 18 3 (1.71%) *p*-value=0. 125 (24.22%) experienced oral health problems due to delay or cancellation of dental appointments for wisdom tooth removal, among them highest were males 73 (58.4%), followed by females 52 (41.6%), *p*-value=0.06. When compared in different age groups, the 18-34 age group was the highest who agreed 95(76%), and the least was under 18, 1(0.8%) *p*-value=0.

Among 184 (35.66%) who were able to consult a doctor during an emergency highest were males 102 (55.43%), followed by females 82 (44.57%), *p*-value of 0.14. when compared in different age groups, the 18-34 age group was the highest who agreed 155 (84.24%), and the least were 55-64 years, 1 (0.76%), *p* value=0.

132 (25.58%) have been able to receive orthodontic treatment during COVID-19 among them highest were males 75(56.82%), followed by females 57 (43.18%), *p*-value 0. When compared in different age groups, the 18-34 age group was the highest who agreed 112 (84.85%), and the least were 55-64 years, 1 (0.76%) *p*-value=0. 114 (22.09%) have been able to access teledentistry or remote dental care services during COVID-19 among them highest were males 66 (57.89%), followed by females 48 (42.11%), *p*-value=0.09. when compared in different age groups, the 18-34 age group was the highest who agreed 97 (85.09%), and the least were 55-64 years, 2 (1.75%) *p*-value 0. 214 (41.47%) have experienced injuries to mouth and teeth during COVID-19 among them highest were males 112(52.34%), followed by female 102 (47.66%), *p*-value 0.49. when compared to different age groups, the 18-34 age group had the highest who agreed 172 (80.37%), and the least were 55-64 years, 1 (0.47%) *p*-value=0. 464 (89.92%) experienced anxiety and fear during COVID-19 among them highest were males 256(55.17%), followed by female 208 (44.83%), *p*-value=0.03. when compared in different age groups, the 18-34 age group was the highest who agreed 376(81.03%), and the least was under 18 years, 8(1.72%) *p*-value 0. 346 (67.05%) have changed their eating habits during COVID-19 among them highest were males 187 (54.05%), followed by females 159 (45.95%), *p*-value=0.13. when compared in different age groups, the 18-34 age group was the highest who agreed 101(58.38%), and the least was under 18 with 3 (1.73%) *p*-value=0.477 have adopted alternate treatments for wisdom tooth removal during COVID-19 among them highest were males 261 (54.72%), followed by females 216(45.28%), *p*-value=0.04. when compared in different age groups, the 18-34 age group was the highest who agreed 389 (81.55%), and the least were 55-64 years, 9 (1.89%) *p*-value=0. 93 (18.02%) have received guidance and recommendation from a dental or health care professional during COVID-19 among them highest were males 52 (55.91%), followed by females 41 (44.09%), *p*-value=0.25. When compared in different age groups, the 18-34 age group was the highest who agreed 74(79.57%), and the least were 55-64 years, 3 (3.23%) *p*-value=0.

Figure 1 explains the oral health problems experienced as toothache 32.47%, dry mouth 22.4%, mouth sores 16.88%, gum inflammation and bleeding 15.58%, bad breath 16.23%, and least salivary secretions wisdom tooth extraction, braces, teeth capping removed, sensitivity, cavity. 118 experienced cavities, 38 experienced orofacial pain, 28 experienced oral lesions followed

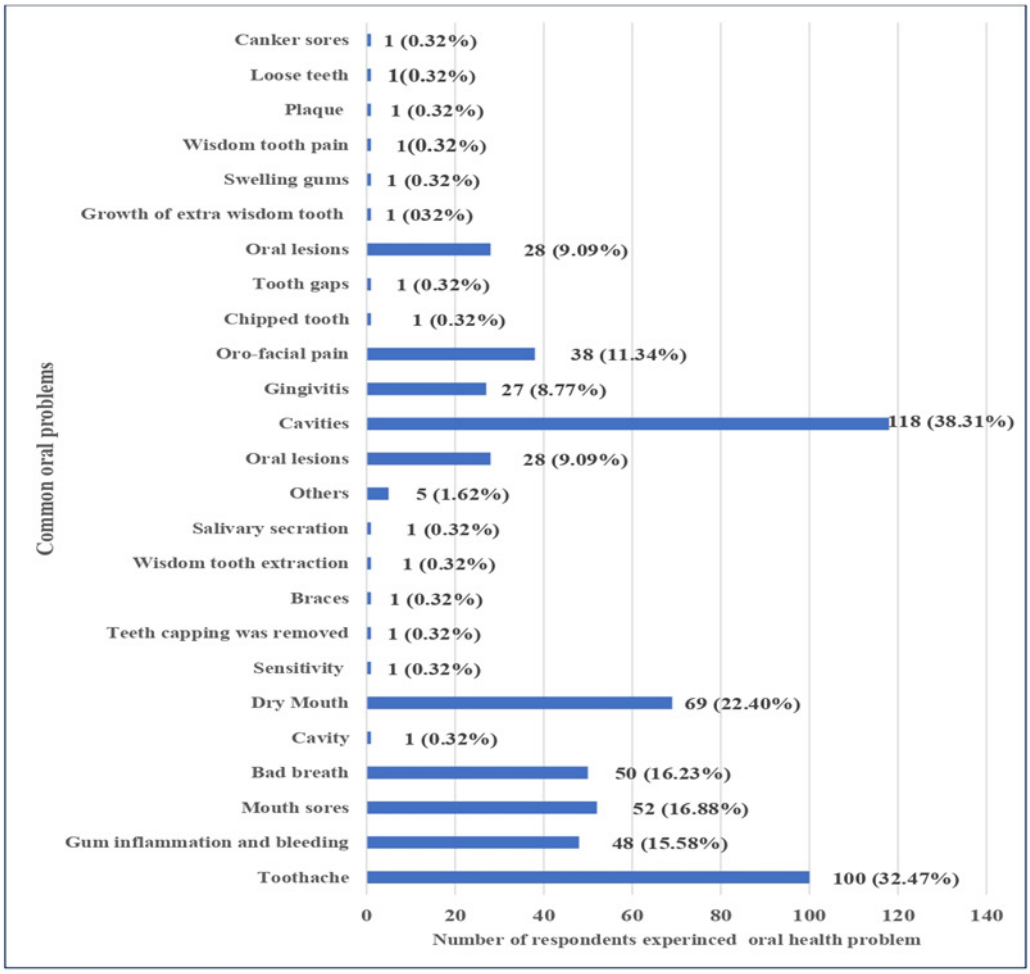

Figure 1: Oral health problems experienced among respondents during COVID-19.

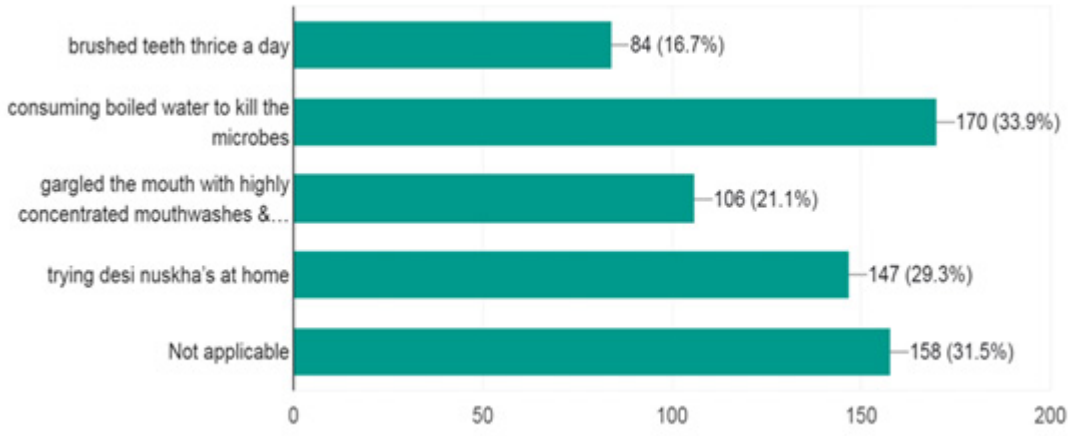

Figure 2: Oral hygiene habits changes, observed during COVID-19.

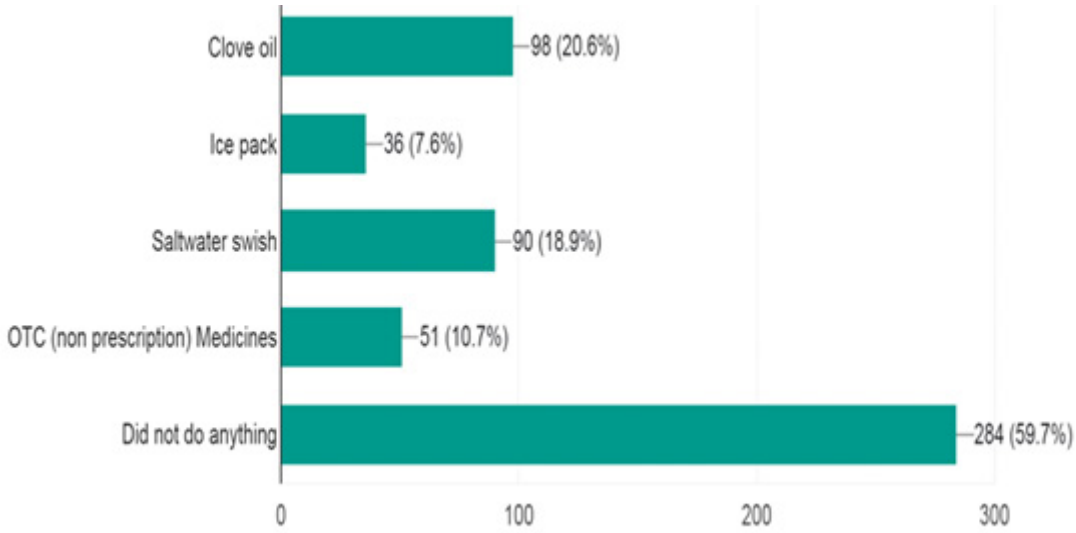

Figure 3: Alternative treatments or remedies for wisdom tooth problems during the pandemic.

by gingivitis in11 and 1 each in loose teeth, canker sores, plague, swelling gums, growth of extra wisdom teeth, tooth gaps, and chipped teeth.

Figure 2 explains Oral hygiene habits changes, observed during COVID-19 the observations were, consuming boiling water 170(33.9%), trying desi nuskas at home 147(29.3%), mouthwash gargle 106(21.1%), brushing thrice a day 84 (16.75).

Figure 3 describes alternative treatments practiced by people, it was found to be 90(18.9%) saltwater wash, 98(20.6%) used clove oil, 51(10.7%) used OTC medications, 36(7.65%) used icepacks, 284(59.7%) used nothing.

DISCUSSION

The COVID-19 pandemic had an impact on the accessibility of dental services by people which had a devastating effect on the oral health of the people.[14] This study was conducted to explore the experiences and general attitudes of people during the COVID-19 pandemic. With the closure of clinics, the people looked for alternate solutions to their problems. One of the positive approaches from the health professionals was an introduction of teledentistry in a few clinics, this was indicated in our study where 15.12% of the people reported using teledentistry during COVID-19 although there is less familiarity and implementation of this service overall, as reported in earlier studies.[15] Its utilization could be encouraged, for early detection and treatment of conditions, reducing cost. In a study conducted in Saudi Arabia, more than half of the study population reported using teledentistry during COVID-19.[16] This could be far better than people turning towards social media, friends and family for non-authentic advice. 78.68% of people reported that they received recommendations and guidance for maintaining their oral health from health professionals during COVID-19. Teledentistry and evidence-based data on social media posted by health professionals could be used for the recommendations and patients' education on oral hygiene during COVID-19.

More than half of our participants (67.25%) were unable to attend clinics for their routine dental checkups during COVID-19. The findings from different studies demonstrate that the pandemic has impacted the provision of emergency dental services, routine oral health services, oral hygiene maintenance at home, changes in dietary preferences, and the use of online information and help-seeking.[17] The most frequently expressed COVID-19 stress was fear of danger and cross-contamination.[18] Adding to this fact, 89.92% of people in our study reported fear and anxiety related to oral health during COVID-19. 47.48% of people claim in our study that they were unable to consult a doctor during an emergency during COVID-19, due to fear and anxiety, 67.64% changed their oral hygiene habits and 67.05% changed their eating habits during COVID-19. People in the United States reported the impact of COVID-19 on the oral health of the public, they faced difficulty in scheduling appointments and worsened their hygiene and eating habits.[14] Several studies reported an increase in sugar consumption. Most studies concluded that there was an increase in the provision and utilization of emergency oral health services like tooth extractions, and orthodontic emergencies.[17] In contrast; our study reported that 74.22% of people were unable to receive any orthodontic treatments during COVID-19.

Overall, when we compared the experience and attitude of the public between gender and age, it was found that males were slightly higher than females who had psychological distress related to their oral health, routinely accessed dental services, experienced a change in oral health due to cancellation of dental appointments, and wisdom tooth removal. Females were slightly higher in the numbers who were able to access the clinics during emergencies and receive orthodontic treatments, using teledentistry. Furthermore, males outweighed females who experienced injuries, anxiety, and fear; changed eating habits used alternative treatments for wisdom tooth problems, and agreed that they received recommendations and guidance for oral health during the COVID-19 pandemic. Females were on the higher side that experienced cancellation of appointments.

When we compare different age groups, this criterion was agreed more with the age group 18-34 years, followed by the 35-44 years age group except access to teledentistry, and emergency services were utilized second most in the age group 45-54 years. One study reported that women had better oral hygiene behaviours than men throughout the pandemic.[17] For adults aged 19 through 64 years, diagnostic and preventive procedures were significantly lower, and direct operative procedures were significantly lower in most of 2020 through 2021.[19]

The most common problems experienced by people during the pandemic were toothache, dry mouth followed by bad breath, mouth sores and cavities. Most of the people were found using home remedies and nonprescription medications. 20.6% used clove oil, followed by 18.9% who used salt water wash 10.7% used OTC medications and 59.7% did not do anything about it. In a study conducted in Saudi Arabia, only about one-fifth of the participants had a dental problem (pain) during the quarantine and nearly half of the participants who had dental problems did not do anything about it,[20] which could be a matter of concern. People in Germany during the COVID-19 pandemic reported toothaches, mucosal problems, and hypersensitivity, myofascial pain.[21] The most delayed treatment was orthodontic treatment and toothache was the most common problem faced by people.[22] During the pandemic, people tried to take better care of their oral hygiene and use boiled water (33.9%), tried desi nuskas (29.3%), gargle with mouthwashes (21.1%), and brushed their teeth thrice a day 16.7%). It is evident that the mouth rinses with chlorhexidine and povidone-iodine are effective antibacterial and antiviral agents and reduce viral load.[23]Various studies reported toothpaste use for sensitive teeth, followed by over-the-counter painkillers, and clove oil.[24]

This study was conducted to determine the experience of people with dental care services and how they managed it during the COVID-19 pandemic using a well-designed survey. However, the study was completed with some limitations. One of the limitations was the small sample size which may be addressed in future studies to determine the post-pandemic utilization pattern of dental care services and people's behavior after the pandemic.

CONCLUSION

During COVID-19 majority of the people were unable to access dental clinics for their routine dental checkups or any emergency. People with orthodontic cases were even devoid of their dental treatments. People did not receive any recommendations from their dental healthcare professionals during the pandemic. Teledentistry was merely used; its use must be encouraged to provide online services to patients in such a pandemic situation. Yet people tried to change their oral hygiene habits and diet to improve their oral health. Being cognizant of the changes during a pandemic, people must be encouraged to visit the dental clinics post-pandemic regularly as they did before the pandemic to maintain their oral health.

ACKNOWLEDGEMENT

The authors express sincere thanks to all the respondents for participating in the survey and providing their feedback on the above-mentioned study.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

COVID-19: Coronavirus disease; **ACE2:** Angiotensin-Converting Enzyme 2; **Delhi-NCR:** Delhi National Capital Region; **p-value:** probability-value; **SARSCoV-2:** severe-acut

e-respiratory-syndrome-related coronavirus; **SPSS:** Statistical Package for Social Sciences; **USA:** United States OF America.

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Cite this article: Chawla F, Arif A, Jain P, Banu N, Ahmed A, Ali MD, *et al*. Assessment of Knowledge of Oral Hygiene Practices during Pandemic and its Post-COVID-19 Impact: A Survey-Based Study. J Young Pharm. 2024;16(2):346-54.