Assessment of Knowledge Regarding Infection Control Protocols among Dental Health Professionals during COVID-19 Pandemic: An Observational Cross-sectional Study

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ABSTRACT

Introduction: It is necessary to prioritise occupational welfare, safety of dental students and health professionals to reduce coronavirus transmission, to offer the best benefit for patients.

Aim: To assess knowledge regarding standard operating procedures to be adhered in clinical setting during pandemic amongst undergraduate, postgraduate dental students and dental interns of dental colleges in northwest region, Karnataka, India.

Materials and Methods: This observational cross-sectional study was undertaken in dental colleges in northwest region, Karnataka from January 2021 to February 2021. Sample size was estimated to be 360 based on a pilot study. Participants were selected by the simple random sampling technique and were interviewed using a questionnaire comprising of 20 close-ended questions. The questionnaire was evaluated for reliability with Cronbach's α value of 0.82, face validity 0.85%, and content validity ratio 0.76. The collected data was entered in MS Excel and analysed using Statistical Package of the Social Science (IBM-SPSS) statistics-

version 21.0 using descriptive analysis, Chi-square analysis, Spearman's correlation coefficient test, and regression.

Results: The mean age of the participants was 24.6±1.35 years with marked gender distribution of 261 (72.5%) females and 99 (27.5%) males. Overall knowledge score for the standard operating procedure to be adhered during the pandemic was found to be 10.92±1.96 (undergraduates), 12.68±1.80 (postgraduates) and 11.55±1.82 (interns). More than half of the respondents 57.78% displayed a moderate level of knowledge. Spearman's correlation coefficient test revealed a high statistically significant difference between awareness about Coronavirus disease 2019 (COVID-19) among participants and recommended masks during the procedure.

Conclusion: Postgraduate students had higher knowledge regarding standard operating procedures to be adhered in dental clinics compared to undergraduate students and interns. It's necessary that dental students are aware of latest infection control guidelines and implement them into their practices right from beginning.

INTRODUCTION

The World Health Organisation (WHO) proclaimed Severe Acute Respiratory Syndrome (SARS-CoV-2)/COVID-19 epidemic a Public Health Emergency of International Concern (PHEIC) or a pandemic on January 30, 2020 [1]. Since then, the viral sickness has spread around the globe at an exponential rate, resulting in a worldwide health disaster. The virus was found in bats and transferred to humans through unidentified intermediary species [1,2]. Human life has been affected in all dimensions, in terms of physical, mental, social and behavioral aspects by putting the world to halt [2,3].

Coronaviruses are a huge virus family that cause illnesses ranging from the common cold, fever, dry cough, shortness of breath, and fatigue to more severe COVID-19 manifestations such as haemoptysis, diarrhoea, vomiting, Middle East Respiratory Syndrome (MERS), and SARS [1,2,4]. A high mortality risk has been associated with older adults or patients with a pre-existing chronic illness [2]. The first dentist reported to have fallen prey to this virus was on January 23rd, 2020 at Wuhan University hospital in China, a country where the infection is said to be originated, and eventually most of healthcare professionals were tested corona positive [3].

To mitigate the pandemic, countries all across the world have implemented certain standard operating procedures. Pervasive guidelines have been provided by Centre of Disease Control (CDC) and government to limit the virus transmission. Dentists were instructed to postpone elective procedures and limit care

to dental emergencies [4,5]. COVID-19 is primarily transmitted through respiratory droplets produced when an infected person coughs or sneezes [6]. Recording the temperatures with infrared thermometers and maintaining a distance of minimum one metre according to WHO (CDC recommends two metres) should be followed in every dental setup [7]. Uncontrolled bleeding, soft tissue bacterial infection, intraoral or extraoral swelling, and facial bone injuries are all considered dental emergencies by the American Dental Association (ADA) [8]. While conducting physical examination of patients, it is mandatory to wear face shield, eye protection, shoe cover, gown, N-95 mask, head cap [9]. Aerosolisation during dental procedures can be reduced by using rubber dams and high volume saliva ejectors. Preprocedural mouthwashes should be used in dental offices to minimise viral load and cross infection risk when treating patients during the pandemic [10,11].

To reduce the danger of transmission to dental students and professionals and to offer the best possible care for patients, occupational health and safety should be prioritised. Therefore, in this study, undergraduates, postgraduates and dental interns in dental college setting were questioned in order to evaluate their knowledge and to eliminate their deficiencies in order to direct patients effectively. This is first kind of study in this region including all budding dental health professionals to keep them aware of the current situation and to inculcate newer infection control guidelines into their routine practice. Objective of this study was to assess

and to compare the knowledge of infection control to be adhered during pandemic among undergraduate, postgraduates and interns working in dental colleges of Northwest region, Karnataka, India.

MATERIALS AND METHODS

This observational, cross-sectional study design based on questionnaire regarding infection control was carried out in dental health professionals and interns from dental colleges, northwest Karnataka from January 2021 to February 2021. Ethical approval obtained from Institutional Ethical Committee (Approval no:1407). The research was carried out in compliance with the ethical standards outlined in the 1964 Declaration of Helsinki and its subsequent modifications. Study participants belonged to KLE Vishwanath Katti Institute of Dental Sciences and M.M.N.G.H Institute of Dental Sciences and Research Centre. After describing the study's aim, the participants signed a written informed consent form. Combined data was collected from participants of dental colleges.

Inclusion criteria: The study only included those healthcare professionals who were present on the day of the study and willing to offer informed consent. Study participants included third year, fourth year undergraduate students, interns, postgraduate students with clinical experience.

Exclusion criteria: Dental students of first and second year undergraduates who are not allowed to treat patients and students unwilling to offer informed consent were excluded from study.

Sample size calculation: The calculation of sample size was done using the formula $n=4pq/d^2$, based on responses observed in the pilot study (p=52%) where, p=prevalence, q=1-p, d=error (10% of p), the sample size was estimated to be 360. Participants were selected by simple random sampling in each of the group for further investigation.

Pretesting (Pilot Study)

The questionnaire was pretested on a small sample of 11 participants to see whether there were any design flaws, such as ambiguous language, inability to know questions, and other issues. Further, these participants were excluded from the main study. Based on the response from the pretest, the questionnaire was further refined by additions and deletions to make it more appropriate and specific to the aim of the study and hence a valid questionnaire was designed. The questionnaire was assessed for reliability with Cronbach's α value and was found to be 0.82 and questionnaire validity was assessed using face validity which was found to be 0.85% and content validity ratio was found to be 0.76.

Details of Questionnaire

The self-administered questionnaire was in English language comprising of 15 close-ended knowledge based questions which were formulated based on study by Esmaeelinejad et al., and hand distributed to individual participants [14]. They were instructed to attempt all the questions in the stipulated time of 15 minutes. Responses were collected from the participants without revealing the identity. Each correct response was given the score of one wherein each participant could obtain minimum score of zero and maximum score 15. Based on quartile derivative, a cut-off knowledge score of ≤8 was set for low knowledge, 9-12 for medium knowledge and 13-15 as high knowledge. The participant's general socio-demographic information was included in the first section of the questionnaire, which was then used for qualitative analysis.

STATISTICAL ANALYSIS

Collected data was entered in MS Excel and analysed using IBM-SPSS® Statistics-Version 21 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 32.0, Armonk, NY, USA: IBM Corp.). Descriptive statistics was applied for the frequency distribution and percentage of students and Chi-square test was applied for the

association between the study variables and knowledge questions. Consequently, Kruskal-Wallis test was applied to test significance among the other study variables. Additionally, the correlation between the knowledge scores was evaluated by Spearman's rank correlation coefficient test whereas, their association with the demographic details of the students was analysed by simple linear regression and multivariate linear regression analysis. The statistical significance was set at p≤0.05 for all the tests.

RESULTS

A total of 360 responses were received out of which 261 (72.5%) females and 99 (27.5%) males based on gender-wise distribution. The mean age of the participants was 24.6±1.35 years. The respondents were equally considered under each grade of dental students. The socio-demographic characteristics of the respondents are depicted in [Table/Fig-1].

[Table/Fig-1]: Socio-demographic characteristics of the respondents.
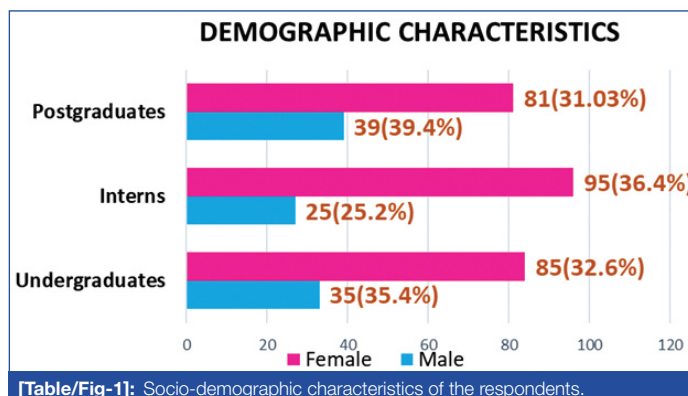
More than half of the respondents 208 (57.78%) displayed a moderate level of knowledge, about 122 (33.89%) showed high knowledge, whereas only small proportion of respondents 30 (8.33%) depicted low knowledge about infection control protocols to be adhered in clinics during pandemic [Table/Fig-2]. The study demonstrated explicit fact that mean overall knowledge score for standard operating procedure to be adhered during pandemic was 10.92±1.96 (undergraduates), 11.55±1.82 (interns) and 12.68±1.80 (postgraduates).

[Table/Fig-2]: Knowledge score towards standard operating procedure among dental students.
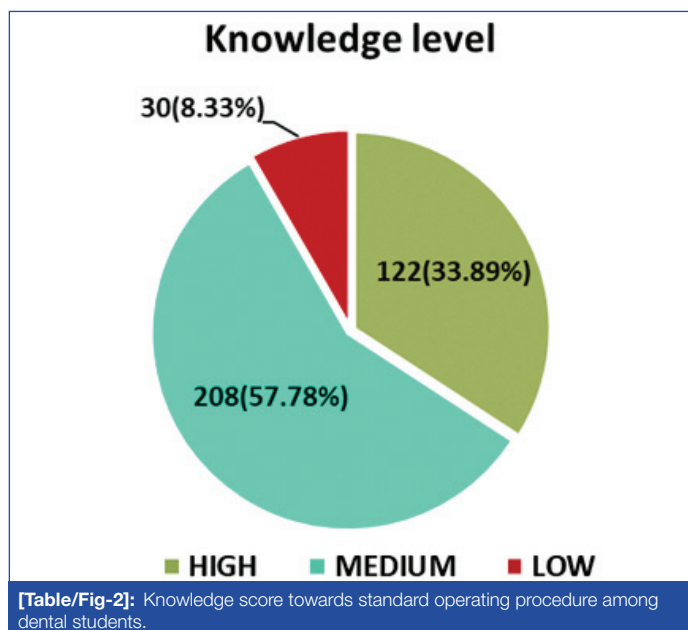
Chi-square association between grades of students and knowledge about standard operating procedures in dental clinic are depicted in [Table/Fig-3]. Kruskal-Wallis test depicted that there was significant difference in the knowledge scores between the students with different educational qualification with p-value=0.003. Also, it was significantly evident that males had slightly higher knowledge about

Question	Response	Total N (%)	Undergraduates	Interns	Postgraduates	p-value
1) Are you aware about transmission of COVID-19	Yes**	348 (96.7)	117	114	117	0.006*
	No	12 (3.3)	03	06	03	
2) Are you aware about instructions given to the patients prior to visit to dental clinics/hospital?	Yes**	358 (99.4)	118	120	120	0.124
	No	02 (0.6)	02	0	0	
3) Is preoperative consent from patient necessary?	Yes**	355 (98.6)	116	119	120	0.064
	No	05 (1.4)	04	01	0	
4) Questions to be asked during history taking with respect to COVID 19 symptoms are?	Fever	84 (23.3)	33	28	23	0.688
	Cough	94 (26.1)	35	32	27	
	Difficulty in breathing	59 (16.4)	20	23	16	
	Loss of taste	26 (7.2)	07	07	12	
	Travel history	25 (6.9)	07	10	08	
	All of the above**	72 (20)	18	20	34	
5) Is preoperative mouth rinse necessary?	Yes**	350 (97.2)	112	118	120	≤0.001*
	No	10 (2.8)	08	02	0	
6) Which of the following is not a dental emergency?	Uncontrolled bleeding.	04 (1.1)	04	00	00	0.013*
	Cellulitis or diffuse	04 (1.1)	04	00	00	
	Facial bones trauma	00	00	00	00	
	Pit and fissure caries**	352 (97.8)	112	120	120	
7) Which type of radiograph is recommended during COVID-19?	OPG**	234 (65)	75	81	78	≤0.001*
	RVG	62 (17.2)	21	14	27	
	IOPA	27 (7.5)	14	01	12	
	CBCT	37 (10.3)	10	24	03	
8) Primary dental triage focuses on provision of 3a's which are?	Analgesia, antimicrobials, ask**	79 (21.9)	26	29	24	0.971
	Analgesia, advice, ask	118 (32.8)	37	41	40	
	Antimicrobials, analgesia, advice	107 (29.8)	39	30	38	
	Ask, assess, advice	56 (15.6)	18	20	18	
9) Aerosol production can be minimised by using which of the following methods?	Rubber dam**	115 (32)	41	34	40	0.195
	Airotor	05 (1.4)	02	01	02	
	High volume saliva ejectors**	134 (37.2)	34	49	51	
	Micromotor	106 (29.4)	43	36	27	
10) What is the distance at which chairs in dental clinic should be placed?	1 Feet	24 (6.7)	21	03	00	≤0.001*
	2 Feet	34 (9.4)	16	12	06	
	3 Feet	85 (23.6)	28	30	27	
	6 Feet**	217 (60.3)	55	75	87	
11) Which mask is recommended to treat COVID-19 patients?	N95**	324 (90)	111	114	99	0.001*
	Respirator	36 (10)	09	06	21	
12) Personal protective equipment consists of?	Face shield	52 (14.4)	16	19	17	0.740
	Eye protection	42 (11.7)	13	16	13	
	Shoe cover	29 (8)	15	05	09	
	Gown	46 (12.8)	19	15	12	
	Mask	50 (13.9)	13	15	22	
	Head cap	23 (6.4)	06	09	08	
	All of the above**	118 (32.8)	38	41	39	
13) Disinfectant recommended to clean the instruments is?	Sodium hypochlorite**	210 (58.3)	54	78	78	≤0.001*
	Ethyl alcohol	90 (25)	30	24	36	
	2% glutaraldehyde	54 (15)	33	18	03	
	Hydrogen peroxide	6 (1.7)	03	00	03	
14) All instruments pertaining to dental procedure should be (according to CDC)?	Only cleaned with soap water	2 (0.6)	00	02	00	0.001*
	Only disinfected with 1% sodium hypochlorite	22 (6.1)	12	10	00	
	Only sterilised with autoclave	03 (0.8)	00	00	03	
	Cleaned, disinfected and sterilised**	333 (92.5)	108	108	117	

15) Which of the following is most effective method for prevention of COVID-19 infection in healthcare setting	Avoid exposure **	190 (52.8)	78	19	93	0.048*
	Vaccine	77 (21.4)	18	50	09	
	Proper history taking	81 (22.5)	21	45	15	
	Performing emergency procedures	12 (3.3)	03	06	03	

[Table/Fig-3]: Association between grades of students and knowledge about standard operating procedures in dental clinic.
*Indicates statistical significance, p-value calculated using Chi-square test. ** Indicates correct answer, For question 9, participants who had answered either rubber dam or high volume saliva ejectors as option were given score of 1 and for other option were given score 0. Both correct answers are marked with (**)

standard operating procedures to be followed in clinical set-up during pandemic with p-value of 0.006 [Table/Fig-4].

Knowledge score	n (mean±SD)				p-value
	High	Medium	Low	Mean score	
Based on education qualification					
Undergraduates	31 (13.3±0.46)	74 (10.62±1.15)	15 (7.6±0.5)	10.92±1.96	0.003*
Interns	43 (13.42±0.40)	68 (11.07±0.89)	9 (7±1.5)	11.55±1.82	
Postgraduates	48 (13.75±0.56)	66 (11.55±1.11)	6 (7±1.09)	12.68±1.80	
Based on gender					
Male	45 (13.26±0.57)	48 (11±0.94)	6 (8±0)	11.85±1.66	0.006*
Female	78 (13.23±0.42)	159 (10.84±1.11)	24 (7.1±1.07)	11.21±1.94	

[Table/Fig-4]: Knowledge scores among various grades of dental students.
*Statistically significant p≤0.05, **Kruskal-Wallis Test

A Spearman's rank correlation coefficient test obtained positive correlation between awareness about transmission of COVID-19 among participants and recommended masks used during procedure with statistically significant p-value=0.003. positive correlation was found between preoperative mouth rinse to be used and aerosol minimization methods to be used for infection control with statistically significant p-value=0.009. There was weak positive correlation obtained between dental chair distancing in clinics and aerosol minimization procedures using Spearman's rank correlation coefficient test. The field wise correlation data are presented in [Table/Fig-5].

Variables		1	2	3	4	5
1. Aware about transmission of COVID-19	r	1				
	p					
2. Preoperative mouth rinse	r	0.068	1			
	p	0.197				
3. Aerosol minimisation methods	r	-0.032	0.137**	1		
	p	0.540	0.009*			
4. Dental chair distance	r	0.015	0.051	0.016	1	
	p	0.781	0.335	0.769		
5. Recommended masks	r	0.156**	0.056	0.054	0.058	1
	p	0.003*	0.286	0.307	0.274	

[Table/Fig-5]: Spearman's correlation between different variables.
r: Spearman's correlation coefficient; **Correlation coefficient at significant value 0.05 level (2-tailed); *Statistically significant p≤0.05

Simple linear regression analysis depicted a significant relationship between knowledge with Education qualification (r=0.233), and with gender (r=0.216). Multiple linear regression analysis revealed that the better knowledge scores were significantly associated with education qualification (0.003) and gender (0.006) with dependence value of (Adjusted R square=0.042) [Table/Fig-6].

DISCUSSION

COVID-19 is a highly infectious disease requiring strict infection control measures. Dentistry involves working directly on the patient

Predictor		Standardised coefficients	Standard error	t	Signifi-cance	Adjusted R square
Knowledge	Constant		0.465	25.192	≤0.001*	0.042
	Education qualification	0.156	0.120	3.014	0.003*	
	Gender	-0.144	0.218	-2.788	0.006*	

[Table/Fig-6]: Multivariate linear regression analysis for the association between demographic variables and knowledge scores of students.
*Statistically significant p≤0.05

mouth and contact with saliva is inevitable. The majority of dental treatments produce aerosols, putting practitioners in the high risk category, according to the ADA, with a risk of 92.3% [10]. As a result, it is critical to decrease the impacts of viral dispersal, transmission, and infection by the COVID-19 virus in a dental setting [11]. To decrease the spread of the disease among the community and dental healthcare providers, a high level of knowledge is crucial and must be obtained from all the available resources [12].

The current study found that dental students had a moderate level of knowledge about standard operating procedures to adhere during a pandemic, which is in agreement with Shrivastava KC et al., concluding that dental healthcare professionals had an average level of knowledge that could be improved through continuing education programs [13].

The understanding of the detailed mechanisms of transmission have made mandatary wearing of masks in public places [14]. Regarding the optimal protection, majority of students 324 (90%) strongly agreed on wearing N95 mask during the procedure to provide sufficient protection against aerosol. Iranian dental student's perceptions emphasised on wearing N95 mask during dental procedure to avoid infection transmission [14]. In contrast to current study findings, Sommerstein R et al., suggested Respirators for certain procedures with higher risk of transmission. Respirator masks are intended to protect the carrier from the inhalation of airborne particles [15].

In the current study, most of the participants 350 (97.2%) were aware of necessity of preprocedural mouth rinse. This was supported by a study by Aboalela A et al., who concluded that hydrogen peroxide is an effective rinse in reducing viral load [16].

In the explicit findings from this study, majority of students 134 (37.2%) emphasised on using high volume saliva ejectors and 115 (32%) of students agreed on rubber dam application for minimising aerosol production during procedure. These findings are supported by Nagraj SK et al., believing use of a high volume evacuator (HVE) may reduce in aerosols less than one foot (~ 30 cm) from a patient's mouth compared to rubber dam which reduces up to one metre but combining both methods have significant outcome [17]. It is recommended to avoid aerosol generating procedures, if not then as many procedures as possible should be carried out under rubber dam isolation and high volume evacuators [18].

Cleaning, disinfecting and sterilising the instruments after every use is a primary protocol to be followed in healthcare set up. Majority of the participants believe that sodium hypochlorite as most effective disinfecting solution to to curtail the spread of infection from inanimate objects supported by Ilangovan et al., stating all instruments used for dental procedures are to be disinfected, cleaned, and sterilised in colour changing sterilisation autoclave pouches and properly stored

in the Ultraviolet (UV) chamber [19]. Similarly, study by Ghimire B and Chandra S, proposed that 72.6% of participants immerse the used instruments in decontamination solution after treatment [20].

Awareness towards personal protective equipment revealed only 118 (32.8%) of the students were aware of the components of kit. However, contrasting finding by Deogade SC et al., that majority of the undergraduates (96.6%-100%) care about protective barriers such as gloves, face mask and head cap and a less concern was observed regarding the protective eyeglasses (37.2%) and protective gowns (21.1%) [21]. Similar findings were obtained in study by MP SK, stated compliance with protective eyewear was very low; only 43% reported using protective eyewear at all times [22]. Poor eyewear use might suggest a lack of understanding among students about the risk of disease transmission through aerosols and blood splashes [22].

The majority of dental students were familiar with the early and frequent symptoms of infection; this finding is critical since students should be able to quickly recognise a suspected case and take appropriate action. In the current study, majority of the students were aware of the symptoms associated with COVID-19 infection and history taking in dental operatory before procedures. On the contrary, study by Umeizudike KA et al., stating that the proportion of respondents with adequate knowledge of the diagnosis, case definition, and symptoms were observed to be low [23]. This could be due rapidly evolving variants of the virus and its associated symptoms. The attitude toward patients with infectious diseases was generally poor among Egyptian dental students [24]. Therefore, it is important to reduce the transmission of diseases by establishing stringent safety measures and increasing trust in them during clinical practice at dental schools [24].

In summary, the study recognises strengths and deficiencies in the knowledge regarding standard operating procedures amongst dental students of Belagavi district in comparison with findings from various studies all over the world [Table/Fig-7] [2,14,20-25].

S. No.	Authors name and year	Place of study	Number of subjects	Parameters compared	Conclusion
1	MP SK (2016) [22]	Chennai, Tamil Nadu, India	150	Knowledge, attitudes, and practices among third year, final year, and internship dental students	Good knowledge and positive attitudes.
2	SC Deogade et al., (2018) [21]	Jabalpur, Madhya Pradesh, India	180	Awareness, knowledge, and attitude of the undergraduate dental students.	Inadequate attitude and awareness.
3	Ghimere B and Chandra S (2018) [20]	Basundhara, Kathmandu, Nepal	144	Knowledge and practice among dental students.	Poor knowledge
4	Mahasneh A et al., (2020) [25]	Jordan	190	Practices among dental healthcare providers	Good practice
5	Esmaeelinejad M et al., (2020) [14]	Iran	531	Knowledge and attitude among Iranian students in the clinical course.	Inadequate level
6	Umeizudike KA et al., (2021) [23]	Nigeria	102	Knowledge, attitudes, and perceptions among undergraduate clinical dental students	Barely adequate
7	El-Saaidi C et al., (2021) [24]	Egypt	1776	Knowledge, attitudes, and practices among third (preclinical), fourth (junior clinical), and fifth year (senior clinical)	Junior clinical > Senior clinical> pre-clinical
8	Shenoy N et al., (2021) [2]	Manipal, India	384	Knowledge, attitudes, and practices among dental practitioners	Adequate
9	Present study	Belagavi, Karnataka, India	360	Awareness and knowledge among undergraduates, interns and postgraduates' dental health professionals	Postgraduates >interns >undergraduates

[Table/Fig-7]: Comparing findings from various studies all over the world [2,14,20-25].

Dental students during their clinical postings are in direct contact with patients and hence they are more vulnerable to COVID-19 infection. Lack of knowledge among them might lead to cross infection which is a matter of concern. These guidelines may change from time to time depending on the course of the diseases and regional needs. Healthcare facilities and individual dentists must be aware of the changes and adjust their facilities and practices accordingly. As a result, efforts should be made to improve dentistry student's knowledge through compliance with infection control requirements in training programs. This could be achieved through the collaborative efforts of global health agencies and government.

Limitation(s)

A study with a more extensive parameters would have made the results even more concrete and substantial. Infection control is a desirable behaviour for dental students. Therefore, results may be affected by social desirability bias, underestimating the magnitude of the problem.

CONCLUSION(S)

Coping with the current situation with rapidly advancing corona variants is a challenge not only for dentists but also for dental students. Postgraduate students had higher knowledge regarding standard operating procedures to be followed in dental set up compared to interns and undergraduate students. Hence proving that educational qualification has direct influence on knowledge of students. It's necessary that dental students are aware of latest infection control guidelines and implement them into their practices right from beginning. Training sessions and extra educational initiatives are desperately needed to improve dental students' knowledge of COVID-19 preventative techniques.

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