



Knowledge and perception regarding oral manifestations of COVID-19 among the undergraduate and postgraduate students of Vishnu Dental College – a questionnaire based study

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Background: The coronavirus disease-19 (COVID-19) and its consequences demonstrate that it is a substantial global health threat with symptoms ranging from mild flu to severe pneumonia. The objective of this study was to assess Indian dental school undergraduate and postgraduate students' knowledge and perception of the oral symptoms present in COVID-19 patients.

Methods: Dental students were compared for knowledge and perceptions regarding oral manifestations of COVID-19 according to their academic, gender and age. The questionnaire was broken into three parts and comprised 12 questions about oral manifestations in COVID-19 patients' knowledge and perception. Each participant received a WhatsApp message with a shareable Google Drive link. After gathering data, the Pearson Chi-Square test was used to do statistical analysis.

Results: This questionnaire survey was completed by 380 dental students. Significant differences were obtained except for one question about knowledge and perception related questions addressing oral manifestations in COVID-19 patients. Only the knowledge-related questions about oral manifestations in COVID-19 patients showed significant differences when compared to perception related questions when compared to gender-related replies.

Conclusions: This study demonstrated that dental students have knowledge of identifying the oral manifestations in COVID-19 infected people, and emphasized the importance of every dental student in identifying oral manifestations and relating these manifestations to the severity of COVID-19 infection in order to preserve patients' oral and overall health.

Keywords: Coronavirus disease-19 (COVID-19); oral manifestations; dental students; knowledge

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Introduction

Coronavirus disease can be asymptomatic or cause respiratory distress, multi-organ failure, ocular symptoms, dermatological

symptoms, and oral signs. The most common symptoms of coronavirus disease-19 (COVID-19) infection include a headache, sore throat, diarrhoea, loss of taste, smell, and

shortness of breath. Some works report manifestations in the oral cavity, in addition to dermatological manifestations (1,2).

COVID-19 infection has atypical oral manifestations that are typically ignored by undergraduate and graduate students because many systemic diseases have some oral presentations similar. But the oral manifestations that are characteristic in COVID-19 have to be identified at the early. If dental practitioners conduct extensive examinations for atypical oral manifestations in COVID-19 patients, they will be able to identify the severity of COVID-19 infection and make recommendations to patients for appropriate medical treatment (3,4).

Dry mouth is the most common oral manifestation in COVID-19 patients, followed by gustatory dysfunction such as loss of salt sensation, loss of sweet sensation, altered food taste, pain or swelling in the salivary gland or cheek, pain or swelling below mandible, oral mucosal changes such as burning mouth sensation, oral ulcerations, mouth and lip spots, tongue redness, and gingival bleeding. These are the oral manifestations observed during COVID-19 infection even at the early stages. Thus identifying these manifestations at the earliest is important to diagnose and prevent the disease (5).

COVID-19 infection is extremely infectious and contagious; hence more research is needed to confirm the link between oral indicators and manifestations. Dental professionals must be aware of early oral manifestations in COVID-19 patients and provide assistance on how to overcome or follow the right treatment protocol to avoid and control the COVID-19 (6,7).

The objective of this study was to assess Indian dental school undergraduate and postgraduate students' knowledge and perception of the oral symptoms present in COVID-19 patients. We present the following article in accordance with the SURGE reporting checklist (available at <https://fomm.amegroups.com/article/view/10.21037/fomm-22-24/rc>).

Methods

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Institutional Ethics Committee-Vishnu Dental College (No. VDC/IEC/2022/F/PI/IVV/53) and informed consent was taken from all the patients. Two experts designed this questionnaire and subjected to validation in 50 participants after reviewing similar questionnaires. The content validity score was 3.8 and above for all the questions included in this study. An online questionnaire was created

to measure dentistry students' knowledge and perception of the existence of oral manifestations in COVID-19 infected people. A total of 380 Vishnu dental college students with at least 6 months of clinical experience in detecting and diagnosing oral diseases have been recruited. Each participant gets a WhatsApp message containing a link to a shareable Google Drive. A digital agreement to participate in this study was obtained before to finishing the questionnaire.

Sample size in each group

A total of 380 students took part in the research. Based on their academic year, 99 students from the 3rd Bachelor of Dental surgery (BDS), 77 from the 4th BDS, 82 from Interns, 43 from the 1st Master of Dental Surgery (MDS), 42 from the 2nd MDS, and 38 from the 3rd MDS participated.

Participants must meet the following criteria: (I) be undergraduate or postgraduate students from the same dentistry school; and (II) have a minimum of 6 months of clinical experience. Students who are not from the same dental school and who have not had at least 6 months of clinical experience are also excluded.

Questionnaire tool

The questionnaire was broken into three parts and comprised 12 questions about oral manifestations in COVID-19 patients' knowledge and perception. The first section dealt with questions about knowledge, while the second dealt with questions about perception. The third segment comprised questions about undergraduate and postgraduate students' perceptions of the prevalence and severity of oral manifestations in COVID-19 infected patients.

Assessment of the knowledge and perception regarding oral manifestations

The participants' knowledge and perception were assessed by the principal investigator based on their responses to the first and second portions of the questionnaire, which indicated the most prevalent oral manifestations of COVID-19 infection. The final component of the questionnaire revealed the frequency and severity of COVID-19 infected patients' oral manifestations.

Statistical analysis

The statistical package IBM SPSS Statistics for Windows, v.

22.0, was used to gather and enter data (IBM Corp., Armonk, USA). The frequency and percentage of categorical variables were calculated. The Pearson Chi-Square test was used to make comparisons between the groups in terms of the incidence of the researched parameters. Statistical significance was defined as a P value of less than 0.005.

Results

Demographic data

The questionnaire survey drew 380 students from Indian dental school. Participants were separated into two groups based on their age (range, 19–24 and 25–30 years). There were 291 females and 89 males among the participants. Participants were divided into four categories based on their academic level: 3rd BDS (n=99), 4th BDS (n=74), Interns (n=81), and postgraduate students (n=126).

Assessment of knowledge and perception regarding oral manifestations in COVID-19

Responses according to the academic year

In this study, we mainly included participants with a minimum of 6 months of clinical experience, so that they know in identifying and diagnosing oral diseases. As reported in *Table 1*, the percentage and number of the respondents who observed oral manifestations in COVID-19 patients in their clinical experience were: Halitosis was about 50.7% [193], Xerostomia—67.4% [256], overgrowth on the tongue, ulcers and burning sensation—54.8% [208], oral ulcerations—51.9% [197], oral or dental pain—38.2% [145], Pain in jaw bones or joint—42.3% [160], vesicles and erosions on the lips, anterior tongue, and buccal mucosa—40.9% [155].

When it comes to the perception-related analysis 89% [338] agreed that oral manifestations are ignored just due to their less prevalence and less severity and 81.1% [308] agreed that nearly half of COVID-19 patients suffer from oral manifestations during infection (*Table 1, Figure 1*).

Responses according to the age

In this study, we mainly included participants with age ranges of 19–24 and 25–30 years. The knowledge and perception regarding oral manifestations according to the age were reported in *Table 2*, and the percentage and number of the respondents who observed oral manifestations in COVID-19 patients in their clinical experience were:

Halitosis was about 57.6% [191], Xerostomia—67.3% [254], overgrowth on tongue, ulcers and burning sensation—54.8% [207], oral ulcerations—52.1% [196], oral or dental pain—38.2% [144], pain in jaw bones or joint—42.6% [160], vesicles and erosions on the lips, anterior tongue, and buccal mucosa—40.7% [153].

When it comes to the perception-related analysis 88.9% [335] agreed that oral manifestations are ignored just due to their less prevalence and less severity and 80.9% [305] agreed that nearly half of COVID-19 patients suffer from oral manifestations during infection (*Table 2, Figure 1*).

Responses according to the gender

In this study, out of 381 individuals, 291 were females and 89 were males. The knowledge and perception regarding oral manifestations according to the gender were reported in *Table 3*, and the percentage and number of the respondents who observed oral manifestations in COVID-19 patients in their clinical experience were: Halitosis was about 51% [193], Xerostomia—68.1% [260], overgrowth on tongue, ulcers and burning sensation—55.9% [213], oral ulcerations—53.0% [202], oral or dental pain—39.3% [151], pain in jaw bones or joint—43.2% [166], vesicles and erosions on the lips, anterior tongue, and buccal mucosa—41.7% [149].

When it comes to the perception-related analysis 89.0% [339] agreed that oral manifestations are ignored just due to their less prevalence and less severity and 81.8% [312] agreed that nearly half of COVID-19 patients suffer from oral manifestations during infection (*Table 3, Figure 1*).

Discussion

The oral mucosa is a key site of infection for SARS-CoV-2 and is thought to be at a high risk of COVID-19 infection (8,9). However, it is still unclear whether oral manifestations are caused by COVID-19 infection, underlying systemic disease, or impaired immune function. The current study aimed to assess Indian dental school undergraduate and postgraduate students' knowledge and perception of the oral symptoms present in COVID-19 patients (10,11).

The oral cavity is well-known for acting as a mirror that reflects the underlying health situation. Because various oral symptoms can be linked with underlying systemic illness and COVID-19 infection, and studies have regarded oral transmission to be one of the major routes of COVID-19 transmission, careful evaluation of the oral cavity will aid in early identification and treatment. The only difficulty in

Table 1 Academic year wise responses of students on oral manifestations of COVID-19

Questions	Academic year	Options			P value
		Unlikely (%)	Neutral (%)	Likely (%)	
Mild-to-moderate cases of COVID-19 infection display oral symptoms	III BDS	4.2	7.9	14	0.000
	IV BDS	5	4.5	10	
	Intern	7.2	6.6	7.7	
	PG	6.6	4.7	21.8	
People with bad oral health can also catch severe COVID?	III BDS	4.2	8.9	12.9	0.008
	IV BDS	4.8	5.8	9	
	Intern	7.1	5.8	8.4	
	PG	8.5	4.5	20.3	
People with COVID, complain of Halitosis (bad smell)?	III BDS	5.8	9.2	11	0.001
	IV BDS	6.6	5.8	7.1	
	Intern	4	5.0	12.3	
	PG	4.8	8.2	20.3	
COVID patients complain of Xerostomia (dry mouth)	III BDS	1.8	9.5	14.7	0.000
	IV BDS	2.9	3.7	12.9	
	Intern	2.9	4.5	14	
	PG	3.7	3.7	25.8	
COVID symptoms on the tongue are manifested as areas of overgrowth tongue, ulcers, and a burning sensation?	III BDS	4	8.7	13.5	0.001
	IV BDS	3.4	8.2	7.9	
	Intern	2.9	6.8	11.5	
	PG	5.5	5.8	21.9	
COVID tongue can be caused by the virus and a heavy load of antibiotic medication?	III BDS	1.4	7.9	16.7	0.043
	IV BDS	2.4	3.7	13.5	
	Intern	1.3	4	16.1	
	PG	2.4	3.4	27.3	
Patients complain of Aphthous-like lesions (Oral Ulcerations) during COVID infection	III BDS	3.5	11.8	10.8	0.003
	IV BDS	3.2	7.1	9.2	
	Intern	2.1	8.4	10.8	
	PG	2.6	9.5	21.1	
Patients complained of Oral or dental pain during COVID infection	III BDS	5.8	13.4	6.9	0.001
	IV BDS	4.7	8.9	5.8	
	Intern	4.2	10	7.1	
	PG	6.3	8.4	18.4	

Table 1 (continued)

Table 1 (continued)

Questions	Academic year	Options			P value
		Unlikely	Neutral	Likely	
Patients complained of pain in jaw bones or joints during COVID infection	III BDS	5	11.3	9.8	0.006
	IV BDS	5.8	7.1	6.6	
	Intern	3.7	9.5	7.9	
	PG	5.5	9.8	18	
Patients complained of vesicles and erosions on the lips, anterior tongue, and buccal mucosa during COVID infection	III BDS	2.6	15	8.4	0.001
	IV BDS	3.4	9.5	6.6	
	Intern	2.6	10.6	7.9	
	PG	5.2	10	18	
Do you agree that oral manifestations are ignored just due to their less prevalence and less severity?	III BDS	2.9	0	23.2	0.475
	IV BDS	2.4	0	17.1	
	Intern	3.2	0	18.2	
	PG	2.6	0	30.5	
Do you agree that nearly half of COVID patients suffer from oral symptoms during infection?	III BDS	22.6	0	3.4	0.164
	IV BDS	14.5	0	5	
	Intern	16.6	0	4.7	
	PG	27.4	0	5.8	

COVID-19, coronavirus disease-19; BDS, Bachelor of Dental surgery; PG, postgraduate students.

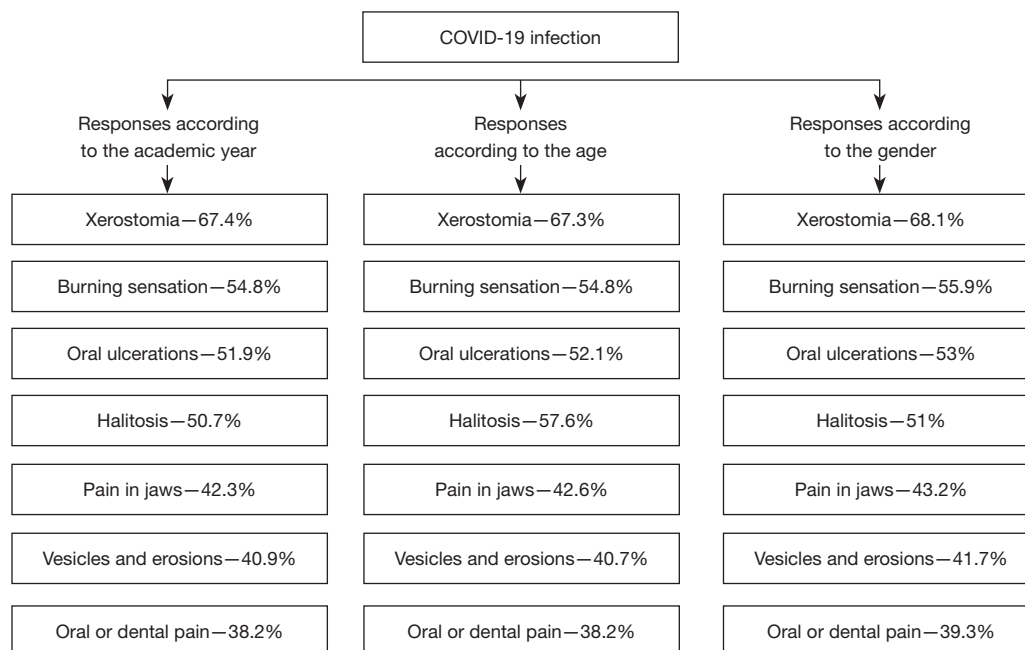


Figure 1 The percentages of oral manifestations observed in COVID-19 infected patients by undergraduate and postgraduate students of Vishnu Dental College in India. COVID-19, coronavirus disease-19.

Table 2 Age-wise responses of students on oral manifestations of COVID-19

Questions	Age (years)	Options			P value
		Unlikely (%)	Neutral (%)	Likely (%)	
Mild-to-moderate cases of COVID-19 infection display oral symptoms	19 to 24	17.7	20.7	33.2	0.000
	25 to 30	5.3	3.2	19.9	
People with bad oral health can also catch severe COVID?	19 to 24	19	20.4	32.1	0.010
	25 to 30	5.5	4.5	18.3	
Do people with COVID, complain of Halitosis (bad smell)?	19 to 24	17.2	21	33.4	0.015
	25 to 30	4	7.2	17.2	
COVID patients complain of Xerostomia (dry mouth)	19 to 24	7.9	18.3	45.3	0.011
	25 to 30	3.4	2.9	22	
COVID symptoms on the tongue are manifested as areas of overgrowth of the tongue, ulcers, and a burning sensation?	19 to 24	10.4	24.9	36.3	0.001
	25 to 30	5.1	4.8	18.5	
COVID tongue can be caused by the virus and a heavy load of antibiotic medication?	19 to 24	4.6	15.5	51.7	0.375
	25 to 30	2.7	3.7	21.9	
Patients complain of aphthous-like lesions (oral ulcerations) during COVID infection	19 to 24	8.2	29.4	34	0.002
	25 to 30	2.7	7.7	18.1	
Patients complained of oral or dental pain during COVID infection	19 to 24	15.9	34	21.8	0.000
	25 to 30	5	6.9	16.4	
Patients complained of pain in jaw bones or joints during COVID infection	19 to 24	15.4	28.7	27.4	0.005
	25 to 30	4.5	8.8	15.2	
Patients complained of vesicles and erosions on the lips, anterior tongue, and buccal mucosa during COVID infection	19 to 24	9.6	36.7	25.3	0.001
	25 to 30	4.5	8.5	15.4	
Do you agree that oral manifestations are ignored just due to their less prevalence and less severity?	19 to 24	8.8	0	62.9	0.289
	25 to 30	2.4	0	26	
Do you agree that nearly half of COVID patients suffer from oral symptoms during infection?	19 to 24	14.3	0	57.3	0.479
	25 to 30	4.8	0	23.6	

COVID-19, coronavirus disease-19.

establishing a link between diagnosis and oral manifestations in COVID-19 patients is that similar manifestations can be seen in a variety of systemic diseases, making it difficult to determine whether these manifestations are the result of systemic disease or COVID-19 infection. Longitudinal research will fill the information gap about COVID-19 oral manifestations and their influence on the oral cavity (12).

According to a study by Huang *et al.*, [2021] the oral manifestations observed roughly in half of COVID-19 patients during the infection. Because only the classic indicators are visible, most undergraduate and postgraduate

students have difficulty recognizing the mild to moderate oral manifestations, which can appear much earlier than the classic signs. As a result, greater study into COVID-19 oral manifestations is needed to determine the link between oral manifestations and COVID-19 infection. Many research investigations have looked into halitosis, xerostomia, COVID-19 tongue, oral ulcerations, oral or dental discomfort, pain in jaw bones or joints, vesicles, and erosions in the oral cavity, in addition to taste loss (13).

Coronavirus targets human cells via angiotensin-converting enzyme 2 (ACE2) receptors, as evidenced by

Table 3 Gender-wise responses of students on oral manifestations of COVID-19

Questions	Gender	Options			P value
		Unlikely (%)	Neutral (%)	Likely (%)	
Mild-to-moderate cases of COVID-19 infection display oral symptoms	Male	6.1	5.5	11.5	0.562
	Female	16.3	17.6	43.0	
People with bad oral health can also catch severe COVID?	Male	4.4	6.8	11.8	0.304
	Female	19.7	17.6	39.7	
Do people with COVID, complain of Halitosis (bad smell)?	Male	4.4	8.1	10.6	0.038
	Female	15.6	19.9	40.4	
COVID patients complain of Xerostomia (dry mouth)	Male	4.0	5.8	13.3	0.058
	Female	7.4	14.7	54.8	
COVID symptoms on the tongue are manifested as areas of overgrowth tongue, ulcers, and a burning sensation?	Male	3.7	8.9	10.5	0.077
	Female	11.8	19.7	45.4	
COVID tongue can be caused by the virus and a heavy load of antibiotic medication?	Male	2.6	4.5	16.0	0.154
	Female	4.5	13.6	58.7	
Patients complain of Aphthous-like lesions (oral ulcerations) during COVID infection	Male	3.4	6.8	12.8	0.250
	Female	7.6	29.1	40.2	
Patients complained of Oral or dental pain during COVID infection	Male	4.7	9.2	9.2	0.304
	Female	16.0	30.4	30.1	
Patients complained of pain in jaw bones or joints during COVID infection	Male	5.7	6.8	10.2	0.158
	Female	13.9	29.9	33.0	
Patients complained of vesicles and erosions on the lips, anterior tongue, and buccal mucosa during COVID infection	Male	3.9	11.8	7.3	0.113
	Female	10.0	32.5	34.4	
Do you agree that oral manifestations are ignored just due to their less prevalence and less severity?	Male	5.5	0	17.6	0.000
	Female	5.5	0	71.4	
Do you agree that nearly half of COVID patients suffer from oral symptoms during infection?	Male	5.2	0	17.8	0.200
	Female	12.9	0	64.0	

COVID-19, coronavirus disease-19.

the fact that ACE2 is the predominant host cell receptor for severe acute respiratory syndrome coronavirus 2. As a result, organs with high ACE2 expression (for example, the lung) might become target cells during SARS-CoV-2 infection, causing inflammatory responses in other organs and tissues (5). The entry of the virus into our bloodstream via receptors called ACE2 found in oral cavity, tongue, and gums is one proposed explanation of coronavirus influencing oral health. As a result, people with poor dental health have more ACE2 receptors. According to studies, those with poor dental health are more likely to get severe

COVID-19 (13).

According to the National Institute of Health [2021], the oral manifestations can even be detected in silent or mild instances of COVID-19 where no other indicators of infection are present. The presence of the virus in oral cavity tissues demonstrated that the oral cavity is the primary site of COVID-19 transmission (13).

Halitosis was identified as one of the oral manifestations in COVID-19 infected patients by 50.7% of participants in this survey. This research builds on prior research by Scully *et al.* [2005], and Zürcher *et al.* [2012], which shown

that halitosis is one of the oral manifestations linked to communicable diseases (14,15).

When asked about patients' complaints of pain during COVID-19 infection, 38.2% of dental students said they had pain in their mouths or teeth, and 42% said they had pain in their jaw bones and joints. This is in line with a study published by Fukuda *et al.* [2016] which found a link between mouth pain and communicable infections (16).

Oral ulcerations are also regularly identified manifestations in COVID-19 patients, according to 51.9% of students. This is in line with the findings of a recent study by Amorim Dos Santos *et al.* [2020] who demonstrated that oral ulcerations are a prevalent sign of COVID-19 infection (17).

COVID-19 infected people have oral symptoms like dry mouth, loss of salt sensation, loss of sweet sensation, altered food taste, oral ulcerations in common even at early stages of COVID-19 infection. By identifying these manifestations at the early stages by the dental practitioners, and relating to the severity of COVID-19 infection, one can preserve the oral and overall health of patients.

The statistical analysis revealed substantial differences in the knowledge and perception levels of oral manifestations found in COVID-19 infected persons based on their mean age and educational level. The scientists also demonstrated a link between high bacterial loads in the mouth and post-viral problems, as well as how better oral hygiene could reduce the likelihood of COVID-19 sequelae. Small sample size and the research done at one dental school are the limitations of the study. Longitudinal research will fill the information gap about COVID-19 oral manifestations and their influence on the oral cavity.

Conclusions

The study demonstrated that dental students have sufficient knowledge to identify the oral manifestations of COVID-19 infected individuals. It also demonstrated the importance of every dental student in identifying oral manifestations and relating these manifestations to the severity of COVID-19 infection, which aids in educating and advising patients on how to follow the proper treatment plan.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://fomm.amegroups.com/article/view/10.21037/fomm-22-24/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Institutional Ethics Committee - Vishnu Dental College (No. VDC/IEC/2022/F/PI/IVV/53) and informed consent was taken from all the patients.

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