

## ORIGINAL ARTICLE

# Educational concerns and awareness level among dental hygiene students during the COVID-19 pandemic

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**Abstract**

**Objective:** This study aimed to evaluate the educational concerns and awareness level among dental hygiene students during the COVID-19 pandemic.

**Materials and Methods:** A questionnaire, created via Google Forms, was sent electronically to 240 dental hygiene students from Turkey, of which 223 replied to the survey. The questionnaire was divided into 4 parts and consisted of 24 close-ended questions.

**Results:** The main symptoms of COVID-19 were correctly recognized by 71% of the students, and 40.2% of the students were aware of the transmission routes. Of all, 77.1% of the students expressed fear of getting infected, 96.9% believed that they would more likely get infected while performing dental procedures, and 91% believed that dental hygienists' cross-contamination risk was high. Furthermore, 69.5% of the students stated that their undergraduate education process was negatively affected, 59.6% appreciated ongoing online education, and 31.8% wanted face-to-face clinical internships.

**Conclusions:** Although most of the students were aware of the transmission routes and preventive measures of COVID-19, concerns regarding disease transmission among them remain. Students appreciated the ongoing online education and believed that face-to-face education is risky during this current pandemic. However, they believe that this process can adversely affect their professional knowledge and especially practical skills. A balance must be struck between sustaining an effective dental hygiene education process and containing the spread of COVID-19.

**KEYWORDS**

COVID-19, dental hygienist, education, pandemic, public health

## 1 | INTRODUCTION

A new  $\beta$ -coronavirus, discovered at a seafood market in Wuhan in the Hubei Province of China, has rapidly spread to other provinces of China and other countries, causing severe and fatal pneumonia. The new coronavirus was named 2019-nCoV, and the World Health

Organization (WHO) declared a pandemic on 30 March 2020.<sup>1</sup> Although COVID-19 is different from severe acute respiratory syndrome (SARS-CoV), they both use the same host receptor, the human angiotensin-converting enzyme 2 (ACE2).<sup>2</sup> The transmission model of the highly virulent COVID-19 is from person to person through saliva and respiratory fluids, directly or indirectly.<sup>3</sup> The transmission

routes of COVID-19 are direct transmission by droplet inhalation, contact transmission due to contact with the oral, nasal, or ophthalmic mucosa and the faecal-oral route.<sup>2,3</sup>

The ACE2+ cell receptors are present in large numbers throughout the respiratory tract. Moreover, it has been shown that ACE2+ cells are morphologically compatible with the ductal epithelium of the salivary glands, and ACE2+ epithelial cells within the salivary gland duct were the early period targets of COVID-19 infection.<sup>4</sup> In dental practice, health care professionals maintain close proximity to the patients, and aerosols containing blood droplets and pathogenic microorganisms are generated by dental equipment.<sup>5</sup> This, therefore, exposes them to a significant risk of contracting COVID-19.<sup>2</sup>

Dental hygienists are members of the dental team, working in collaboration with dentists to improve the quality and efficacy of oral healthcare services. Dental hygienists perform various duties such as welcoming patients, teaching patients appropriate oral hygiene strategies to protect oral health, performing dental radiography, sterilizing the manual tools and equipment, maintaining infection control, developing infection control protocol, providing direct patient care in all dental specialties, and assisting dentists during procedures.<sup>6</sup>

Due to the nature of the occupation, it is inevitable for dental professionals to be interwoven with infectious diseases. Therefore, during the undergraduate period, dental hygiene students are trained on risk assessment of infectious diseases and using personal protective equipment (PPE).<sup>7</sup> According to the American Occupational Safety and Health Administration, dental health care professionals are in the very high-risk category for contracting COVID-19 as they are constantly exposed to procedures that generate potential virus-carrying aerosols, promoting cross-infection.<sup>8</sup> Hence, in response to prevent COVID-19 transmission in this practice, the authorities recommended postponing routine dental procedures during the pandemic, except for urgent dental procedures by reducing the production of droplets and aerosols, using strict PPEs. In addition, the recommendation suspended clinical education and complete patient care provided in all schools worldwide, but undergraduate education continued as online courses and webinars.<sup>7,9</sup>

Studies reporting on the pandemic's impact on undergraduate dental education are limited.<sup>10-13</sup> There is also no official information on ensuring continuity of dental education to protect students, faculty and patients.<sup>11</sup> Therefore, new studies assessing the quality of online education and providing suggestions for its improvement are needed during the pandemic period. This study aimed to evaluate the educational concerns and awareness level of dental hygiene students during the COVID-19 pandemic.

## 2 | MATERIAL AND METHODS

### 2.1 | Setting and participants

This cross-sectional study included dental hygiene students who attended the preclinical and clinical semesters of the Kirikkale University Department of Dental Hygiene. The Ethics Committee of

Non-Interventional Research of Kirikkale University approved the study protocol (date: 26 November 2020, decision # 2020.11.01). The size of the source population was obtained from the statistical data published by the Turkish Council of Higher Education. According to this data, there are 7602 undergraduate dental hygiene students enrolled in public and private institutions. At an 85% confidence level and with a type 1 alpha error of 0.05, it was estimated that 202 participants would be required for adequate power to detect statistical significance.

### 2.2 | Questionnaire Instrument

The questionnaire was prepared based on the U.S. Centers for Disease Control and Prevention Guidance for Dental Settings<sup>3</sup> for questions regarding the COVID-19 pandemic and based on the studies conducted by Desai<sup>12</sup> (2020) and Iyer et al.<sup>11</sup> (2020) for education-related questions. The questionnaire, created via Google Forms, was divided into 4 parts and consisted of 24 close-ended questions. It included questions regarding the students' demographic characteristics, their perceptions and awareness level towards the COVID-19 pandemic, and their educational concerns. The questionnaires were sent out online to a total of 240 students attending the preclinical and clinical semesters of the Kirikkale University Department of Dental Hygiene in Turkey between 10 January and 20 January 2021. The aims of the research, warrant of confidentiality, using the findings of the study only for research and publication purposes, and voluntary participation were declared to the students. The voluntary consent of each participant was obtained online.

### 2.3 | Data analyses

The collected data were extracted from Google Forms and converted to Excel (Microsoft, USA) sheets. Statistical analyses were performed at a 5% significance level using SPSS 21.0 software (SPSS Inc.). The analysed population's demographic data were presented as grouped by sex and semester (preclinical or clinical). The results of the preclinical- and clinical-semester students were presented as average. Differences among the variables were assessed using the Mann-Whitney U test and chi-square test, with a significance level of  $p < 0.05$ .

## 3 | RESULTS

### 3.1 | Demographics

Out of 240 delivered questionnaires, 223 were completed, with a response rate of 93%. Table 1 shows the distribution of students' age and sex demographics by year of education. Of the respondents, 35.9% were male and 64.1% were female. Furthermore, of the 223 participating students, 108 (48.4%) were preclinical and

115 (51.6%) were clinical students, with an average age of 19.99 and 20.39 years, respectively.

### 3.2 | Assessment of students' educational concerns

The answers to the questions assessing students' educational concerns based on their perceptions of the COVID-19 pandemic were presented in Table 2. Of the students, 59.6% appreciated ongoing online education, 31.8% preferred face-to-face education, and 8.5% suggested receiving written documents/sheets during the pandemic. While 69.5% of the students believed that their dental hygiene education has been negatively affected by the pandemic. The ratio of clinical students who considered clinical internships risky was statistically significantly higher than that of preclinical students ( $p = 0.010$ ). Furthermore, 83.9% were concerned that the pandemic would continue until their postgraduation period, although no statistically significant difference was observed between the preclinical and clinical students regarding their answers to this question ( $p = 0.872$ ). The percentage of students who considered performing their profession after graduation despite the pandemic was statistically higher in female (87.4%) ( $p = 0.001$ ) than in male students

TABLE 1 Distribution of participants' age and sex demographics by year of education

|     | 1st Semester                           | 2nd Semester                           | p-value |
|-----|--|--|---------|
| Age | 19.99 ± 1.19<br>min:18 max:24          | 20.39 ± 1.34<br>min:19 max:25          | 0.052*  |
| Sex | Male: 42 (38.9%)<br>Female: 66 (61.1%) | Male: 38 (33.0%)<br>Female: 77 (67.0%) | 0.363** |

\*Mann-Whitney  $U$  test and \*\* Chi-square test shows statistically significant differences ( $p < 0.05$ ).

TABLE 2 Participants' educational concerns based on their perceptions of the COVID-19 pandemic.

|   | 1st Semester  | 2nd Semester  | p-value |
|---|---|---|---------|
| During the pandemic period, how should undergraduate education be implemented?        | Online education: 64 (59.8%)<br>Written documents/sheets: 11 (10.2%)<br>Clinical internship: 33 (30.6%) | Online education: 69 (60.0%)<br>Written documents/sheets: 8 (7.0%)<br>Clinical internship: 38 (33.0%) | 0.672   |
| How was the quality of undergraduate education you received in the pandemic affected? | Positive: 14 (13.0%)<br>Negative: 71 (65.7%)<br>Not sure: 23 (21.3%)                                    | Positive: 16 (13.9%)<br>Negative: 84 (73.0%)<br>Not sure: 15 (13.0%)                                  | 0.260   |
| Do you consider face-to-face education is risky during the pandemic?                  | Yes: 56 (51.9%)<br>No: 40 (37.0%)<br>Not sure: 12 (11.1%)   | Yes: 67 (58.3%)<br>No: 38 (33.0%)<br>Not sure: 10 (8.7%)  | 0.607   |
| Do you consider clinical internship training risky during the pandemic?               | Yes: 47 (43.5%)<br>No: 41 (38.0%)<br>Not sure: 20 (18.5%)   | Yes: 73 (63.5%)<br>No: 30 (26.1%)<br>Not sure: 12 (10.4%)   | 0.010*  |
| Are you concerned about the continuation of the pandemic after graduation?            | Yes: 90 (83.3%)<br>No: 15 (13.9%)<br>Not sure: 3 (2.8%)   | Yes: 97 (84.3%)<br>No: 16 (13.9%)<br>Not sure: 2 (1.7%)   | 0.872   |
| If the pandemic continues after graduation, do you intend to continue doing your job? | Yes: 94 (87.0%)<br>No: 7 (6.5%)<br>Not sure: 7 (6.5%)   | Yes: 89 (77.4%)<br>No: 11 (9.6%)<br>Not sure: 15 (13.0%)  | 0.156   |

\*Chi-square test shows statistically significant differences ( $p < 0.05$ )

(72.5%). However, there was no statistically significant difference between female and male students regarding answers to the other questions ( $p > 0.05$ ).

### 3.3 | Assessment of perceptions regarding COVID-19 and dental clinical procedures

Table 3 shows the students' perceptions towards COVID-19 and their responses to the questions regarding dental clinical procedures. Table 3 suggests that 94.6% of the students considered COVID-19 infection as fatal. Information regarding the COVID-19 pandemic was mostly accessed via the internet (65.9%) and television (20.6%). Of all, 77.1% of the students expressed fear of getting infected, 87.9% reported that they were not infected with COVID-19 or were unsure of the status, 96.9% believed that they would more likely get infected while performing dental procedures, and 91% believed that dental hygienist' cross-contamination risk was high. The ratio of students who believed their knowledge regarding infection control was sufficient during the pandemic was 51.6%.

### 3.4 | Assessment of students' awareness level regarding COVID-19 pandemic

Table 4 shows the students' answers to questionnaire using multiple-choice and open-ended questions concerning the COVID-19 pandemic. Of all, 34.5% of the students had the correct information regarding the causative virus for COVID-19, severe acute respiratory syndrome CoV2 (SARS-CoV-2). The main symptoms of COVID-19 were correctly recognized by 71% of the students (Figure 1), and 40.2% of the students were aware of the transmission routes (Figure 2).

TABLE 3 The participants' perceptions towards COVID-19 and their responses to the questions regarding dental clinical procedures

|  | 1st Semester  | 2nd Semester  | p-value |
|--|---|---|---------|
| Do you consider that COVID-19 infection as fatal?                                    | Yes: 102 (94.4%)<br>No: 5 (4.6%)<br>Not sure: 1 (0.9%)  | Yes: 109 (94.8%)<br>No: 2 (1.7%)<br>Not sure: 4 (3.5%)  | 0.212   |
| What is your source of information on COVID-19?                                      | Television: 21 (19.4%)<br>Internet: 73 (67.6%)<br>Family physician/nurse: 5 (4.6%)<br>Current literature: 9 (8.3%)<br>Other: 0 (0.0%) | Television: 25 (21.7%)<br>Internet: 74 (64.3%)<br>Family physician/nurse: 3 (2.6%)<br>Current literature: 12 (10.4%)<br>Other: 1 (0.9%) | 0.724   |
| Are you concerned about getting infected with COVID-19?                              | Yes: 83 (76.9%)<br>No: 20 (18.5%)<br>Not sure: 5 (4.6%)   | Yes: 89 (77.4%)<br>No: 25 (21.7%)<br>Not sure: 1 (0.9%)   | 0.200   |
| Have you encountered a COVID-19 infection?   | Yes. symptomatic: 8 (7.4%)<br>Yes. asymptomatic: 3 (2.8%)<br>No: 90 (83.3%)<br>Not sure: 7 (6.5%)                                     | Yes. symptomatic: 14 (12.2%)<br>Yes. asymptomatic: 2 (1.7%)<br>No: 88 (76.5%)<br>Not sure: 11 (9.6%)                                    | 0.470   |
| Do you believe you may be infected with COVID-19 while performing dental procedures? | Yes: 104 (96.3%)<br>No: 2 (1.9%)<br>Not sure: 2 (1.9%)  | Yes: 111 (96.5%)<br>No: 2 (1.7%)<br>Not sure: 2 (1.7%)  | 0.996   |
| What do you believe is the risk of COVID-19 infecting dental hygienist?              | Low: 3 (2.8%)<br>Moderate: 8 (7.4%)<br>High: 97 (89.8%)<br>Not sure: 0 (0.0%)   | Low: 2 (1.7%)<br>Moderate: 15 (13.0%)<br>High: 96 (83.5%)<br>Not sure: 2 (1.7%)   | 0.249   |
| Do you believe personal protective equipment would protect from COVID-19?            | Yes: 49 (45.4%)<br>No: 48 (44.4%)<br>Not sure: 11 (10.2%)   | Yes: 47 (40.9%)<br>No: 50 (43.5%)<br>Not sure: 18 (15.7%)   | 0.460   |
| Do you have sufficient knowledge regarding infection control during the pandemic?    | Yes: 50 (46.3%)<br>No: 44 (40.7%)<br>Not sure: 14 (13.0%)   | Yes: 65 (56.5%)<br>No: 37 (32.2%)<br>Not sure: 13 (11.3%)   | 0.304   |

Note: Chi-square test shows statistically significant differences ( $p < 0.05$ ).

No statistically significant difference was observed inter-sex regarding the overall correct answer ratio ( $p = 0.783$ ). The ratio of female students (98.6%) who considered COVID-19 fatal was statistically significantly higher ( $p = 0.001$ ) than male students (87.5%). Furthermore, female students were found to be significantly more concerned about getting infected with COVID-19 than their male counterparts ( $p = 0.026$ ). Similarly, the proportion of female students (74.1%) who believed that the quality of education had been adversely affected was statistically significantly higher ( $p = 0.032$ ) than male students (61.3%). Moreover, 84.6% of female students and 82.5% of male students were concerned that the outbreak would continue even after graduation ( $p > 0.05$ ).

According to Figure 4, to prevent the COVID-19 transmission, 74.9% of the students recommended that dental procedures should be performed using PPE, 73.1% believed that PPEs should be used more frequently in clinical surface cleaning, 68.6% suggested that only urgent dental treatments should be performed during the pandemic, 63.2% suggested interval patient appointments, 52% believed in using pre-treatment antiseptic mouthwashes, 47.5% recommended that the procedures should be performed using a rubber-dam, and 13.9% suggested that dental procedures should be avoided completely during the pandemic.

## 4 | DISCUSSION

Although reaction towards COVID-19 varies worldwide according to the health systems, economies and political differences, the pandemic has created significant challenges concerning dental education systems worldwide.<sup>7</sup> In addition, it has been observed that in exceptional circumstances, such as the current pandemic, universities worldwide have no sustainable, forward-looking action plans for education.<sup>8</sup> The main objective of dental hygiene education was to develop healthcare workers who can provide effective and safe treatments to patients with oral diseases with dentists. Due to the COVID-19 pandemic, this objective has been attempted to accomplish via online education. And, it is critical to strike a balance between continuing the learning process and not promoting the spread of infected cases. During the pandemic, many dental schools around the world are working extremely hard, using modern information technologies, to ensuring dental hygiene education continuity, and it is very useful to examine the official information from lecturers from different countries and to share their experiences.<sup>14</sup>

In different studies to aim to measure the effect of the pandemic on dental professionals, either the relationships between patients and dental professionals have been taken into consideration<sup>15</sup> or data regarding the effects of the pandemic on dentistry students'

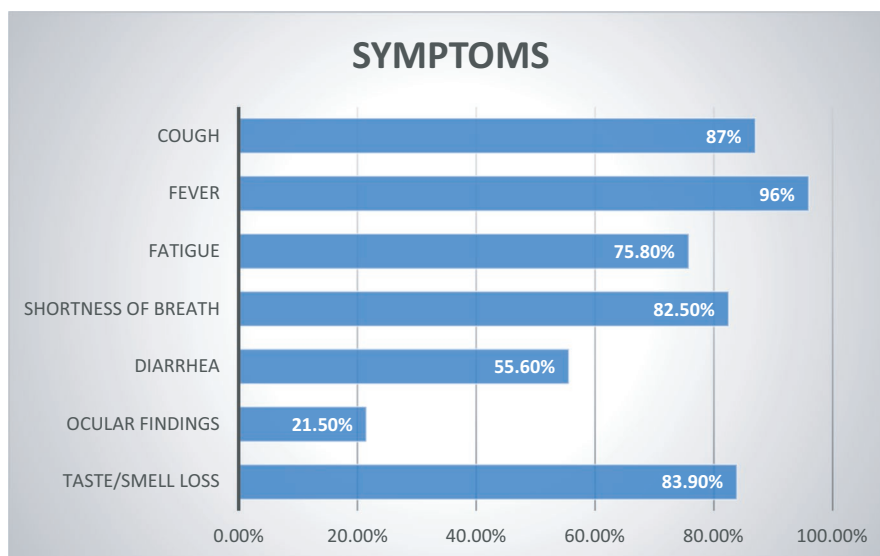
TABLE 4 The participants' answers to questionnaire using multiple-choice and open-ended questions regarding the COVID-19 pandemic

|  | 1st Semester   | 2nd Semester   | p-value |
|--|--|--|---------|
| What is the name of the causative virus for COVID-19 infection? <sup>a</sup>     | SARS-CoV-2: 36 (33.3%)<br>COVID-19 virus: 42 (38.9%)<br>Others: 30 (27.8%)   | SARS-CoV-2: 41 (35.7%)<br>COVID-19 virus: 34 (29.6%)<br>Others: 40 (34.8%)   | 0.716   |
| How many days is the incubation period of COVID-19? <sup>a</sup>                 | 7 and 14 days: 95 (88.0%)<br>Others: 13 (12.0%)  | 7 and 14 days: 91 (79.1%)<br>Others: 24 (20.9%)  | 0.077   |
| What are the symptoms of COVID-19 infection? <sup>b</sup>                        | Cough: 94 (87.0%)<br>Fever: 105 (97.2%)<br>Fatigue: 85 (78.7%)<br>Shortness of breath: 86 (79.6%)<br>Taste/smell loss: 89 (82.4%)<br>Others: 49 (45.4%)  | Cough: 100 (87.0%)<br>Fever: 109 (94.8%)<br>Fatigue: 84 (73.0%)<br>Shortness of breath: 98 (85.2%)<br>Taste/smell loss: 98 (85.2%)<br>Others: 64 (55.7%) | 0.661   |
| What are the transmission routes of COVID-19? <sup>b</sup>                       | Droplet Inhalation: 87 (80.6%)<br>Nasal mucosa: 40 (37.0%)<br>Eye mucosa: 29 (26.9%)<br>Saliva-blood: 70 (64.8%)<br>Others: 19 (17.6%)                   | Droplet Inhalation: 97 (84.3%)<br>Nasal mucosa: 60 (52.2%)<br>Eye mucosa: 32 (27.8%)<br>Saliva-blood: 68 (59.1%)<br>Others: 21 (18.3%)                   | 0.508   |
| Which protective equipment should be used during dental treatments? <sup>b</sup> | Gloves: 101 (93.5%)<br>Surgical mask: 94 (87.0%)<br>N95 mask: 79 (73.1%)<br>Shield: 87 (80.6%)<br>Goggles: 76 (70.4%)<br>Protective clothing: 87 (80.6%) | Gloves: 108 (93.5%)<br>Surgical mask: 97 (87.0%)<br>N95 mask: 93 (73.1%)<br>Shield: 96 (83.5%)<br>Goggles: 89 (77.4%)<br>Protective clothing: 94 (80.6%) | 0.391   |
| Can transmission occur while using dental handpieces during dental treatments?   | Yes: 73 (67.6%)<br>No: 7 (6.5%)<br>Not sure: 28 (25.9%)  | Yes: 87 (75.7%)<br>No: 13 (11.3%)<br>Not sure: 15 (13.0%)  | 0.183   |

Note: Mann-Whitney *U* test shows statistically significant differences ( $p < 0.05$ ),

<sup>a</sup>Open-ended question, <sup>b</sup> multiple-choice question

FIGURE 1 Participants' knowledge on the main symptoms of the COVID-19 infection



undergraduate education have been reported.<sup>11,12</sup> A small number of studies have assessed the pandemic's psychological effects on dentistry or dental hygiene students.<sup>10,13</sup> Furthermore, to the best of our knowledge, there are no studies in the literature assessing the educational concerns and awareness level among dental hygiene students during the COVID-19 pandemic. Since 13 March 2020, dental hygiene face-to-face clinical education has been suspended and continues online in our country. Therefore, at the time of the questionnaire

conducted in this study, dental hygiene education was delivered online. The undergraduate curriculum did not include education explicitly related to COVID-19, other than lessons regarding oral disorders and infectious diseases. COVID-19-related topics were only included in the lessons after the questionnaire data were obtained.

Table 2 shows the students' replies to the questions regarding educational concerns during the COVID-19 pandemic. The table suggests that 55.2% and 53.8% of the students considered face-to-face

theoretical education and clinical internship training risky during the pandemic, respectively. Preclinical students, however, had a significantly lower rate regarding the risk of clinical internship education ( $p = 0.010$ ). Most students (59.6%) appreciated ongoing online education during the pandemic. Female students had a statistically higher ratio than males ( $p = 0.032$ ). Nonetheless, 69.5% of the students considered that the pandemic adversely affected their professional knowledge and skills. A study conducted by Bellini et al.<sup>13</sup> (2020) found that 63.2% of the students were extremely concerned about getting infected with COVID-19 during clinical internship training and 36.1% and 42.6% of the students expressed the risk associated with face-to-face educational activities as high and medium, respectively. Furthermore, a higher percentage of students among senior students considered face-to-face education risky for disease transmission because of more clinical internship training activities than the lower classes ( $p < 0.001$ ), in line with the findings of the present study. A study that evaluated dental students' opinions on online learning found that the students were satisfied with the online lectures and e-learning methods.<sup>16</sup> However, the lack of practical training was significantly perceived as an important limitation in the structure of the current online approach. The pandemic's continuation has created concerns worldwide, especially for clinical students, affecting their professional self-confidence.<sup>13</sup>

In the present study, although female students had a statistically higher ratio than males ( $p = 0.001$ ), 83.9% of the students were concerned regarding the possible continuation of the pandemic even after graduation. Irrespectively, most of the students (82.1%) intend to pursue their profession after graduation, which was a positive outcome (Table 2). A study conducted by Bellini et al.<sup>13</sup> (2020) including Italian dental hygiene students reported that 17.7% of the students expressed the severity of the COVID-19 pandemic's effect on their university career as excessive or high, 45.4% as moderate, and 36.9% as little or none. In addition, 36.2% of the Italian students graded the effect of the pandemic on their profession after graduation as excessive or high, 41.8% as moderate, and 22% as little or none. Another study conducted by Zhao et al.<sup>17</sup> (2021) reported that most dental graduates believed that the impact of COVID-19 on their immediate postgraduation

career was limited, which is in line with the findings of the present study. In addition, the infection control curriculum appeared effective to develop a positive attitude among dental providers.<sup>17</sup>

The incubation period of COVID-19 ranges from 7 to 14 days, without manifesting any clinical symptoms.<sup>18</sup> The findings of our study showed that 34.5% of the students had the correct information regarding the name of SARS-CoV-2, and 83.4% were aware of the 7–14 days incubation period. This misinformation regarding the name of the virus, SARS-CoV-2, could be attributed to the different nomenclatures given on television and the internet, which are common sources of information. The ratio of students who considered COVID-19 as fatal ( $p = 0.001$ ) and the ratio of those concerned about getting infected were statistically significantly higher in female than in male students ( $p = 0.026$ ). In our study, 2.25% of the students reported that they were asymptomatic and 9.8% were symptomatic, whereas only 0.5% of Italian dental hygienists were reported to be COVID-19 positive.<sup>19</sup> The prevalence of COVID-19 among U.S. dental hygienists was reported as 3.1% ( $n = 149$ ). A study conducted by Bellini et al.<sup>13</sup> (2020) reported no disease transmission among the students, and 75.2% have not encountered any infection. The increased number of positive cases reported in our study could be explained by gathering this study's data at the peak of pandemic.

The typical clinical symptoms in patients infected with COVID-19 are dry cough, fever, myalgia or fatigue, shortness of breath and diarrhoea.<sup>20,21</sup> As shown in Table 4, students cited the main symptoms of COVID-19 as fever (96%), cough (87%) and loss of taste/smell (83.9%). Dental professionals are frequently exposed to saliva, blood and other body fluids during routine dental procedures. Direct contact with these contents via the oral, nasal, or eye mucosa or droplet inhalation constitutes the transmission routes of COVID-19.<sup>22</sup> To et al.<sup>23</sup> (2020) reported the COVID-19 carrier rate as 91.7% in saliva and stated that the saliva of infected individuals could transmit COVID-19. Therefore, the potential infectivity of salivary glands, saliva and other oral fluids alone should be emphasized in the undergraduate curriculum.<sup>23</sup> The study conducted by Bellini et al.<sup>13</sup> (2020) determined that 97.9% of dental hygiene students were aware that the main transmission route was droplet inhalation, and 97.2% knew

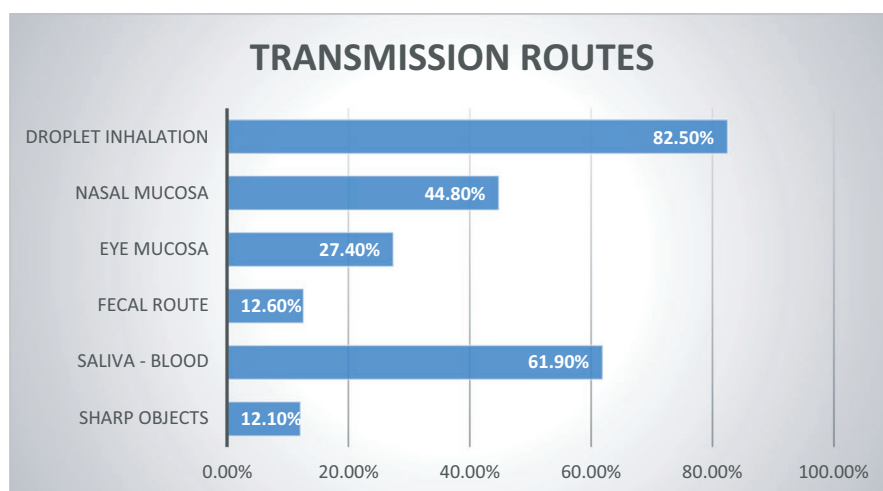


FIGURE 2 Participants' knowledge on the transmission routes of the SARS-CoV-2 virus

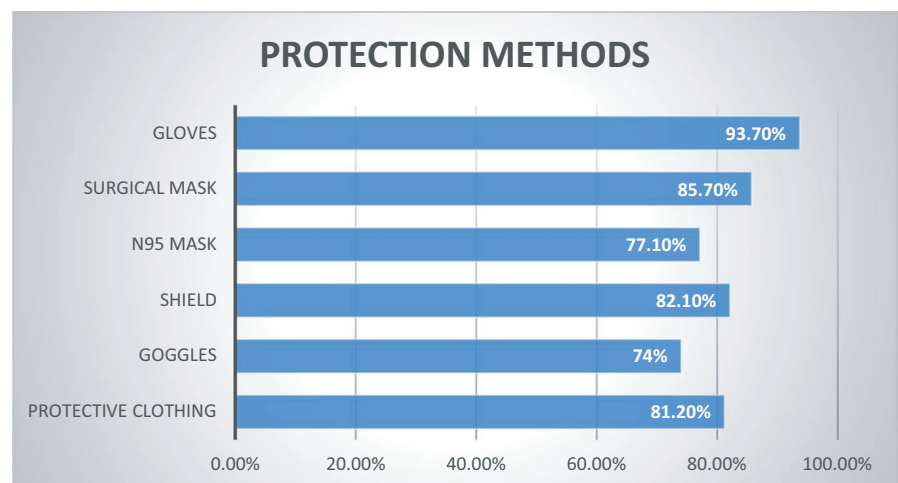
that indirect transmission could occur via contaminated objects. In addition, 17.7% expressed that it might occur via the faecal route, and 12.1% stated that transmission could be possible via contaminated plastic surfaces.<sup>13</sup> In the present study, the percentage of correct answers to all questions was 64.8%, with no significant inter-sex difference ( $p = 0.783$ ). The main transmission route of COVID-19 according to 82.5% of the students was droplet inhalation, 61.9% saliva blood and 44.8% nasal mucosa. The students' knowledge regarding COVID-19's leading symptoms and transmission routes was reasonable because of the lessons they were given on oral disorders and infectious diseases in the undergraduate curriculum.

Due to excess aerosol production and microbial spread during dental procedures and the ability of microorganisms to survive on surfaces,<sup>22</sup> dental healthcare professionals are at significant risk of infection via the oral cavity and respiratory tract.<sup>24,25</sup> As part of the infection control measures, dental professionals should take the utmost precautions and use PPE to prevent transmission.<sup>19</sup> A study conducted including Italian dental hygienists reported that 90.55% of them used protective goggles, 90.10% used gloves, and 82.80% used surgical masks as PPEs.<sup>19</sup> Similarly, in the present study, 43.12% of

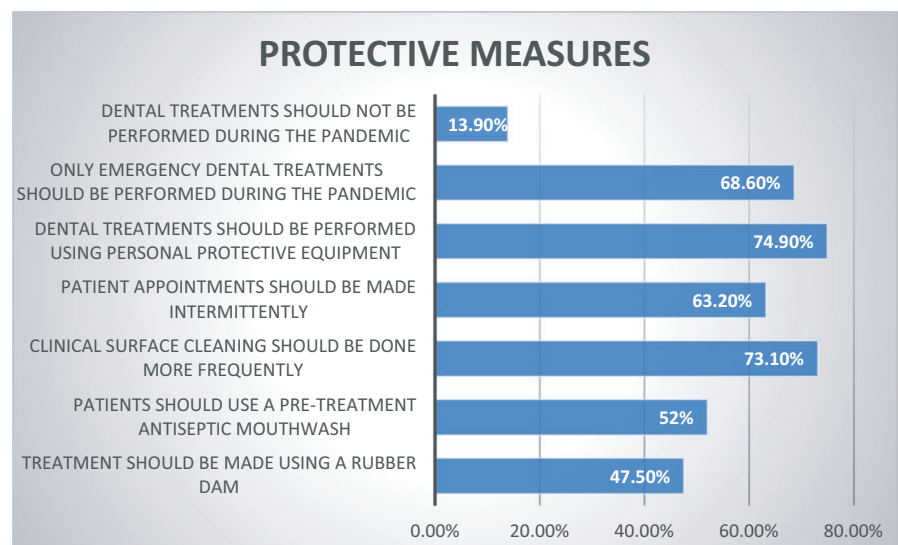
the students believed that using PPE would provide sufficient protection, whereas 43.9% believed that PPE was insufficient. Moreover, 71.7% believed that using handpieces in dental procedures increased the transmission risk (Table 4). Furthermore, 93.7% of the students recommended using gloves, 85.7% considered surgical masks, 82.1% face shields, 81.2% protective clothing, 77.1% N95 masks and 74% goggles (Figure 3). The students' knowledge regarding the recommendations, as published by authorities, to prevent cross-infection during dental procedures varied between 47.5% and 74.9% (Figure 4). These results indicated that students would take the necessary measures for cross-infection control if the pandemic continues after graduation.

In the present study, 96.9% of the students were aware of the increased risk of transmission during dental procedures, and 86.5% of the students were aware of the high transmission risk of COVID-19 among dental hygienists. There was no significant difference between the preclinical and clinical students regarding the answers to both questions ( $p = 0.996$  and  $p = 0.249$ , respectively). Furthermore, 74.9% of the students believed that dental procedures should be performed with PPE, and 68.6% recommended that only urgent dental procedures should be performed during the pandemic. Moreover,

**FIGURE 3** Participants' knowledge on personal protective equipment required during the 2019-nCoV pandemic



**FIGURE 4** Participants' knowledge on measures that can be taken to prevent transmission of SARS-CoV-2 virus



94.6% considered that COVID-19 is fatal, and 77.1% were concerned about its transmission. However, the students included in the study by Bellini et al.<sup>13</sup> (2020) reported a lower level of concern regarding COVID-19 transmission as compared to the present study. In addition, 44.7% of the students were moderately concerned, and 3.5% were extremely concerned about the transmission during daily activities.<sup>13</sup>

Bellini et al.<sup>13</sup> (2020) further reported that 24.8% of the students found the probability of patients getting infected with COVID-19 during dental procedures as excessive or high and 38.3% as moderate, whereas 53.9% of the students considered disease transmission among dental hygienists during procedures as excessive or high and 41.8% as moderate. However, contrary to the present study, the perception of risk was lower in preclinical students than the students in both upper classes ( $p < 0.01$ ).<sup>13</sup> Palla and Callahan<sup>26</sup> (2021) found that the risk of COVID-19 infection in a population seeking oral health care reflects the current positivity rate in the city or state. Understanding the presence of increased risk of infection and the mitigation of that risk is critical to the delivery of oral health care. Dental professionals must exercise caution as they progress into future stages of this global pandemic and ensure that lessons are cultured for the future.

This study has some limitations. First, this is a small sample-sized study conducted in a short period. Second, it was confined to only one department of dental hygiene. Students in urban areas where the COVID-19 outbreak is more prevalent or students from countries where the prevalence is extremely low might have different opinions. Also, due to uncertainties concerning the pandemic process, the students' level of concern and perceptions might show variations. Available data can provide insight into the development of educational needs in other dental hygienist education programmes and can provide a basis for guidelines to be developed by authorities.

## 5 | CONCLUSION

Although most of the students were aware of the transmission routes and preventive measures of COVID-19, concerns regarding disease transmission among them remain. Students appreciated the ongoing online education and believed that face-to-face education is risky during this current pandemic. However, they believe that this process can adversely affect their professional knowledge and especially practical skills. A balance must be struck between sustaining an effective dental hygiene education process and prevention of containing the spread of COVID-19.

## 6 | CLINICAL RELEVANCE

### 6.1 | Scientific rationale for study

Students appreciated the ongoing online education and believed that face-to-face education is risky during this current pandemic. However, they believe that this process can adversely affect their professional knowledge and especially practical skills.

### 6.2 | Principal findings

The main goal of dental hygiene education is to educate health-care workers who know dental equipment and materials, sepsis and antisepsis. A balance must be struck between sustaining an effective dental hygiene education process and containing the spread of COVID-19.

### 6.3 | Practical implications

Studies reporting on the pandemic's impact on undergraduate dental education are limited.

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### CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

### AUTHOR CONTRIBUTIONS

Both the authors (ATM and MM) provided a substantial contribution to the research and the manuscript. Specifically, ATM planned the study, collected data and supervised the project and the paper, conceptualization and writing. MM contributed to conception and design of the study, analysis, and/or interpretation of data, revising the manuscript critically for important intellectual content, review and editing, and approval of the version of the manuscript to be published.

### DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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