

Knowledge and Awareness of Dental Undergraduate Students Concerning the Manifestation of Covid-19 and its Appropriate Infection Control Measures: A Systematic Literature Review

Afnan Arnous^{1*}; Marwa Sharaan²

¹Undergraduate Student, College of Dentistry, Suez Canal University, Egypt.

²Professor of Endodontics, College of Dentistry, Suez Canal University, Egypt.

Corresponding Author: Arnous A

Undergraduate Student, College of Dentistry, Suez Canal University, Egypt.

Email: arn_af@outlook.com

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Abstract

The purpose of this paper is to highlight the extent of the knowledge and awareness of dental undergraduate students worldwide, concerning the manifestation of COVID-19, and in-turn, the students' knowledge on the appropriate infection control measures to take regarding COVID-19 in dental clinics. The paper took a systematic review approach and collected data from 50 articles across four databases. The results were derived from 16 papers written across 13 different countries across four different continents published during the beginning and height of COVID-19. It was concluded that the majority of the students exhibited great understanding of the manifestation of COVID-19 and its appropriate infection control measures, but that it is necessary for universities to provide more thorough courses related to infectious diseases as COVID-19 and the handling of the appropriate infection control measures, as well as improve syllabi regarding this topic.

Keywords: COVID-19; Dental undergraduates; Infection control; Knowledge; Preventative measures.

Introduction

Coronavirus disease 2019 (COVID-19) is a contagious, viral respiratory disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2 virus) [1] that resulted in a global pandemic stretching from March 2020 to May 2023. It has impacted the lives of billions, resulting in a global lockdown and the death of over 6 million worldwide [1]. In turn, this has affected the education [2] of dental students globally. The most glaring epidemiological characteristic of COVID-19 is its ability to spread through suspended aerosol and micro-droplets, entering through mucus membranes [3]. With the return of individuals to their day-to-day pre-pandemic lives, it has become difficult to avoid cross infection and contamination. This has undoubtedly impacted the field of dentistry due to necessary contact with saliva and blood, especially during time-consuming procedures. If we highlight the fact that the distance between the dentist and the working field is approximated to be around 40 cm [4], and that infected blood and saliva may spread

through rotary dental and surgical equipment such as ultrasonic scalers and high-speed handpieces through a visible spray [5], this provides a recipe for a virus-laden environment. Aerosol may remain suspended and airborne for a considerable amount of time and can be inhaled or may settle on nearby surfaces [5], leading to the further spread of COVID-19. In turn, necessary infection control measures and preventative behaviors were taken across the globe by dental practitioners, students, and graduates alike.

Many papers have explored the experience of dental students during the pandemic and have discussed the limitations it brought to both professional activity and education for practicing dental students, due to the poor integration of theoretical work into clinical skills and the lack of non-verbal communication. The aim of this paper is to assess the awareness of dental undergraduate students regarding the manifestation COVID-19 and how to handle suspected patients and perform the necessary infection control measures, as soon-to-be dental professionals.

Methodology

The paper took a systematic literature review approach in which the author gathered information and statistics from 16 papers, published from 2020 to 2023, from 15 different journals, across four databases (SCOPUS, PubMed, ProQuest, Science Direct). The papers were selected from 13 different countries: South Africa, Iran, Italy, Malaysia, Saudi Arabia, Brazil, India, Pakistan, Nigeria, Turkey, Sudan, Austria, and Palestine, across 4 continents. This was to highlight the differences and similarities in the handling of infection control measures and the extent of understanding towards both preventative measures and the manifestation of COVID-19 by dental students worldwide.

The keywords used for the selection criteria were “COVID-19”, “Dental”, “Infection Control”, “Students” and “Undergraduates”. Furthermore, only papers published from 2020 to 2023 were selected. All the chosen papers were open access and indexed from reliable databases. Overall, 760 papers were identified through database searching, 50 of which were excluded for duplication then the remaining was screened. Overall, 50 papers were found to be related to the research, and in turn were then assessed and examined, and 16 were selected. Any multicentric papers that included dental postgraduates, dental interns, dental professionals, or any area outside of dental undergraduates were excluded, such as other healthcare fields, and papers only conducted on dental interns and professionals were also excluded, as this study is solely focused on dental undergraduates. The only paper centered on dental hygienists was also excluded as dentists and dental hygienists, while similar, have different bachelor programs and degrees. Papers that were not open access were also excluded. The data extraction method is presented in the following PRISMA flowchart:

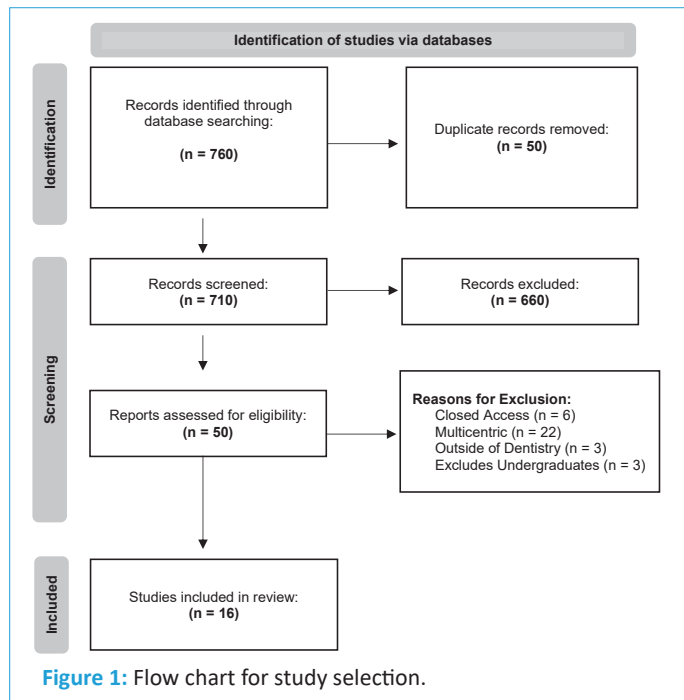


Figure 1: Flow chart for study selection.

Results & discussion

A study conducted in one South African university concluded that despite the lack of consistency regarding dental undergraduate students’ knowledge of infection control measures related to COVID-19, students still regularly conducted common practices as sanitization of equipment and handwashing. However, there remained a need for increasing awareness beyond classroom and clinical measures. The study was conducted at a single dental training site using a quantitative survey through

a self-conducted questionnaire, which had a response rate of 70.5% using a snowball sampling technique. Most students agreed that regular handwashing and sanitization of personal possessions was mandatory, but there were inconsistencies regarding the regular wear of scrubs and the washing of lab coats. The majority also acknowledged that optimal protective measures were conducted, but a low number found social distancing unnecessary. While some agreed that COVID-19 is transmitted through aerosol droplets from dental equipment, some were unsure [6].

A cross sectional study was conducted in Iran, the first ever one published regarding this topic in Iran post-COVID-19 according to the author. It was conducted using an online questionnaire and received 531 responses from dental students across 32 Iranian universities. The overall percentage of attitude and knowledge was very low. The mean percentage of knowledge was concluded to be 59.7%, and the mean percentage of attitude was 66.0%. Despite the lack of relation between the level of education and level of COVID-19 knowledge, the consensus was that junior students exhibited less understanding than their seniors. Senior students were well-informed of obligatory infection control protocols, while juniors were not. Some students understood the proper measures to perform specifically in dental clinics but lacked knowledge regarding the manifestation of COVID-19 [7].

Another study conducted in one university in Italy also performed an online questionnaire, with 72 respondents. Overall, it was concluded that participants had 87.6% awareness of key points regarding COVID-19. All participants understood that COVID-19 was contagious and transmittable via physical contact and had an incubation period of 2-14 days. The majority knew where COVID-19 originated from, and over half understood its symptoms. The majority also fully understood the related infection control measures, while the rest thought social distancing was enough. Interestingly, 50.0% believed dentists have a higher rate of exposure to COVID-19 compared to other health professionals, while 44.4% thought it was equal, and 4.20% believed dentists were less exposed, which shows that many underestimated the risk COVID-19 could pose to dentists. However, 94.4% of the dental students demonstrated a good understanding of infection control measures as use of alcohol-based handwipes and minimization of social contact [8].

A study in Malaysia with 533 dental students across 13 universities was also performed using online questionnaires. Overall, 93.5% of the participants exhibited a great understanding of COVID-19’s manifestation and the required infection control measures. Clinical dental students had higher scores than pre-clinical dental students, and senior students scored higher than their juniors. Interestingly, the 270 students of Malay ethnicity had the highest perceived risk score, and the 60 students of Chinese ethnicity scored the highest in knowledge, but the mean preventative score was insignificant ethnicity-wise. In addition, it was concluded that off-campus students took more preventative measures while on-campus students understood more about perceived risk and knowledge. 91.8% knew the incubation period of COVID-19, and nearly all the participants understood the symptoms. All participants acknowledged breathing in droplets from an infected patient was a source of transmission and 94.9% understood that direct contact with aerosol from infected patients during dental procedures was a potential source of infection. Prevention-wise, all participants agreed that hand washing was necessary, but only 37.2% washed

their hands according to the recommended time. The majority agreed on the importance of facemasks and social isolation, and 53.5% avoided greeting others physically due to knowledge of perceived risk and preventative behavior [9].

A Saudi Arabian study used a self-administered questionnaire of 29 questions split into four sections, with the third section focused on assessing infection control measures regarding the COVID-19 pandemic. Remarkably, the mean knowledge was higher for interns and sixth year students, and lower in fourth and fifth year students, with statistically significant differences (P -value <0.05). The results showed that 96.0% of participants understood how COVID-19 is transmitted through sneezing and coughing, 82.0% through shaking hands, and 71.0% through touching external surfaces. 82.0% knew antibiotics do not help with COVID-19, and nearly all the participants understood the symptoms well. The majority recognized that cleaning your hands with alcohol-based wipes or soap and social isolation and distancing as well as the routine cleaning of surfaces helped in infection control, and 97.0% of participants agreed it to be necessary for patients to perform this before entering the clinic, and the rest believed such restrictions could cause an out-cry and panic. Surprisingly, only 67.0% were up to date on the latest information regarding the pandemic's case definitions. When asked about the perceived risk of the virus, fifth year students thought it the most dangerous, most interns discerned it was 'moderately dangerous', and an insignificant number of students believed it to be 'not dangerous'. Nearly every student participating concluded the use of PPE and the use of rubber dams and antimicrobial mouthwash to be necessary. Overall, 80.0% of the participants believed the pandemic to be a serious issue, but interestingly only a little over half thought they were fully ready to deal with the outbreak. Questions about the overall adequacy for handling suspected cases in dental clinics showed that 13.0% showed high skepticism, 14.0% showed confidence, and the rest believed they could handle it to variable extents [10].

Another Saudi Arabian cross-sectional study performed on 622 students; compared the performance of infection control measures pre-COVID-19 in 2019 with 410 students and post-COVID-19 in 2020 with 212 students. Overall, pre-pandemic, students were 1.4 times more likely to infringe on preventative measures, namely when it came to hand hygiene and the use of eye protection. The percentage of violation in 2019 was 5.70%, and 1.70% in 2020. Post-pandemic, they were more likely to adhere to the use of PPE than hand washing, and the use of protective gowns increased by 100%. The adherence to recommended hand hygiene practices also increased from 92.5% to 96.2%, and hand washing immediately after the removal of gloves increased from 83.6% to 90.6%. Furthermore, the use of PPE held a violation of 4.60% pre-pandemic, and 2.50% post-pandemic, while hand hygiene violation was 7.50% pre-COVID-19 and 3.80% post-COVID-19. Males notably complied with preventative measures both before and after more than females, but post-pandemic, female students were 1.6 times as likely to wear a N95 mask. Generally, both male and female students were found to most likely double mask than wear a single mask. Surprisingly, this is the only study where seniority was not a significant factor, but GPA was found to be correlated [11].

Another cross-sectional study sought to identify the extent of knowledge regarding COVID-19 and its infection control measures across Saudi Arabia, India, and Pakistan, and was conducted throughout December 2020 to January 2021 on

872 respondents, 648 of whom were undergraduates, using an online questionnaire. Independent sample t-test and one-way analysis of variance (ANOVA) were conducted. 322(36.9%) of the sample were from Saudi Arabia, 298(34.2%) were from India, and 252(28.8%) were from Pakistan, and it was concluded that the knowledge between all three groups was equal, as the difference between the groups in knowledge was found to be statistically insignificant ($P>0.05$). Overall, it was assessed that 69.8% had moderate knowledge on the general information related to the transmission, diagnosis, and treatment of COVID-19. However, they had poor knowledge related to the necessary medication and global disease distribution. Unlike the aforementioned studies, male participants generally had more knowledge about COVID-19, while female participants displayed better understanding of the use of medication, high risk populations, incubation period, sampling for diagnosis and prevention. Indian students showed better knowledge in how COVID-19 is transmitted. Pakistani students displayed more knowledge in questions as how diagnostic COVID-19 tests are conducted, the disease severity, life-threatening complications, high risk occupations and the incubation period, but displayed less understanding towards the available treatment. Generally, it was shown that the knowledge of the students was acceptable, but that dental schools required stronger syllabi regarding viral diseases [12].

A study conducted by researchers in Brazil also used an online self-administered questionnaire, which received 833 responses. 87.0% of the respondents agreed COVID-19 to be especially risky in a dental setting. While 73.0% of the participants reported COVID-19 to be dangerous, 11.0% believed it to only be dangerous to those with risk factors. Like previous studies, many of the respondents were students in their fourth and fifth years. Interestingly, 67.2% of respondents reported 7-14 days to be the COVID-19 incubation period. The majority recognized the most common symptom was difficulty in breathing and a significant portion of senior students agreed dry cough to be a primary symptom. Around 53.0% thought shaking hands with an infected person transmitted COVID-19, and 70.0% recognized it to be transmitted through infected surfaces. Additionally, 95.0% understood it to be transmitted through air droplets while 59.0% agreed it could be through exposure to aerosol. Only 1.70% believed it to be transmitted through contaminated sharp objects. Less than half the participants agreed the use of high suction, rubber dams and manual instruments when applicable to be helpful for preventing the further spread of infection. The most common method recommended by participants to avoid the spread of COVID-19 was hand hygiene before and after meeting a patient followed using mucosa-protecting barriers as face shields and goggles. Interestingly, only 4% had received practical training in biosafety measures, 53.0% understood general information but had never received formal training, and the rest had no prior experience or training. Overall, participants showed an acceptable level of knowledge [13].

An Indian cross-sectional study performed in Mangalore with a sample of 868 dental undergraduates from 2 different universities found that awareness regarding the manifestation of COVID-19 was good, but their knowledge to necessary infection control as hand hygiene was limited, as only 90.0% were aware. That said, 89.9% had sufficient knowledge of basic infection control precautions regarding COVID-19, that they had gained through social media, television, newspaper, word of mouth, and interestingly, 2 students mentioned caller tunes. While a percentage of 95.5% were aware of the symptoms and

spread, only 83.8% understood who to contact if infected [14].

Another Indian-based study, this time conducted in Mangalore and Manipal, conducted an online survey sent to 500 students with 301 respondents, 99.7% of which deemed COVID-19 to be dangerous. Dangerous enough in fact that 73.4% admitted to steering away from cases suspected to be positive, and generally avoided working with aerosol-producing procedures, choosing to focus more on atraumatic treatment. Students reported avoiding procedures requiring the use of micromotors and air rotary in favor of perioperative measures as the use of rubber dams, high volume ejectors and hand instruments. Interestingly, the majority agreed that the basic preventative measures practiced prior to COVID-19 were not appropriate enough for the pandemic and did not feel prepared enough to deal with suspected cases, but 89.4% understood who to approach if exposed to the virus. However, around a third mentioned they could not access any pandemic-related dental guidelines. Nearly all the respondents agreed the use of N95 was very protective, and agreed that taking a thorough history of the patient to ensure no COVID-19 symptoms were present was necessary. The study concluded that it is crucial that dental schools implement an official infection prevention guideline through workshops and seminars [16].

A Nigerian study with 102 participants from 9 of the 12 dental schools in Nigeria ruled that the sample did not have sufficient knowledge on COVID-19, as around half the sample knew little about it and the mean knowledge was 70.17 ± 10.0 . That said, students in their final year had the highest amount of knowledge regarding the topic, and the students generally had a positive attitude towards preventative measures. Students reported that the information they knew was mostly obtained from social media platforms and television, with only 8.80% mentioning academic training courses. The majority understood the route of transmission of COVID-19, but only 52.9% knew it was airborne. Most of the sample knew to social distance, but only 19.6% knew the minimum social distance. It is worth noting that this is the only paper with a higher male participation rate, at 54.9%, and had one of the highest mean ages, at 25.3 years. The study concluded that an official guideline is extremely necessary [17].

Another Nigeria-based cross-sectional study was able to obtain responses from 178 of the 507 clinical dental students across the country, and supported the previously mentioned Nigerian study, as it also concluded that while students were knowledgeable about the manifestation of COVID-19, they had very limited information regarding infection control measures. This can be attributed to insufficient training and the lack of protective equipment. Thus, the paper also mentions a deficiency in the syllabus regarding infection control of disaster medicine and suggests a more thorough syllabus, especially early in the curriculum [18].

A Sudanese study sent a self-administered questionnaire to 288 dental surgery students in their final year. Of the 288 participants, 97.9% showed significantly high knowledge and 0.70% had poor knowledge, in relation to COVID-19. Interestingly, gender and knowledge, assumed severity and knowledge score, as well as knowledge source and knowledge score had a statistical relation in this study.

Over half the students perceived COVID-19 not to be fatal and the majority believed health care workers to be at higher risk. Most of the students regularly disinfected surfaces con-

tacted by suspected or known patients, used rubber-dams and high evacuation suction during aerosol-producing procedures, socially distanced chairs in waiting rooms, regularly checked visiting patients' temperatures, and used PPE. Students were most conflicted on the use of aerosol-producing procedures, with 85.1% agreeing on their avoidance, and 12.5% agreeing on their use. Furthermore, there was conflict on whether COVID-19 can be controlled or not, with 29.2% of the sample reporting they were unsure, 34.4% believing it to be uncontrollable, and 36.5% thinking it controllable. Overall, students had a good knowledge [19].

A Turkish study conducted on 355 pre-clinical and clinical students also found a statistical significance between gender and clinical status, and between pre-clinical and clinical students. The most noteworthy find in the study was that students were most worried about endodontic rotations at 29.9%, followed by oral and maxillofacial surgery at 25.1%, then prosthodontics at 16.3%, followed by periodontology at 15.2%, and finally restorative dentistry, diagnosis, radiology, pedodontics at lower values with orthodontics being the lowest at 1.1%. Prevention-wise, the majority questioned patients about symptoms beforehand, and most used high suction during aerosol-producing procedures. A percentage of 17.7% used chlorhexidine-containing mouthwashes and 15.9% used rubber-dams. Surprisingly, 8.80% reported they did nothing. This study also supported previously mentioned studies where students gained most of their knowledge through communication groups, social media platforms, professional websites, and television, with the least number of students finding out from meetings held by institutions. This is supported by the majority of students reporting that their schools held no COVID-19 related seminars or courses. Generally, while students' knowledge was sufficient, the study ruled that knowledge of infectious diseases as COVID-19 should be built more sufficiently in pre-clinical years, and that clinical students should be aware of special measures to take with asymptomatic patients [20].

An Austrian study had 77 clinical students participate in an online questionnaire and found that students were equally torn on their preparedness on handling COVID-19, with 38.0% feeling ready, 33.3% unready, and the remainder unsure. Like previous papers, the majority of the participants were female, but the age range was on the older side compared to other papers, ranging from 25 to 34. More than half of the participants deemed COVID-19 to be moderately dangerous on a general level, but slightly less than half found it to be moderately dangerous on a personal level. Most of the students (90.0%) reported that they learnt about COVID-19 through official sources, unlike previous studies where students mostly relied on social media, however, only 44.0% were aware of the official infection control guidelines. Students reported that the most effective method to avoid infection was through social distancing, followed by regular disinfection, then the use of PPE, though only 19.6% understood the correct sequence for putting on the equipment. Interestingly, 56.0% of the participants agreed on the use of FFP2 masks, followed by FFP3 at 46.0%, with the addition of faceshields at 58.0%. All in all, the results show that the students have a good understanding of COVID-19's manifestation and preventative measures [21].

A study performed on 305 Palestinian students in their clinical years in two different universities reported that while 29.0% had attended a training course on COVID-19 and 59.0% had received an updated training related to COVID-19's infection

control measures, the majority still preferred to avoid working with suspected cases, as they believed regular infection control measures were not safe or strict enough. When faced with a suspected case, 37.0% would treat them then refer them to a hospital, while 58.0% would refer them to a hospital and refuse to treat them. Most students also agreed that their main source of information was social media platforms. Overall, the mean score for the knowledge variable was 6.58 ± 1.45 , on a 2-9 scale. Interestingly, one school was more knowledgeable than the other on the transmission, diagnosis and symptoms of COVID-19, and unlike previous studies, fourth year students seemed to have better knowledge than both their seniors and juniors. This study agreed that females seemed to have a higher risk perception, which is in line with other studies. It is worth noting that this study recommended teledentistry and is the only study to do so. Overall, around half the students believed it to be their duty to educate others on COVID-19 and how it's spread, and were sufficiently aware of COVID-19's infection control measures [16].

Conclusion

In summary, it is evident that the perceived risk of COVID-19 among dental students is quite high globally, as well as their understanding of the symptoms, signs, and the ways of transmission of the disease and virus. It is also clear that the majority have great knowledge regarding infection control measures and the reasons behind it. However, these papers show that students have a clear lack of knowledge on how to handle infected patients and received most training informally through word of mouth and the internet, and therefore require formal training.

It is worth noting that every study mentioned was a cross-sectional study. In addition, nearly every paper had significantly more female participants than male participants, and risk perception-wise, females seemed to have higher perception in most of the studies, and the average age in many of the studies was 22 years. Furthermore, many of the papers agreed that students in their final year of dental school had higher knowledge than their junior peers. All the studies were performed through online questionnaires spread over social media platforms as Whatsapp, Twitter, Youtube, Instagram, Viber, Google docs and Facebook, which is in line with the fact that the pandemic required social distancing and isolation. While nearly all the studies agreed that dental undergraduate students had sufficient knowledge of the manifestation of COVID-19 and the necessary preventative measures, the majority did not feel confident enough to handle real-life clinical situations with the risk of COVID-19 positive patients. Furthermore, COVID-19-related information was mostly spread through social media and word of mouth, and not from dental schools. Thus, many of the studies were united on the fact that a more thorough and detailed guide and education is required for disaster situations like the COVID-19 pandemic, as most of the undergraduate students had no baseline or experience on dealing with such situations.

The author hopes more research will be conducted in this area. Many limitations are seen in this paper, as the references are all taken from different times throughout the pandemic; some at the beginning of COVID-19 and some at height of it. The questions posed in the questionnaires, while similar, had some differences. The period each questionnaire was distributed is also different as some gathered data for 10 days and others for several weeks. The samples taken in each country were numerically different as well. In addition, more papers per country

should be included to gain a clear understanding of how each country's dental students dealt with COVID-19.

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