



## KNOWLEDGE REGARDING MUCORMYCOSIS AMONG THE DENTAL PRACTITIONERS OF HARYANA, INDIA DURING COVID-19 PANDEMIC- A CROSS-SECTIONAL STUDY

Sahrish Tariq<sup>1</sup>, Nidhi Gupta<sup>2</sup>, Preety Gupta<sup>3</sup> and Aditi Sharma<sup>4</sup>

<sup>1,2</sup>Department of Public Health Dentistry, Swami Devi Dyal Hospital and Dental College, Haryana, India

<sup>3,4</sup>Swami Devi Dyal Hospital and Dental College, Haryana, India

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### ABSTRACT

**Background:** During the current pandemic of COVID-19, a myriad of manifestations and complications have emerged and are being reported on. Mucormycosis is one of them, it is a rare opportunistic fungal infection characterized by infarction and necrosis of host tissues. The global mucormycosis case fatality rate is 46%. Early diagnosis and treatment are essential, as a delay of even 6 days is associated with a doubling of 30- day mortality from 35% to 66%.

**Aim:** To assess the Knowledge regarding Mucormycosis among the Dental Practitioners of Haryana, India, during the COVID-19 pandemic- A Cross-sectional Study.

**Methods:** A cross-sectional study was conducted using a self-administered online questionnaire among 422 dental practitioners categorized into two groups (BDS, MDS) in Haryana from 15th May to 10th June 2021. The main outcome variable of the study was the mean knowledge score of mucormycosis.

**Results:** The study found 422 responses from the dental practitioners of Haryana. Among them, more than half were BDS (61.8%) and the majority did the private job (78.3%). Only 31.5% worked during COVID-19. The mean Knowledge score was 24.21±2.90, which implies that they had good knowledge regarding mucormycosis. A more knowledge score was obtained for the age group >31 years (24.58±3.01), who had income more than 30 K (24.45±2.86) and doing the private job (24.29±2.93). Those who contracted COVID-19 (24.33±2.88) and whose family and friends died of COVID-19(24.31(2.81) had a higher mean knowledge score. But no significant association was found between knowledge mean score and the independent variables in the study.

**Conclusion:** Mucormycosis, a new public health emergency, is critical to improving the knowledge and perceptions of healthcare professionals. The standard management of mucormycosis requires early diagnosis, a reversal of risk factors, and underlying illness. The clinician must have a high index of suspicion to diagnose this disease in any of its forms when it presents in a patient with risk factors. It highlights the role of the interprofessional team in evaluating and treating patients with this condition.

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### INTRODUCTION

Since its inception in late 2019s, COVID-19 has devastated human health worldwide also additionally heavily impacting the world economy. SARS-CoV-2 has affected over 220 countries and territories, with approximately 4176,185 deaths so far across the world (world meters 2021). While the 'second wave' of SARS-CoV-2 and its variants-mediated COVID-19 continue to affect the world population the deadly rise of myriads of manifestations and complications and, specifically, the rise of fatal fungal infection, the mucormycosis, has put the lives of COVID-19 patients additional at high risk<sup>1</sup>

Since the dental interventions are unique, due to the proximity of the dental care provider to the patient's mouth and throat, the dentists along with their teams are at a high risk of

exposure and transmission of this virus to other patients and the staff. Therefore, to avoid any risk, some of the measures that dental care providers are advised to take are given as under:

- Perform procedures in negative pressure rooms, if possible, for procedures that generate aerosol
- To avoid the gag reflex, extraoral radiographs should be considered
- Number of dental care providers should be limited
- Airborne precautions along with standard and contact precautions should be practiced
- The use of high-speed hand pieces should be minimized along with ultrasonic instruments and 3-way syringes

\*Corresponding author: Sahrish Tariq

Department of Public Health Dentistry, Swami Devi Dyal Hospital and Dental College, Haryana, India

- Maintain a dry environment and use EPA- approved chemicals as disinfectants

Etiologically, mucormycosis(also known as black fungus) could be a serious fungal infection caused by a family of mold referred to as micromycetes (class Phycomycetes, order Mucorales). These fungi are widely distributed within the environment, with a particularly higher prevalence in moist soils, decaying plants and foods, bird and animal feces, water, and the air around construction sites<sup>2,3</sup>.

Mucor-derived angioinvasion presents diverse signs and symptoms with nasal stuffiness; mucoid, purulent, bloody or black nasal discharge; epistaxis; facial, nasal, or periocular edema and discoloration, speaking defects, vision impairment, and an excruciating headache. It has been noted that individuals with co-morbidities like diabetes, neutropenia, iron overload, deferoxamine therapy, renal failure, protein-calorie malnutrition, cancer, and other diseases, all of which affect or are linked with the immune system, are particularly extremely prone<sup>4,5,6</sup>.

An increasing number of patients with COVID-19-associated mucormycosis have been reported from India recently. The association of these two critical infectious diseases is challenging for India and the rest of the globe. Notably, developing countries such as India, the second most COVID-19-affected country in the world, have seen a sudden surge of mucormycosis incidences with variable degrees of severity and pathologies. In India, more than 45,432 cases and 4252 deaths due to mucormycosis are reported as of the fifteenth July 2021, either among COVID-19 infected patients or in patients who had recovered from COVID-19 with Rhino cerebral mucormycosis (77.6%) being the most common kind of presentation<sup>7</sup>. Given this, the Government of India has declared mucormycosis as an epidemic in many states and territories.

Since mucormycosis prevalent after Covid-19 infection, an expeditious diagnosis and an assertive treatment plan can surely benefit such patients. Thus, this study can work as an important tool for public health dentists to provide the patients with proper treatment along with proper dental assessment.

## METHODS

A Cross-sectional study was conducted during the COVID-19 pandemic between 15th May 2021 to 10th June 2021 to assess the Black fungus or Mucormycosis knowledge among Registered Dental professionals of Haryana, India. The ethical clearance was obtained from the Ethical Committee of Swami Devi Dyal Hospital and Dental College, Barwala, Panchkula before the onset of the study. The research presents no more than minimal risk of harm to subjects and involved no procedure for which written consent is normally required outside of the research context.

Due to the COVID-19 pandemic face to face data collection was not done. For data collection, the "Google Form" link was distributed on social media platforms, WhatsApp messenger, or sent by text messages and was collected by a semi-structured self-response questionnaire, followed by convenience and snowball sampling methods. When the practitioners clicked on the link, sociodemographic items were presented on the first page, workplace-related items were presented on the second page and six items related to the

perception of mucormycosis were delivered on the third page of the questionnaire. The study included the dental practitioners of Haryana, that totaled up to 480 participants among them 15 dental practitioners were a part of the pilot study and were not included in the final analysis, and a total of 422 dental practitioners submitted the duly filled questionnaire, with a response rate of 90%.

The original version of questionnaire<sup>7</sup> was pilot tested to determine the test-retest reliability of the survey questions, 15 private dental practitioners completed the survey during the initial administration. The respondents were also asked for feedback on the clarity of the questions and whether there was difficulty in answering the question or ambiguity as to what sort of answer was required. Chronbach's alpha of the questionnaire was found to be acceptable (0.84).

A survey Google proforma was prepared to acquire demographic details such as age, sex, income, residence, profession, marital status, children, and living status. work-related information such as job type, working condition, having PPE (personal protective equipment), and directed patient care, and COVID-19 related information (COVID-19 positive status, friend and family members' (FNF) COVID-19 positive status, and FNF COVID-19 death status). To examine the knowledge of mucormycosis in this study, a six items measure was presented. The items were responded to a five-point Likert scale; 1 for strongly disagree to 5 for strongly agree. After summing all the items, the total score ranged from 6 to 30, whereas a higher score indicated a higher level of black fungus knowledge.

The responses in a Google form include the replies to all questions made by a form respondent when they submit the form. Data from all responses are available in the Response tab and are manually stored in the response spreadsheet. The data from the response spreadsheet was processed using the SPSS v21.0 software package (SPSS Inc. Chicago, IL, U.S.A). For hypothesis testing significance was pre-determined at a  $p \leq 0.05$ . The results were expressed in percentages. Descriptive statistics such as mean, standard deviations, and the proportions (% of subjects affected) were used. The multinomial linear regression analysis was performed to assess the association of Dental professionals' demographic and professional characteristics with the knowledge questions.

## RESULTS

Among 422 Dental Practitioners, more than half were BDS 261(61.8%), whereas 161 (38.2%) were MDS. Among them, 47.6% were male and 52.4% were female. The majority of Dental practitioners 40.3% earned more than 30K. The highest knowledge mean score was obtained for the age group > 31years i.e.,  $24.58 \pm 3.01$ , and earning more than 30K i.e.,  $24.45 \pm 2.86$ (Table 1).

The majority of the Dental practitioners 331(78.4%) did the private job, 133 (31.5%) worked in COVID-19 conditions and 147(34.8%) were having PPE. Almost two-thirds 318(72%) of the participants didn't get contracted with COVID-19. On the other hand, 318(75.4%) of the participants' FNF got COVID-19 infection and 93(22.0%) died of COVID-19 infection. The Dental practitioners who did the private job had a mean knowledge score of  $24.29 \pm 2.92$  in comparison to  $23.90 \pm 2.79$  scores for practitioners doing government jobs. The dental practitioners who didn't get contracted with COVID-19

infection had a mean knowledge score of 24.33± 2.88 and those who got contracted with Covid-19 had a score of 23.88± 2.91 The practitioners whose family and friends (FNF) died of COVID-19 infection had the mean knowledge score of 23.86±3.16 and those whose family and friends (FNF) didn't die of COVID-19 infection has a score of 24.31± 2.81(Table-2).

The Distribution of responses by the Dental practitioners regarding Mucormycosis is given in Table -3. Mucormycosis is known as the black fungus was known to 92.6% of the participants, however, only 48.3% of the subjects strongly agreed to it.79.2% were conscious of the fact that the person with a history of COVID-19 infection is at higher risk of black fungus infection, however, only 48.3% of the subjects strongly agreed to it. The majority (73.3%) were knowing that the Overuse of immunosuppressive drugs for COVID-19 treatment, could be a reason for the black fungus surge, however, only 30.6% strongly agreed with the statement. Very few (22.0%) strongly agreed that reuse of 'unwashed' or 'one-time mask' may be a risk factor of black fungus infection.

The mean knowledge score of the practitioners was 24.21 ± 2.90 and the median value was 25(Table 4).

Multivariable linear regression analysis was carried out to find out the determinants of knowledge among Dental practitioners. The demographic(age, gender, residence, profession, income, marital status, having children, living status) and work-related characteristics (job type, working condition, having PPE, direct patient contact, Covid-19 positive, FNF Covid-19 positive, FNF Covid-19 death) were incorporated into the model, no significant association was found between knowledge mean score and these independent variables(Table 5).

**Table 1** Distribution of Dental Practitioners according to their Demographic Characteristics and Mean knowledge score of Mucormycosis

| Variable assessed      | Frequency (n) | Percentage (%) | Knowledge mean (SD) |
|------------------------|---------------|----------------|---------------------|
| <b>AGE</b>             |               |                |                     |
| <24                    | 18            | 4.3            | 23.33 (3.44)        |
| 24-27                  | 168           | 39.8           | 24.8 (2.89)         |
| 28-30                  | 146           | 34.6           | 24.33 (2.74)        |
| >31                    | 90            | 21.3           | 24.58 (3.01)        |
| <b>GENDER</b>          |               |                |                     |
| Male                   | 201           | 47.6           | 24.31(2.88)         |
| Female                 | 221           | 52.4           | 24.11(2.91)         |
| <b>RESIDENCE</b>       |               |                |                     |
| RURAL                  | 50            | 11.8           | 23.86(3.27)         |
| URBAN                  | 372           | 88.2           | 24.26(2.84)         |
| <b>PROFESSION</b>      |               |                |                     |
| BDS                    | 261           | 61.8           | 24.22 (2.85)        |
| MDS                    | 161           | 38.2           | 24.18 (2.97)        |
| <b>INCOME</b>          |               |                |                     |
| <20K                   | 89            | 21.1           | 23.97 (2.86)        |
| 20K-30K                | 163           | 38.6           | 24.08 (2.95)        |
| >30K                   | 170           | 40.3           | 24.45 (2.86)        |
| <b>MARITAL STATUS</b>  |               |                |                     |
| Unmarried              | 193           | 45.7           | 24.2 (2.91)         |
| Married                | 229           | 54.3           | 24.21 (2.89)        |
| <b>HAVING CHILDREN</b> |               |                |                     |
| No                     | 316           | 74.9           | 23.99 (2.95)        |
| Yes                    | 106           | 25.1           | 24.28 (2.88)        |
| <b>LIVING STATUS</b>   |               |                |                     |
| Alone                  | 89            | 21.1           | 24.14 (2.83)        |
| Withothers             | 333           | 78.9           | 24.23 (2.92)        |

**Table 2** Distribution of Dental Practitioners according to their Work-related information and Mean knowledge score of Mucormycosis

| Variable assessed             | Frequency (n) | Percentage (%) | Knowledge mean (SD) |
|-------------------------------|---------------|----------------|---------------------|
| <b>Job type</b>               |               |                |                     |
| Govt                          | 91            | 21.6           | 23.90 (2.79)        |
| Private                       | 331           | 78.4           | 24.29 (2.92)        |
| <b>Working during</b>         |               |                |                     |
| Covid-19                      | 133           | 31.5           | 24.0 (3.13)         |
| Non-covid-19                  | 289           | 68.5           | 24.3 (2.78)         |
| <b>Having PPE</b>             |               |                |                     |
| Yes                           | 147           | 34.8           | 24.48 (2.79)        |
| No                            | 275           | 65.2           | 24.06 (2.95)        |
| <b>Direct patient contact</b> |               |                |                     |
| Yes                           | 316           | 74.9           | 24.08 (2.89)        |
| No                            | 106           | 25.1           | 24.59 (2.91)        |
| <b>Covid-19positive</b>       |               |                |                     |
| Yes                           | 118           | 28.0           | 23.88 (2.91)        |
| No                            | 304           | 72.0           | 24.33 (2.88)        |
| <b>FNFCovid19positive</b>     |               |                |                     |
| Yes                           | 318           | 75.4           | 24.27 (2.89)        |
| No                            | 104           | 24.6           | 24.03 (2.93)        |
| <b>FNFCovid-19death</b>       |               |                |                     |
| Yes                           | 93            | 22.0           | 23.86 (3.16)        |
| No                            | 329           | 78.0           | 24.31 (2.81)        |

**Inference**

Multivariable linear regression analysis was carried out to find out the determinants of knowledge among Dental practitioners. no significant association was found between knowledge mean score and these independent variables.

**DISCUSSION**

The recent surge in cases of COVID-19 in India during the second wave of the pandemic had been associated with increased reporting of invasive mucormycosispost-COVID-19, of up to 14,872 cases till 28 May 2021 and are continuously being reported to be rising, popularly known as black fungal infection<sup>8</sup>. There are multiple possible contributing factors for the development of mucormycosis among patients with COVID-19 and these include diabetes mellitus, obesity, use of corticosteroids, and the development of cytokine storms. The triad of SARS-CoV-2, steroid and uncontrolled diabetes mellitus have contributed towards a significant increase in the incidence of angio-invasive maxillofacial mucormycosis. However, the presence of spores and other factors might play a role as well<sup>9</sup>.

Diagnosing mucormycosis by imaging studies (radiological or CT or MRI), culture studies or serological tests are not unswerving. Good clinical examination with history and an astute approach in treating without delay can reduce morbidity and mortality. Mucormycosis, a recently declared Epidemic in many states and territories by the Government of India, has been spreading at an alarming pace. Therefore, it becomes important for the entire healthcare personnel to constantly update their knowledge including Dental practitioners so that they can potentially screen such patients for prevention of the possible spread of the disease.Hence, the present study was planned to assess the knowledge regarding mucormycosis among dental practitioners of Haryana, India, during the COVID-19 pandemic<sup>10</sup>.

In the present study, a total of422 practitioners participated, among them, 168(39.8%) belonged to the age group of 24-27 years and 146(34.6%) belonged to the age group 28-30 years.

**Table 3** Distribution of responses provided by the Dental practitioners regarding Mucormycosis

| Items of Knowledge about Black Fungus   | Strongly Disagrees n (%) | Disagree n (%) | Neutral n (%) | Agree n (%) | Strongly Agree n (%) |
|---|--------------------------|----------------|---------------|-------------|----------------------|
| K-1: Mucormycosis is known as “black fungus”.   | 6 (1.4)                  | 5 (1.2)        | 20 (4.7)      | 187 (44.3)  | 204 (48.3)           |
| K-2 Person with a history of COVID-19 infection is at higher risk of black fungus infection.                                      | 10 (2.4)                 | 20 (4.7)       | 58 (13.7)     | 178 (42.2)  | 156 (37.0)           |
| K-3 Person with steroids treatment is at higher risk of black fungus infection.   | 8 (1.9)                  | 8 (1.9)        | 43 (10.2)     | 191 (45.3)  | 172 (40.8)           |
| K-4 Overuse of immunosuppressive drugs for COVID-19 treatment could be a reason for black fungus surge.                           | 21 (5.0)                 | 31 (7.3)       | 61 (14.5)     | 180 (42.7)  | 129 (30.6)           |
| K-5 Person with comorbidities (ex: diabetes, kidney disease, cardiovascular disease) is at higher risk of black fungus infection. | 6 (1.4)                  | 5 (1.2)        | 20 (4.7)      | 187 (44.3)  | 204 (48.3)           |
| K-6 Reuse of ‘unwashed’ or ‘one-time mask’ may be a risk factor of black fungus infection.  | 46 (10.9)                | 66 (15.6)      | 95 (22.5)     | 122 (28.9)  | 93 (22.0)            |

**Table 4** Knowledge among Dental practitioners regarding Mucormycosis

| Measures                   | Knowledge |
|----------------------------|-----------|
| Mean score                 | 24.21     |
| Standard deviation         | 2.90      |
| Standard error of the mean | 0.14      |
| Median                     | 25.00     |

**Table 5** Association between the Demographic and work-related characteristics of Dental practitioner with knowledge mean score.

| Variables              | Knowledge Mean |      |       |         |
|------------------------|----------------|------|-------|---------|
|                        | Co-efficient   | SE   | t     | P-value |
| Age                    | .28            | .20  | 1.39  | .16     |
| Gender                 | -.28           | .29  | -.97  | .33     |
| Residence              | .34            | .46  | .74   | .45     |
| Profession             | -.14           | .30  | -.46  | .64     |
| Income                 | .06            | .22  | .28   | .77     |
| Marital Status         | .09            | .29  | .33   | .73     |
| Having Children        | -.39           | .35  | -1.11 | .26     |
| Living Status          | -.11           | .38  | -.31  | .75     |
| Jobtype                | .31            | .36  | .86   | .38     |
| Working Condition      | .02            | .333 | .06   | .95     |
| Having Ppe             | -.31           | .32  | -.99  | .32     |
| Direct Patient Contact | .46            | .33  | 1.37  | .16     |
| Covid19 Positive       | .37            | .33  | 1.11  | .26     |
| Fnf Covid19 Positive   | -.32           | .33  | -.97  | .33     |
| Fnf Covid19 Death      | .45            | .35  | 1.29  | .19     |

The reason for this finding may be internet is a critical ‘social domain and communication tool’ for youths, who are generally quick to incorporate and integrate technology into their lives. More than half of the participating practitioners were BDS 261(61.8%), as there are more BDS than the MDS in Haryana, and the majority of them were earning more than 30K i.e 170(40.3%). The maximum of them was married 229(54.3%) and not having children 316(74.9%).

The majority of practitioners were doing private jobs 331(78.4%), not working in COVID-19 conditions 289(68.5%) and 275(65.2%) didn’t have Personal Protected Equipment’s, possible reason for this finding may be as the vacancies for dental professionals in Government sector are very less in number. Records show that only 5% of graduated dentists are working in the government sector.

Among the practitioners 304(72%) didn’t contract COVID-19 infection, 318(75.4%) of the practitioner’s family and friends contracted COVID-19 and 93(22%) practitioners’ families and friends died of COVID-19 infection. The reason for this finding is due to the alarming levels of spread and severity of covid-19 among the masses. The World Health Organisation (WHO) on March 11, 2020, has declared the novel coronavirus outbreak a global pandemic.

The majority of the practitioners responded to the items of knowledge about Mucormycosis as Strongly agree and agree. Majority of Dental Practitioners 673% responded correctly to the overuse of immunosuppressive drugs for COVID-19 treatment, as a reason for black fungus surge. Alarmingly, only 50.9% of dental practitioners responded correctly to the Reuse of “unwashed” or “one-time mask” as a risk factor of Mucormycosis. The reason might be due to the lack of clinical evidence yet, to establish the link between the two. Using the same mask, over and over again without washing, runs the risk of contracting the infection, as fungus will grow in moist or unhygienic areas.

Our study revealed that the dental practitioners had a mean knowledge score of 24.21, which implies they had high knowledge regarding Mucormycosis. The highest mean knowledge score was observed when age was highest (>31 years) and the lowest for the age group below 24. For dental practitioners, aging helps them to gain experience and knowledge.

For both genders, there was an almost equal spread of knowledge between male and female dentists. As both, genders are equally interested to gain more knowledge.

The profession as a variable related to knowledge was not statistically correlated. We found that dentists with BDS or MDS had almost the same knowledge mean score as Mucormycosis. This could be due to the current scenario of the COVID-19 pandemic has forced dentists to prepare themselves by updating their knowledge and receiving training to face the after-effects of COVID-19.

The knowledge means the score was less among dental practitioners who earned <20k, as they do little to increase their knowledge to combat recent threats and mainly focus on dental practice only.

The knowledge means score with other demographic variables of the dental practitioners i.e., marital status, having children, and living status was almost equally distributed.

Private dental practitioners were found little more knowledgeable on Mucormycosis than government dental practitioners. The possible reason could be that in this study more than two-thirds of practitioners were doing private dental practice as compared to a government job.

The dental practitioners who had contracted COVID-19 infection and had a death of family and friends due to COVID-19 had slightly more mean knowledge scores than their counterparts. This may be because they want to increase their knowledge to combat recent threats and the social curiosity which may propel them to acquire knowledge helps to eradicate death anxiety.

The knowledge mean score with other work-related variables of the dental practitioners i.e., working conditions, having PPE, Direct patient contact, FNF Covid-19 death was almost equally distributed.

The total mean knowledge scores of the respondents we reanalyzed with the various variables, it revealed no statistical significance (P-value>0.05).

### Strengths and limitations of the study

Possibly this is the first study attempted to evaluate the mucormycosis knowledge among dental practitioners in India. A better understanding regarding this issue can come in handy in case of implementing preventive measures more effectively. However, there are several limitations. Due to the pandemic, it was not possible to execute face-to-face interviews of participants. Thus, sampling bias owing to unintentional ruling out the dentist who has no internet access. The inadvertent creeping in of social desirability bias. Alongside, since this is a cross-sectional study, it was not possible to draw a cause-effect relationship. In addition, data presented here are only representative of practitioners residing in Haryana, and knowledge among dental health care professionals can vary geographically affecting the generalizability of the study.

### CONCLUSION

A fair amount of knowledge is present among dental practitioners of the Haryana area. It has become important that doctors can be acquainted with recent medical happenings from time to time regarding these recent outbreaks and the internet could facilitate the reading of articles related to such outbreaks to constantly update their knowledge.

To cease the rise of mucormycosis, early diagnosis and management become the crucial step in this time of COVID-19 pandemic. A dentist plays a huge role in the management of the outbreak of this fungal infection and acts as an important lethal weapon in making the early diagnosis possible. This fatal fungal infection can be managed with minimum morbidity and mortality with help of early diagnosis and preventive measures and safeguarding the interests of the people. Assessing the knowledge level of the Dental practitioners in terms of different variables may impact the health care system of India in general. Identifying the cause of different levels of knowledge in terms of variables and taking corrective action accordingly will be highly recommended.

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