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KNOWLEDGE, AWARENESS, AND ATTITUDE TOWARD MUCORMYCOSIS AMONG DENTISTS, INTERNS, AND DENTAL STUDENTS IN SAUDI ARABIA: A CROSS-SECTIONAL STUDY.

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Abstract

Introduction: Mucormycosis, also known as black fungus, is a rare but dangerous fungal infection affecting immunocompromised individuals. It's angioinvasive, caused by specific Mucorales fungi in the Zygomycetes class. The infection causes thrombosis and tissue necrosis. The infection leads to rapid progression and mortality unless risk factors are are controlled, antifungal therapy is administered, and surgical excision is done.

Objectives: This study aimed to assess the level of knowledge, awareness, and attitude regarding mucormycosis among dentists, interns, and dental students in Saudi Arabia.

Methodology: This study is an observational cross-sectional study, based on a structured questionnaire, conducted between July to December 2024 in Saudi Arabia. The study plans to recruit participants through social media sites. All dental practitioners, dental interns, and 3rd, 4th, 5th, and 6th year undergraduate dental students who agreed to participate in the questionnaire in Saudi Arabia were included in the study. The sample size calculation was conducted to ensure a minimum of 384 participants, with a 95% confidence level and 5% margin of error. The questionnaire consisted of four parts: demographic information, knowledge questions, awareness questions, and attitude questions. The answers were tabulated and statistically analyzed.

Results: This study evaluates the knowledge, awareness, and attitudes regarding mucormycosis among 466 dental professionals, interns, and students in Saudi Arabia. The results reveal that only 53.2% correctly identified mucormycosis as a fungal infection, indicating educational gaps, particularly in symptom recognition, with just 29.8% aware of its clinical manifestations. Despite 38.2% considering it "moderately dangerous," 45.3% deemed it "very dangerous," reflecting a general awareness but also misconceptions. Notably, 85.2% of respondents emphasized the need for educational initiatives, while 66.1% recognized dentists as essential in managing this condition. These findings underscore a critical

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need for enhanced training in mucormycosis across dental education.

Conclusion: The findings of this study highlight significant gaps in knowledge and awareness of mucormycosis among dentists, interns, and dental students in Saudi Arabia. The results underscore the urgent need for enhanced educational initiatives to address these gaps, improve overall awareness, and ensure effective clinical management of this serious fungal infection.

Keywords: knowledge, Awareness, Mucormycosis, Black fungus, Dentist, Dental students, Dental interns, Saudi Arabia.

Introduction:

Mucormycosis, also referred to as black fungus, is a rare but dangerous fungal infection that typically affects immunocompromised individuals [1]. It is an angioinvasive infection caused by specific Mucorales fungi within the class Zygomycetes, including Rhizomucor, Cunninghamella, and Rhizopus [2].The clinical feature of invasive mucormycosis is tissue necrosis resulting from angioinvasion and subsequent thrombosis [3]. The infection rapidly progresses and leads to mortality unless underlying risk factors are treated and intensive treatment with antifungal medications and surgical excision is performed [4]. Paultauf initially defined mucormycosis as a disease affecting humans in 1885 [5]. Mucormycosis can impact any individual in the world from 0.005 to 1.7 cases per million people, and it has a 46% mortality rate [6]. With fatalities varying from 40 to 80%, mucormycosis remains a major consequence of uncontrolled diabetes, with a high prevalence in COVID-19 patients [7]. In 2023, Vundela et al, conducted a questionnaire-based survey study to evaluate the knowledge of dentists towards mucormycosis disease, The study found that dentists exhibited a strong level of knowledge but highlighted the necessity for further training in the provision of care [8]. In contrast, the findings of AL-Shamaa et al, study showed a general weakness in the level of knowledge about the disease [9]. Moreover, in a study by Devalla et al, the awareness of mucormycosis disease was evaluated among undergraduate and postgraduate dental students. Postgraduates showed the highest level of awareness compared to pre-clinical and clinical undergraduates [10]. Additionally, Chauhan et al, in their study, assessed the level of knowledge among postgraduate dental professionals regarding the prosthodontic treatment plan for patients diagnosed with mucormycosis, as well as the associated symptoms. The results revealed that these professionals possessed a moderate level of awareness and comprehension of the disease [11]. Dentists are pivotal in managing the spread of mucormycosis and are essential for early detection and prevention, which in turn can significantly reduce the morbidity and mortality associated with this lethal fungal infection. Therefore, it is crucial for dentists to possess adequate knowledge and awareness of mucormycosis. The literature on dentists, interns, and dental students knowledge and awareness is scarce, especially in Saudi Arabia, and some studies suffer from a limited sample size, which affects the accuracy of the result.

Objectives:

This study aimed to assess the level of knowledge, awareness, and attitude regarding mucormycosis among dentists, interns, and dental students in Saudi Arabia.

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Methodology:

Study design and setting:

This study is an observational cross-sectional study, based on a structured questionnaire, conducted between July 2024 and December 2024 in Saudi Arabia. All dental professionals in Saudi Arabia, including dentists, dental interns, 3rd, 4th, 5th, and 6th year undergraduate dental students, are included in this study. Sample recruiting strategy relays on social media sites (e.g., WhatsApp, Twitter, Instagram, Snapchat, Facebook, etc.). Participants were sought out, and each one gave their prior approval.

Sample size:

A sample size calculation was implemented to ensure the minimum number of participants required to form a representative sample of the entire population. According to the Raosoft sample size calculator analysis output, a total sample size of 384 participants was determined based on an indicator percentage of 0.50, margin of error of 5%, a statistical power of 99%, and a confidence interval of 95%.

Inclusion and Exclusion criteria:

All dentists, dental interns, and 3rd, 4th, 5th, and 6th year undergraduate dental students (private or governmental) who agreed to participate in the questionnaire in Saudi Arabia were included in the study. The dental auxiliaries, dental hygienists, and dental students in their pre-clinical years were excluded.

Method for data collection, instrument and score system:

Data collection was done in the form of the participants' responses to the questions. The self-administered online questionnaire used in the study was developed after a thorough literature search and utilizing the various published studies [12,13]. It encompasses 17 questions within four sections. The first section includes demographic data (place of residence, education, work, and gender); the second section is intended to assess knowledge about mucormycosis (type, risk factors, clinical signs, and transmission to dentists); the third section assesses awareness of mucormycosis (perceptions, benefits of early detection, and prevention roles); and the fourth section is intended to assess attitudes towards mucormycosis (recent encounters, the role of dentists in treatment, and understanding of diagnosis and treatment).

Each correct answer in the knowledge level was given 1 point, while incorrect answers received 0 points. Some answers were scored on a two-point scale to allow respondents to express varying degrees of knowledge. In the awareness level answers, a two-point scale is utilized, with more than one answer receiving 1 point and the most correct answer receiving 2 points to reflect the varying degree of awareness in the responders. In the attitude level answers, each correct answer receives 1 point while the wrong answer receives 0 point, and the last two questions were scored utilizing a three-point scale, with more than one answer receiving 1 point and the most correct answer receiving 3 points.

Scoring system:

The participants divided into three groups based on their scores according to the original Bloom's cut-

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off points: 80%–100% consider a high level, 60%–70% consider a moderate level, and less than 59% consider a low level. The knowledge overall score is 9, which gives a 7-9 score a high knowledge level, a 5-6 score a moderate level of knowledge, and less than 5 a low level of knowledge. The overall awareness score is 7, which gives a 6-7 a high level of awareness, 4-5 a moderate level of awareness, and less than 4 a low level of awareness. The attitude overall score is 8; this gives a 6–8 score for a positive attitude, a 4-5 score for a balanced attitude, and less than 4 a negative attitude.

Pilot test:

The questionnaire was distributed to 20 people and asked them to complete it. This was done to assess the questionnaire's simplicity and the study's feasibility. The data from the pilot study was excluded from the study's final results.

Analyzes and entry method:

Using the "Microsoft Office Excel Software" (2016) Windows program, data was input on the computer. Then, the data was uploaded to the Statistical Package of Social Science Software (SPSS) program, version 20 (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.) to be statistically analyzed.

Results:

Table (1) displays various demographic parameters of the participants with a total number of (466). Table 1 summarizes the sociodemographic characteristics of the participant cohort (466 subjects), with a majority being female totaling 67.4%. The findings bring into focus the large majority of the Saudi nationals, which constitute 92.7% of sample, the southern region of Saudi Arabia hosting 49.4% of the participants potentially suggesting regional variations or national trends in dental education and dental practice. In the sixth year, there is a diverse pool of dental students (the largest at 22.1%) reflecting an emphasis on advanced academic engagement. Additionally, 68.5% of participants are associated with dental schools, underscoring an educational institution to be an integral player in establishing such a strong linkage between educational institutions and the participants, their professional landscape.

Table (1): Sociodemographic characteristics of participants (n=466)

Parameter		***No.***	***Percent (%)***
Gender	Female	314	67.4
	Male	152	32.6
Nationality	Non-Saudi	34	7.3
	Saudi	432	92.7
Region of residence	The North of Saudi Arabia	46	9.9
	The South of Saudi Arabia	230	49.4
	The Centre of Saudi Arabia	67	14.4
	The East of Saudi Arabia	61	13.1
	The West of Saudi Arabia	62	13.3
Educational level	Dental student (3rd year)	79	17.0

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	Dental student (4th year)	67	14.4
	Dental student (5th year)	82	17.6
	Dental student (6th year)	103	22.1
	General dentist (GP)	78	16.7
	Intern	57	12.2
Place of work	Dental schools	319	68.5
	Government clinic	95	20.4
	Private clinic	52	11.2

As shown in figure 1, Specifically, data regarding the classification of mucormycosis infections is further elucidated by using a total sample size of 466 respondents. Of these 248 people identified mucormycosis as a fungal infection, representing almost 53.2% of the sample population, self-flagging this was shown. Conversely, in a concerning degree of misinformation regarding the pathophysiology of this condition, 130 respondents (27.9%) categorized it incorrectly as bacterial. Additionally, 39 respondents (8.4%) labeled it as viral, 49 respondents (10.5%) said they didn't know.

Figure (1): Illustrates the type of infection of mucormycosis among participants.

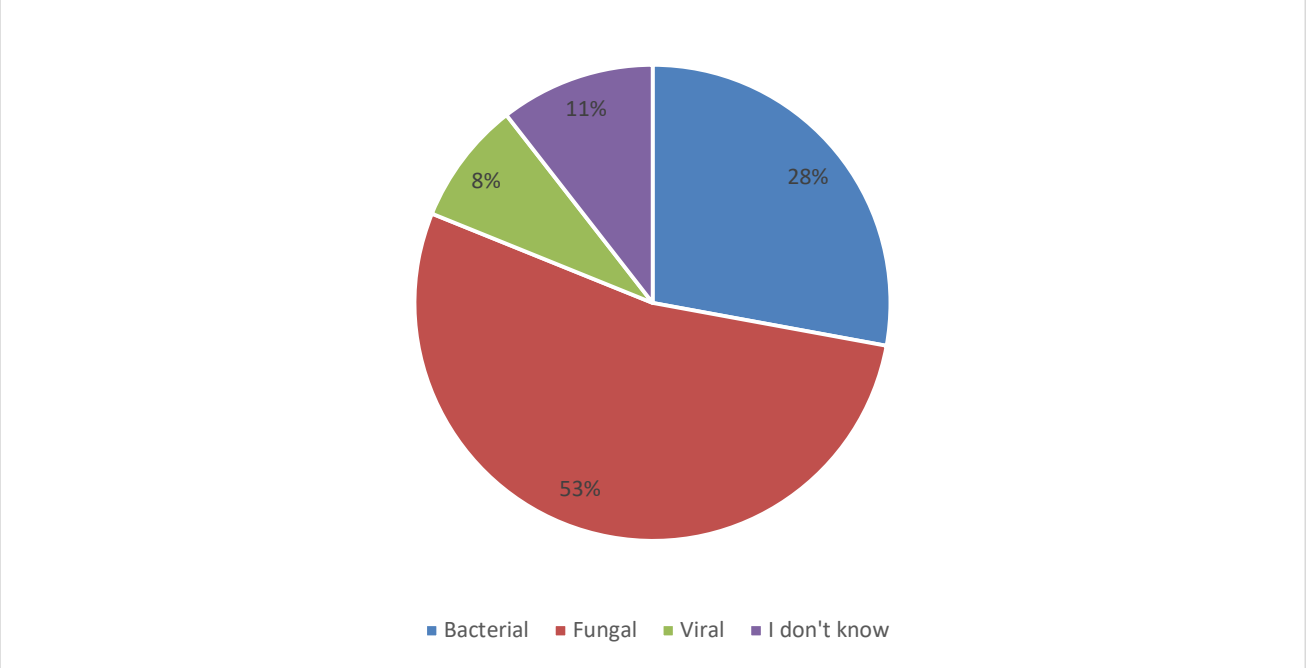

Table 2 presents the data providing significant findings about the knowledge of mucormycosis among dentists, interns dental students in Saudi Arabia sample size 466 respondents. First, 53.2% of the subjects correctly classified mucormycosis as a fungal infection, but unfortunately 27.9% missed its classification as such and believed it to be bacterial, which indicates that education about nasal fungal infection may be lacking in some populations. Notably, of nearly half of the respondents (47.6%), most of them noted that mucormycosis occurs most commonly in patients with multiple risk factors e.g. diabetes and other immunocompromised states, which is a positive sign regarding awareness. Nevertheless, there is wide disparity in awareness of clinical manifestation of this infection; only 29.8% stated a wide spectrum of symptoms, which suggests the need for comprehensive training to provide

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knowledge of this infection. Additionally, more than one third of respondents (38%) expected that infected individuals can transmit disease to dental professionals, but 19.5% respondents remained uncertain of transmission dynamics, an important knowledge gap.

Table (2): Parameters related to knowledge toward mucormycosis among dentists, interns, and dental students in Saudi Arabia (n=466).

Parameter		***No.***	***Percent (%)***
What type of infection is mucormycosis?	Bacterial	130	27.9
	Fungal	248	53.2
	Viral	39	8.4
	I don't know	49	10.5
The occurrence of mucormycosis is most common in:	Diabetic patient	102	21.9
	Immunocompromised patient	104	22.3
	Patients on corticosteroids	38	8.2
	All of the above	222	47.6
What is the clinical manifestation of mucormycosis?	One sided facial pain, numbness or swelling, blackish discoloration over bridge of nose/palate	105	22.5
	Sinusitis – nasal blockade or congestion, nasal discharge (blackish/bloody), blurred vision	134	28.8
	Toothache, loosening of teeth, jaw involvement, fever, skin lesion; thrombosis & necrosis, Chest pain, pleural effusion, haemoptysis, worsening of respiratory symptoms	88	18.9
	Any of the above	139	29.8
Can infection be transmitted from an infected person to a dentist?	No	91	19.5
	Yes	177	38.0
	Maybe	115	24.7
	I don't know	83	17.8
Which jaw is the most frequently affected by mucormycosis?	Mandible	90	19.3
	Maxilla	168	36.1
	I don't know	91	19.5
	Both	117	25.1

As shown in figure (2), In total, 466 respondents, thanks to the presented data at least, have experienced the perception of presence of mucormycosis, a serious fungal infection. Our findings show that 16.5% (77) of respondents consider mucormycosis not dangerous. On the contrary however, a great majority of respondents judge this condition as dangerous for health and 38.2% (178) considered it moderately dangerous, along with 45.2% (211) of the sample that deemed mucormycosis very dangerous for health.

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Figure (2): Illustrates perception of mucormycosis among participants.

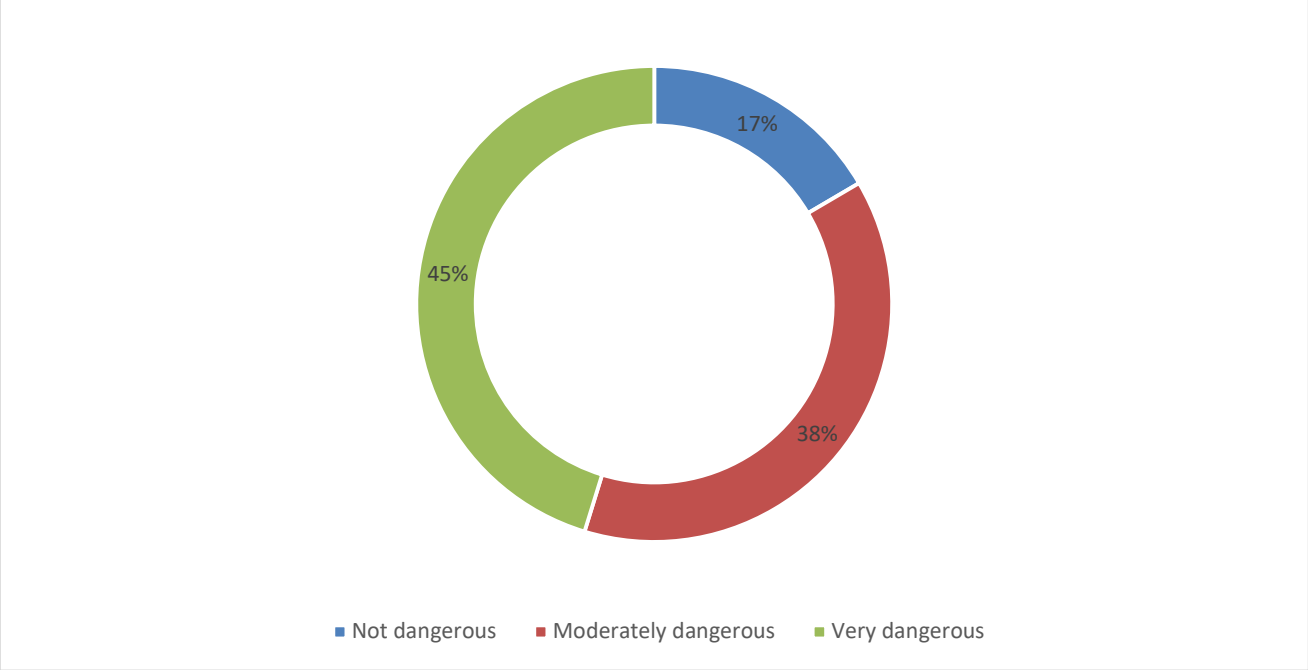

Table 3 presented the awareness and perceptions of mucormycosis among 466 dentists, interns and dental students in Saudi Arabia. This is a notable finding – more than a third (38.2%) see mucormycosis as "moderately dangerous" and a majority (45.3%) say it's "very dangerous" – which suggests both a general understanding of its severity but also potential holes in complete knowledge. Also, as much as 11.4 percent of participants do not find early detection to save lives, possibly due to a lack of awareness of its critical part or misinformation. Main takeaway is that we need increased outreach and educational initiatives around public education on mucormycosis based on an overwhelming consensus (85.2%) that education on mucormycosis is necessary. Additionally, respondents agree to a combined 74.3 percent that dentists have a 'highly' or 'moderately' significant role.

Table (3): participants' awareness toward mucormycosis among dentists, interns, and dental students in Saudi Arabia (n=466).

Parameter		***No.***	***Percent (%)***
What is your perception of mucormycosis?	Not dangerous	77	16.5
	Moderately dangerous	178	38.2
	Very dangerous	211	45.3
Mucormycosis has a poor prognosis. Do you believe that early detection can reduce the mortality rate?	No	53	11.4
	Yes	305	65.5
	Maybe	108	23.2
Is it important to educate people about mucormycosis in order to prevent it?	No	69	14.8
	Yes	397	85.2
What are your thoughts on the dentist's role in teaching	Highly	196	42.1

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others about mucormycosis?	Significant		
	Moderately significant	150	32.2
	Not significant	120	25.8

As can be seen in Table 4, the data presented provides us with a critical overview of the attitudes toward mucormycosis among dentists, interns, and dental students in Saudi Arabia regarding notable variation in awareness and perception regarding the serious fungal infection. A notable majority of respondents (67.4 percent) either had no personal interaction with people impacted additionally by mucormycosis or was unsure if such interaction had occurred. This lack of direct exposure was not necessarily counter to that finding, as a robust 66.1% expressed the belief that dentists should act as first line practitioners in treating mucormycosis and were willing to tackle potentially complex clinical scenarios with a limited history of prior experience. Additionally, the diagnostic approaches described by these authors are remarkably inconsistent regarding an appropriate methodology and combined total of 27.9% recognizes the need for comprehensive diagnostic strategies involving CT scans, tissue biopsies, and fine needle aspirations. In the treatment aspect, 27% also together support combining antifungal therapy and surgical treatment for this condition in their perspectives, indicating the double-faced clinical management for this condition.

Table (4): participants' attitude toward mucormycosis among dentists, interns, and dental students in Saudi Arabia (n=466).

Parameter		***No.***	***Percent (%)***
Have you met anyone who has recently been affected by mucormycosis?	No	314	67.4
	Yes	152	32.6
Do you believe that dentists should treat mucormycosis in first line?	No	158	33.9
	Yes	308	66.1
How will mucormycosis be diagnosed?	CT scan of lungs, sinuses etc, Fine needle aspiration	37	7.9
	CT scan of lungs, sinuses etc.	63	13.5
	CT scan of lungs, sinuses etc., Tissue biopsy	67	14.4
	CT scan of lungs, sinuses etc., Tissue biopsy, Fine needle aspiration	130	27.9
	Fine needle aspiration	50	10.7
	Tissue biopsy	75	16.1
	Tissue biopsy, Fine needle aspiration	44	9.4
How will you treat mucormycosis?	Antifungal therapy for at least 4-6 weeks	123	26.4
	Antifungal therapy for at least 4-6 weeks, surgically debriding of necrotic (dead) tissue	120	25.8
	Installation of the peripherally inserted central catheter (PICC line)	42	9.0
	Installation of the peripherally inserted central catheter (PICC line), Antifungal	126	27.0

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	therapy for at least 4-6 weeks, surgically debriding of necrotic (dead) tissue		
	Surgically debriding of necrotic (dead) tissue	55	11.8

Table 5 presents a comprehensive glance over the data concerning knowledge of mucormycosis by dentists, interns and dental students in Saudi Arabia. A noteworthy feature of the response was that a large portion of the respondents (46.6 percent) exhibited moderate knowledge about this serious fungal infection and combined 53.4 percent had a high- or low-level knowledge about this serious fungal infection highlighted a worrying gap across comprehensive awareness. Balanced distribution of high knowledge (26.8%) and low knowledge (26.6%) implies a large proportion of practitioners must lack the key and critical insights regarding mucormycosis for proper diagnosis and management.

Table (5): Shows knowledge toward mucormycosis among dentists, interns, and dental students in Saudi Arabia score results.

	Frequency	**Percent**
High knowledge level	125	26.8
Moderate knowledge level	217	46.6
Low knowledge level	124	26.6
Total	466	100.0

Table 6 presents data on the awareness among dentists, interns, and dental students in awareness of mucormycosis in Saudi Arabia. More significantly, a high 40.6% of respondents showed a high level of awareness on this opportunistic fungal infection and this is indicative of how much of a role educational creativity in dental community plays. On the other hand, 34.5% of the participants had moderate awareness, requiring the need for targeted training programs to become aware further. A troubling 24.9 percent of respondents had a low awareness level — which is alarming because it might negatively impact care for patients and how the condition is handled by dental professionals.

Table (6): Shows awareness toward mucormycosis among dentists, interns, and dental students in Saudi Arabia score results.

	Frequency	**Percent**
High awareness level	189	40.6
Moderate awareness level	161	34.5
Low awareness level	116	24.9
Total	466	100.0

The results of the data presented in Table 7 show that dental professionals, including dentists, interns and the dental students in Saudi Arabia have had the attitude of them towards mucormycosis. A large part (i.e. 48.1 per cent) appears to have a balanced attitude toward the disease, indicating an understanding of the seriousness of the disease, as well as of the measures to be taken to check and manage it. It is disconcerting that 29.2% of respondents view mucormycosis positively, a posture

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perhaps innocent of all that entails or of risks in immunocompromised patients. Noteworthy is that the 22.7% with a negative attitude may indicate a gap of education or understanding of the disease.

Table (7): Shows attitude toward mucormycosis among dentists, interns, and dental students in Saudi Arabia score results.

	Frequency	**Percent**
Positive attitude level	136	29.2
Balanced attitude level	224	48.1
Negative attitude level	106	22.7
Total	466	100.0

Table (8) shows that knowledge level towards mucormycosis has statistically insignificant relation to gender, nationality, place of residence, educational level, and place of work.

Table (8): Relation between knowledge level towards mucormycosis among dentists.

Parameters		***Knowledge level***		***Total (N=466)***	***P value****
		High knowledge level	**Moderate or low knowledge**		
Gender	Female	80	234	314	0.346
		64.0%	68.6%	67.4%	
	Male	45	107	152	
		36.0%	31.4%	32.6%	
Nationality	Non-Saudi	10	24	34	0.724
		8.0%	7.0%	7.3%	
	Saudi	115	317	432	
		92.0%	93.0%	92.7%	
Place of residence	The North of Saudi Arabia	13	33	46	0.424
		10.4%	9.7%	9.9%	
	The South of Saudi Arabia	56	174	230	
		44.8%	51.0%	49.4%	
	The Centre of Saudi Arabia	16	51	67	
		12.8%	15.0%	14.4%	
	The East of Saudi Arabia	22	39	61	
		17.6%	11.4%	13.1%	
	The West of Saudi Arabia	18	44	62	
		14.4%	12.9%	13.3%	
Educational level	Dental student (3rd year)	20	59	79	0.763
		16.0%	17.3%	17.0%	
	Dental student (4th year)	19	48	67	
		15.2%	14.1%	14.4%	
	Dental student (5th	20	62	82	

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	year)	16.0%	18.2%	17.6%	
	Dental student (6th year)	27	76	103	
		21.6%	22.3%	22.1%	
	General dentist (GP)	26	52	78	
		20.8%	15.2%	16.7%	
	Intern	13	44	57	
		10.4%	12.9%	12.2%	
Place of work	Dental schools	86	233	319	0.892
		68.8%	68.3%	68.5%	
	Government clinic	24	71	95	
		19.2%	20.8%	20.4%	
	Private clinic	15	37	52	
		12.0%	10.9%	11.2%	

P value was considered significant if ≤ 0.05.

Table (9) shows that awareness level towards mucormycosis has statistically insignificant relation to gender, nationality, place of residence, educational level, and place of work.

Table (9): Awareness level towards mucormycosis in association with sociodemographic characteristics.

Parameters		***Awareness level***		***Total (N=466)***	***P value****
		High awareness level	**Moderate or low awareness**		
Gender	Female	126	188	314	0.786
		66.7%	67.9%	67.4%	
	Male	63	89	152	
		33.3%	32.1%	32.6%	
Nationality	Non-Saudi	12	22	34	0.516
		6.3%	7.9%	7.3%	
	Saudi	177	255	432	
		93.7%	92.1%	92.7%	
Place of residence	The North of Saudi Arabia	21	25	46	0.197
		11.1%	9.0%	9.9%	
	The South of Saudi Arabia	102	128	230	
		54.0%	46.2%	49.4%	
	The Centre of Saudi Arabia	23	44	67	
		12.2%	15.9%	14.4%	
	The East of Saudi Arabia	18	43	61	
		9.5%	15.5%	13.1%	
	The West of Saudi Arabia	25	37	62	
		13.2%	13.4%	13.3%	
Educational level	Dental student (3rd year)	23	56	79	0.143
		12.2%	20.2%	17.0%	

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	Dental student (4th year)	27	40	67	
		14.3%	14.4%	14.4%	
	Dental student (5th year)	37	45	82	
		19.6%	16.2%	17.6%	
	Dental student (6th year)	39	64	103	
		20.6%	23.1%	22.1%	
	General dentist (GP)	39	39	78	
		20.6%	14.1%	16.7%	
	Intern	24	33	57	
		12.7%	11.9%	12.2%	
Place of work	Dental schools	126	193	319	0.766
		66.7%	69.7%	68.5%	
	Government clinic	40	55	95	
		21.2%	19.9%	20.4%	
	Private clinic	23	29	52	
		12.2%	10.5%	11.2%	

P value was considered significant if ≤ 0.05.

Table (10) shows attitude level towards mucormycosis has statistically significant relation to place of residence (P value=0.002) where participants residing in south region were found to have better attitude level towards mucormycosis. It also shows statistically insignificant relation to gender, nationality, educational level, and place of work.

Table (10): Attitude level towards mucormycosis in association with sociodemographic characteristics.

Parameters		***Attitude level***		***Total (N=466)***	***P value****
		Balanced or negative attitude	**Positive attitude level**		
Gender	Female	224	90	314	0.722
		67.9%	66.2%	67.4%	
	Male	106	46	152	
		32.1%	33.8%	32.6%	
Nationality	Non-Saudi	28	6	34	0.124
		8.5%	4.4%	7.3%	
	Saudi	302	130	432	
		91.5%	95.6%	92.7%	
Place of residence	The North of Saudi Arabia	29	17	46	0.002
		8.8%	12.5%	9.9%	
	The South of Saudi Arabia	150	80	230	
		45.5%	58.8%	49.4%	
	The Centre of Saudi Arabia	60	7	67	
		18.2%	5.1%	14.4%	
	The East of Saudi Arabia	45	16	61	
		13.6%	11.8%	13.1%	

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	The West of Saudi Arabia	46	16	62	
		13.9%	11.8%	13.3%	
Educational level	Dental student (3rd year)	58	21	79	0.218
		17.6%	15.4%	17.0%	
	Dental student (4th year)	42	25	67	
		12.7%	18.4%	14.4%	
	Dental student (5th year)	66	16	82	
		20.0%	11.8%	17.6%	
	Dental student (6th year)	70	33	103	
		21.2%	24.3%	22.1%	
	General dentist (GP)	56	22	78	
		17.0%	16.2%	16.7%	
	Intern	38	19	57	
		11.5%	14.0%	12.2%	
Place of work	Dental schools	221	98	319	0.365
		67.0%	72.1%	68.5%	
	Government clinic	68	27	95	
		20.6%	19.9%	20.4%	
	Private clinic	41	11	52	
		12.4%	8.1%	11.2%	

P value was considered significant if ≤ 0.05.

Discussion:

The objective of this present study was to assess dentists', interns' and dental students' knowledge, awareness and attitudes toward mucormycosis in Saudi Arabia. These findings suggest that there are widespread knowledge gaps and misconceptions about this serious fungal infection, recognized for years as a significant health threat in immunocompromised populations. Previous studies also present similar trends supporting further educational initiatives at improving understanding and managing mucormycosis in dental professionals.

Our study found only 53.2 percent of participants recognized mucormycosis as a fungal infection while 27.9 percent misidentified it as bacterial. This result is consistent with the finding of Mujawar et al. by whom dental practitioners of Maharashtra demonstrated sufficient level of knowledge regarding the fungal etiology of mucormycosis; however, there remained gaps in the comprehension on its clinical manifestations and risk factors [14]. Moreover, Patel et al. showed that existing lack of awareness of the epidemiology and treatment of mucormycosis may entail delays in diagnosis and treatment and higher morbidity and mortality [15]. Results from the present study echo such concerns as 28.9% of the participants were unaware of clinical manifestations of mucormycosis, a critical need for targeted education.

About half of participants were aware of the most common risk factors for mucormycosis, such as diabetes, although fewer than 50% recognized the connection between the disease and these conditions. However, this leaves a large proportion of dental professionals without some basic knowledge to begin with. Alavian et al. have not directly addressed mucormycosis, but rather it points out gaps in our knowledge of infectious diseases among dental students [16]. This implies that while some infectious diseases are emphasized in dental education, others, for example those from recent medical emergencies

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such as the COVID 19 pandemic, are not accorded the required attention. Participants had varying perceptions of mucormycosis severity: 38.2% deemed it as 'moderately dangerous,' and 45.3%' very dangerous.' This perception actually highlights both a general awareness of the infection's seriousness and educational deficiencies as 11.4% underestimated how important early detection was. During the COVID-19 pandemic, Islam and colleagues found that mucormycosis awareness increased at the same rate as personal experiences of COVID-19, demonstrating that upsurge in awareness of such risks could help to increase awareness of mucormycosis [17]. Integration of current health crises into the dental education to make student aware and prepared for the presently as well as emerging infectious diseases is the essence of this relationship.

In addition, the present study revealed that the large majority of participants (42.8%) considered education about mucormycosis essential, and 29.7% thought that dentists played an important role in its management. In accordance with Vundela et al., dentists had very high levels of knowledge of mucormycosis, but there was clearly a need for more training to deliver optimal care to patients [18]. The first line docs (dentist) should play an acknowledged role in combating mucormycosis, as they are often the first point of contact for patients, and as such their understanding of the disease is critical for early diagnosis and intervention.

Despite high awareness of mucormycosis, the study found that 67.4% of participants had not interacted purposely with affected subjects and these knowledge gaps may be responsible for proportionate gaps. It is concerning because practical experience is a huge part of reinforcement of theory. A study by Jboor et al. reported that dentists who had received continuing professional development (CPD) coursework were more likely to have satisfactory knowledge of oral cancer and it may help improve knowledge of mucormycosis among dental professionals [19]. As a result, case discussions that combine practical training and dental curricula could fill these gaps between theoretical knowledge and clinical practice.

Participants reported inconsistent diagnostic approaches, with only 27.9 percent of them acknowledging that comprehensive strategies, including imaging and biopsy methods, are important. The finding here is particularly alarming because timely and accurate diagnosis is key to treating mucormycosis. According to Patel et al. increases in mortality rates can result from delays in diagnosis, and that better diagnostic protocols and training for dental professionals are necessary [15]. The study by Reddy et al also highlighted that knowledge of diagnostic procedures of the dental students was scarce, adding to the difficulties to be confronted with complicated cases such as mucormycosis [20].

Less than one third (27%) of participants supported combined antifungal and surgical treatment, suggesting limited understanding of the complexity of managing mucormycosis. This is supported by Gupta and Kasulkar's finding of dental students having a good grasp of some infectious diseases but had huge gaps in knowledge with regard to management of complex conditions [21]. With the increasing prevalence of mucormycosis and the lack of awareness amongst providers regarding the appropriate treatment modalities, patient outcomes have the potential to suffer greatly, informing the need for comprehensive training in mucormycosis.

Limitations of the study include dependence on self-reported data and the possibility of a non-representative sample from recruitment via social media. Also, the cross-sectional study design precludes causal inference of knowledge and awareness levels. Future research should also look at the feasibility of using targeted educational interventions to enhance knowledge and attitude about mucormycosis among dental professionals.

Conclusion:

This study found major gaps in the knowledge and awareness of mucormycosis among dental clinicians, including dental interns and students, in Saudi Arabia. Results highlight the urgent need for improved

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educational initiatives to close these knowledge gaps, increase overall awareness, and promote optimal clinical management of this seriously debilitating fungal infection. A deeper understanding of how mucormycosis has appeared and increased annual incidence among the dental professional provides an opportunity to better serve your patients in maintaining their health and improving their health outcomes with this emerging problem.

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Ethical approval

An informed consent was obtained from each participant after explaining the study in full and clarifying that participation is voluntary. Data collected were securely saved and used for research purposes only.

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Conflict of interests

The authors declare no conflict of interest.

Informed consent:

Written informed consent was acquired from each individual study participant.

Data and materials availability

All data associated with this study are present in the paper.

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