Nursing Students' Knowledge and Preventive Measures Regarding Black Fungus Infection

Nahed Karam Mahmoud El Sehry[1], Dalia Hassan Youssef Sultan[2, 3], Neamat Mazloum Mohamed[4], Samira El Sayed El Mezayen[5]

[1, 4,5] Assistant professor of Community Health Nursing, Faculty of Nursing,Tanta University, Egypt.

[2]Nursing Teacher at Secondary Technical Nursing School, Kafr El- Sheikh, Egypt.

[3]Master student at Community Health Nursing, Faculty of Nursing, Tanta University, Egypt.

Corresponding author: Dalia Hassan Youssef Sultan

Email: daliasultan6@gmail.com

Abstract

Background: Black fungus infection is a life-threatening fungal infection associated with an increasing morbidity and mortality despite the availability of therapeutic tools. **Aim:** To assess nursing student's knowledge and preventive measures regarding black fungus infection. **Study design:** A descriptive cross sectional study design was used. **Study setting:** This study was conducted at Faculty of Nursing, Tanta University. **Study subjects:** A random sample of 1145 nursing students. **Tools:** Two tools were used. **Tool I**: A structured questionnaire schedule included two parts: Part (1): Socio demographic characteristics of the nursing students and part (2): Knowledge of the nursing students about black fungus diseases. **Tool II**: Self-reported measures of nursing students regarding preventive measures of black fungus diseases. **Results:** The majority (92.9%) of nursing students displayed low level of knowledge about black fungus infection. The study revealed that 58.5% of the students exhibited satisfactory practices. Total knowledge score positively correlated with total reported practices score. **Conclusion:** There was a highly statistically significant positive correlation between total knowledge score and total practices score. **Recommendations:** Organize workshops or webinars with infectious disease specialists or experts in mycology to update nursing students about emerging trends in the diagnosis, treatment, and prevention of mucormycosis.

Key words: Black fungus, knowledge, Nursing students, preventive measures.

Introduction:

Mucormycosis, vastly known as black fungus, has turn out to a major health attention in the awaken of the COVID-19 pandemic. This attacker fungal infection is characterized by its capability to infest blood vessels, causing tissue necrosis and serious complications, particularly among individuals with compromised immunity **(Haidry et al., 2022, Muthu, V. & Prakash et al., 2020).** The infection is caused by saprophytic fungi commonly found in soil and decaying organic matter. While these fungi are usually harmless to healthy individuals, they can become pathogenic under certain conditions, such as uncontrolled diabetes, immunosuppressive therapy, or prolonged steroid use.

Ensuring that nursing students possess adequate knowledge and awareness of emerging infectious diseases is essential for effective public health intervention. Their ability to engage in preventive measures depends on their understanding of the disease's transmission, symptoms, risk factors, and management. This makes educational strategies crucial, particularly during public health crises as COVID-19 pandemic **(Albaqawi et al., 2020).**

The World Health Organization **(WHO, 2024)** reports that the annual incidence rate of black fungus infection, also known as mucormycosis, ranges between 0.005 and 1.7 cases per 100 million people. Recently, the infection has been linked to a high mortality rate, particularly in low- and middle-income countries, where approximately 140 cases per million inhabitants are impacted by this severe condition. In India, the rate is nearly 80 times higher than in developed nations. Between May and July 2021, India recorded over 47,000 new cases of mucormycosis, surpassing the number of reported cases in other countries during the same period. **(Chander et al., 2018; Muthu, Rudramurthy, Chakrabarti & Agarwal, R 2021; WHO, 2024).**

A study conducted in Egypt during the third wave of the pandemic by **Farghly et al. (2022)** examined the prevalence and consequences of mucormycosis among COVID-19 patients. Out of 433 confirmed COVID-19 cases at Assiut University Hospital, 33 patients (7.63%) were diagnosed with mucormycosis. The research identified significant associations between mucormycosis and conditions such as diabetes mellitus, hypertension, smoking, and

high inflammatory markers. The study also reported a notably higher steroid dosage among infected patients and an alarming mortality rate, with only three out of 33 patients surviving. Although mucormycosis is typically categorized as an opportunistic infection affecting immunocompromised individuals, cases have also been reported among immunocompetent patients, particularly those with trauma **(Rocha et al., 2021).** The infection ranks third among deep fungal infections, following candidiasis and aspergillosis, and is known for its rapid progression and high mortality.

Preventive measures are critical in limiting the expansion of black fungus infection. These include suitable personal hygiene; utilize protective equipment during exposure to dust or soil, and careful management of underlying conditions. High-risk individuals, such as those undergoing organ transplantation, may also benefit from prophylactic antifungal treatments **(Dogra et al., 2022; Skiada et al., 2020).** Effective treatment typically combines antifungal therapy with surgical debridement of necrotic tissue.

Nurses, particularly in community health settings, perform a vital role in disease prevention and public education. They are key in raising awareness about black fungus, guiding individuals on risk avoidance, and promoting hygienic practices. Their educational efforts can significantly reduce disease transmission, especially during health crises like the COVID-19 pandemic **(Adhikari & Chakrabarti, 2021; Prakash & Yadav, 2023).**

Community health nurses teach individuals ways to lessen the odds of skin infection, such as cleaning skin injuries with soap and water, particularly if exposed to grime. Also, the community health nurse educates people about the importance of wearing gloves while handling materials like soil, moss, or compost to prevent black fungus infection. (**Dumit, 2017).**

Significance of the study:

Black fungus is a serious and ultimately deadly fungal infection that generally impacts patients with altered immunity. Usually, these fungi are non-pathogenic in immune-competent patients, but in the case of patients with immunocompromised (whether steroids or any other comorbidity like diabetes, cancers, malignant and hematologic disorders) can become life-threatening. The fatality rate in black fungus cases is very high; mortality is as high as 80%

if a patient goes untreated, or remains unaddressed for a long time. Even if treated, the mortality rate is still 40-50% in cases where the infection is caught at the sinus stage itself. Despite the fatality and severity of black fungus infection, its actual incidence couldn't be detected particularly in Egypt. This could be because of its under-reporting. However, it's so crucial to investigate knowledge and practices about this black fungus infection. So, this study aimed to assess nursing students' knowledge and their application of preventive measures concerning black fungus infection.

Aim of the Study: The study aimed to assess the nursing student's knowledge and preventive measures regarding black fungus infection.

Subjects and method:

Subjects

Study Design: A descriptive cross sectional study design was used to conduct this study. **Study settings:** This study was conducted at Faculty of Nursing, Tanta University.

Study subjects: The sample was selected from Faculty of Nursing at Tanta University. Equal proportion allocation sampling technique using 30% of all the students at the 1st, 2nd, 3rd and 4th academic years according to statistical procedure that showed the level of knowledge was expected to be at 50% with a 5% margin of error. The level of significance was 95% with 80% power of the study. The study sample was chosen randomly by stratified and systematic random sampling from the four academic years. The total number of the selected nursing students was 1145 at academic year 2023-2024 according to the following table:

Grade	Total number	Selected number
1st	644	193
2nd	1100	330
3rd	1038	311
4th	1037	311
Total	**3819**	**1145**

Tools of data collection:

The researcher used two tools to gather the data needed for this study.

Tool I: A structured questionnaire schedule: It consisted of two parts as follows:

Part (1): Socio demographic characteristics of the nursing students: This part included data about age, sex, academic year and residence.

Part (2): Knowledge of the nursing students about black fungus diseases: This part was developed by the researcher after reviewing the recent related literatures to collect data **Rajshekhar et al, (2024) and**

Simijaca, et al, (2022). The aim of this part was to assess student's knowledge about black fungus infection. It covered the following areas: source of information, previous knowledge about black fungus infection, definition, mode of transmission, risk factors, causes, signs & symptoms, types, complications, prevention and treatment of black fungus infection.

Scoring system:

-Every correct answer was scored one (1), the incorrect answer and don't know was scored zero (0). These scores were summed up and the total score was ranged from (0 – 79) point which was converted into a percentage score and classified as follows:

-low knowledge < 60 % (< 47 point) from the total score.

-Moderate knowledge 60% - 75 % (47 -59 point) from the total score.

-High knowledge > 75 % (>59 point) from the total score.

Tool II: Self-reported measures of nursing students regarding preventive measures of black fungus diseases: It was developed by the researcher to assess self-reported practices of nursing students regarding preventive measures of black fungus diseases. (**Alom et al., 2021; Alqarihi, et al., 2023; Baddley, 2022; Narayanan, Chua et al., 2022 & Rautemaa-Richardson et al., 2021).** It included the following items: personal hygiene such as oral care, skin care and scrub bath, wearing personal protective equipment such as wearing shoes, long trousers, long sleeve shirts and gloves when handling soil and caring of skin injuries which included clean the skin with warm water and by using antiseptic solution to avoid having skin infection.

The scoring system for student's self-reported practice was calculated as follows:

-Reported item of practice to be done was taken one point (1) and not done item of practice was scored zero point (0)**.** Theses scores were summed up and the total score was ranged from (0- 43) point which was converted into a percentage score and classified as follows:

-Satisfied practices ≥ 75% (≥32 point) from the total score.

-Unsatisfied practices < 75% (< 32 point) from the total score.

Methods:

Obtaining approval

An official permission to conduct the study was obtained from the Dean of the Faculty of Nursing.

Ethical considerations:

-Consent of the Scientific Research Ethical Committees of the Faculty of Nursing about the study was obtained. (81-8-2202).

-An informed consent was obtained from the chosen students to participate in this study after providing appropriate explanation about the purpose and benefits of the study at the beginning of the interview.

- Every nursing student was informed that he/she had the right to withdraw from the study at any time he/she wanted.

- Nature of the study didn't cause any harm or pain for the entire sample.

- Confidentiality and privacy were taken into consideration regarding the collected data.

Developing the study tools:

-The study tools were developed by the researcher based on reviewing of related literatures **(Gogineni et al., 2022; Rahman, et al., 2021; & Sholly, (2021).**

- Study tools were tested for content validity by a jury of five experts in the field of community health nursing before conducting the study.

- Cronbach's Alpha test was used, and it was found to be (0.849) for all the study tools, (0.726) for socio-demographic characteristics, (0.913) for knowledge items, and (0.910) for reported practices about black fungus infection

Pilot study:

-A pilot study was carried out by the researcher on 10% (106 students) of the nursing students from the four academic years to test the tool for its clarity, applicability and identify obstacles that might be encountered with the researcher during data collection. Accordingly, the necessary modifications were done. Those students were excluded from the study sample.

Actual study:

- The studied students were asked to fill the questionnaire in the faculty according to the schedule of their lectures. (Between and after lectures in the free time).

- The duration of the study was about 6 months.

Statistical analysis of the data:

The data were organized, tabulated and statistically analyzed using statistical package for social studies (SPSS) version 23. The mean, standard deviation and range were calculated for quantitative data. For categorical variables numbers and percent were calculated. Comparison was done using chi-square test (x^2), when chi square isn't appropriate Fissure Exact test was used. Pearson's correlation coefficient (r)

was used to identify correlation between variables. A significance was adopted at P<0.05 for interpretation of results of tests of significance (*). Also, highly significant was adopted at P<0.01 for interpretation of results of tests of significance (**).

Results

Table (1): Shows the distribution of the studied nursing students according to their socio-demographic characteristics. It was observed that, 66.1% of the studied students fell within the age of 20-21 years old, with a mean of 20.35 ± 1.235 years, 71.6% of them were females, 28.8% of the studied nursing students were second-year, followed by 27.2% were in third and fourth years, and 16.9% were in first year.

Additionally, 68% of studied nursing students lived in rural areas, 69.5% reported having enough income.

Figure (1): Shows Distribution of the studied nursing students based on their levels of knowledge about black fungus infection. It was observed that, the majority (92.9%) of nursing students displayed low level of knowledge about black fungus infection, while 6.9% exhibited a moderate level of knowledge and only 0.2% had a high level of knowledge with a mean of 27.28 ± 13.288**.**

Figure (2): Represents the distribution of studied nursing students according to their levels of reported practices regarding preventive measures against black fungus infection. It was noticed that 58.5% of the students exhibited satisfactory practices, while 41.5% had unsatisfactory category practices with a range of 0 to 47, and a mean of 34.29 ± 9.603.

Table (2): Illustrates the relation between socio-demographic characteristics of nursing students and levels of knowledge about black fungus infection. It was found that, there was a significant relation between age, previous hearing about black fungus infection and knowledge levels at (p<0.015, 0.011) respectively. In addition, academic year has statistically significant relation with level of knowledge at (p<0.001). On the other hand, there was no significant relation between sex, place of residence, family monthly income and nursing student's level of knowledge.

Table (3): Reveals the relation between socio-demographic characteristics of nursing students and levels of reported practices to preventive measures of black fungus infection. It was noticed that, there was statistically significant relation

between all elements of socio-demographic characteristics and nursing students' levels of reported practices at p<0.001, except for place of residence and family monthly income.

Table (4): Represents the relation between sources of nursing students' knowledge about black fungus infection and their levels of knowledge. It was revealed that; there was a highly statistically significant relation between all sources of nursing students' knowledge and their levels of knowledge at(p<0.001) except for family source and special training courses about infectious diseases.

Table (5): Shows the relation between sources of nursing students' knowledge about black fungus infection and their levels of reported practices about preventive measures for black fungus infection. It was noticed that, there was a significant relation between the studied students' levels of reported practices and the source of knowledge in relation to friends, family, special training courses about infectious diseases and internet at p= (0.009, 0.019, 0.016 and <0.001) respectively,While there was no significant relation regarding of books, medical magazine and media (radio and TV).

Table (6): Represents the correlation between age, academic years, total knowledge and total reported practices scores of nursing students. It was found that, there was a highly statistically significant positive correlation between age, academic year and total knowledge score and total practices score at (p=0.001). Additionally, total knowledge score positively correlated with total reported practices score (r=0.126, p=0.001).

Table (1): Distribution of the studied nursing students according to their socio-demographic characteristics

Socio-demographic of nursing students characteristics	The studied nursing students (n=1145)	
	No	%
Age of students		
Less than 20	200	17.5
From 20-21	757	66.1
More than 21	188	16.4
Range	17 – 23	
Mean ± SD	20.35 ± 1.235	
Sex		
Male	325	28.4
Female	820	71.6
Academic year		
First year	193	16.9
Second year	330	28.8
Third year	311	27.2
Fourth year	311	27.2
Place of residence		
Rural	779	68.0
Urban	366	32.0
Family monthly income		
Enough and save	143	12.5
Enough	796	69.5
Not enough	206	18.0

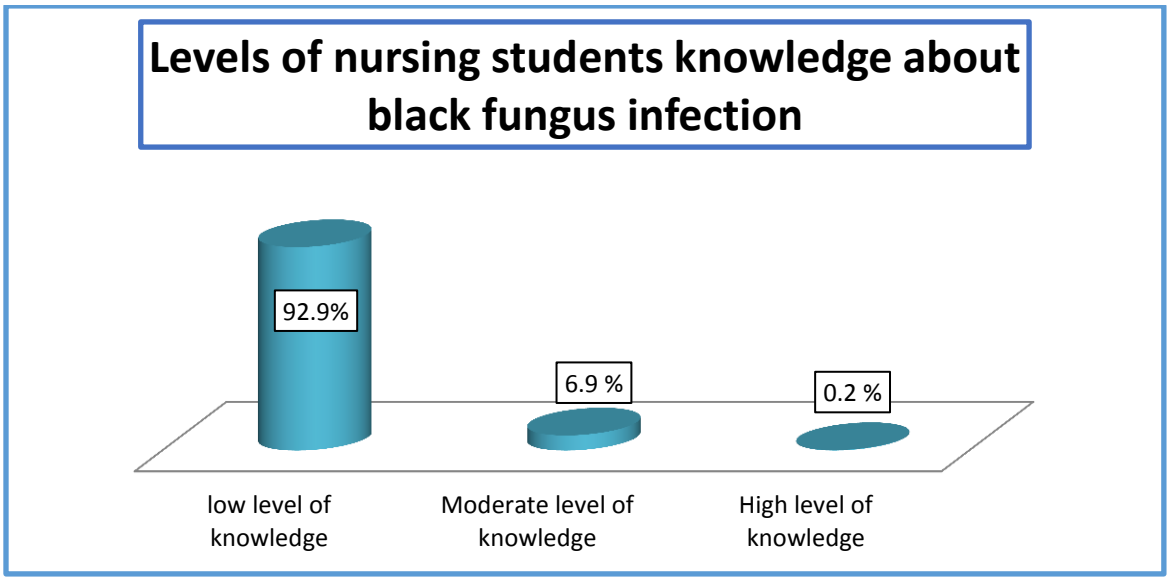

Figure (1): Distribution of the studied nursing students' levels of knowledge about black fungus infection

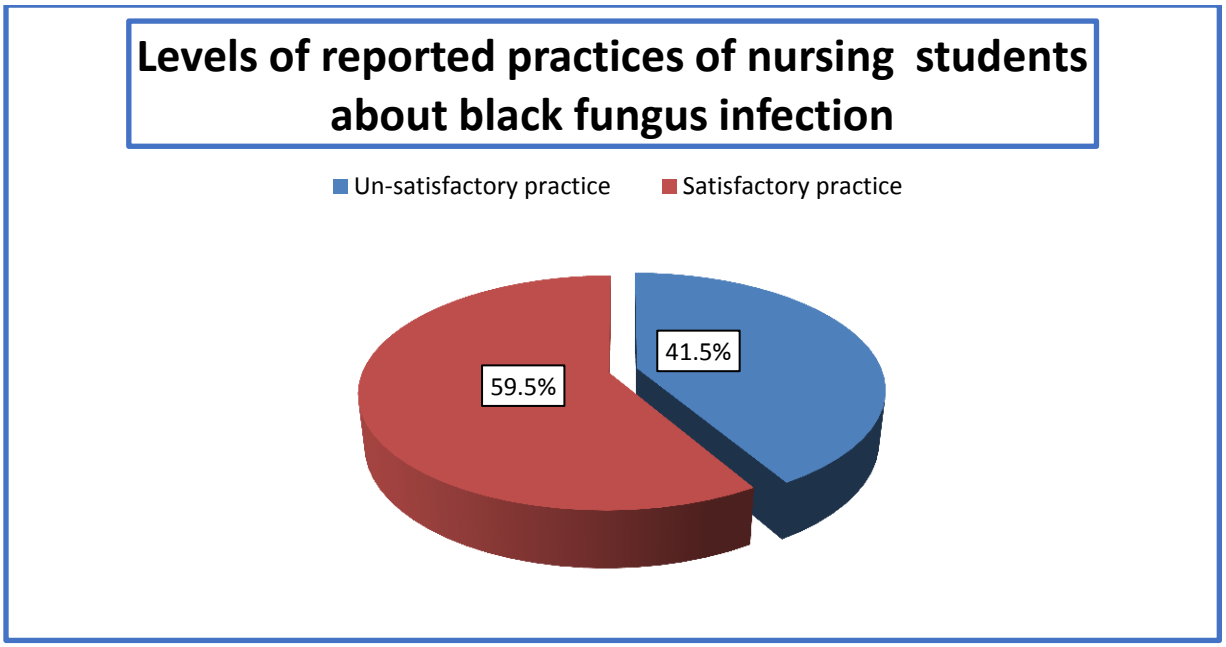

Figure (2): Distribution of the studied nursing students' levels of reported practices regarding preventive measures of black fungus infection

Table (2): Relation between socio-demographic characteristics of nursing students and levels of knowledge about black fungus infection.

Socio-demographic characteristics of nursing students	The studied nursing students (n=1145)						X^2 p
	levels of knowledge						
	low level of knowledge (n=1064)		Moderate level of knowledge (n=79)		High level of knowledge (n=2)		
	No	%	No	%	No	%	
Age							
Less than 20 n= (200)	192	96.0	8	4.0	0	0.0	FE 0.015*
From 20-21 n= (757)	690	91.1	65	8.6	2	0.3	
More than 21 n= (188)	182	96.8	6	3.2	0	0.0	
Sex							
Male n= (325)	302	92.9	21	6.5	2	0.6	FE 0.112
Female n= (820)	762	92.9	58	7.1	0	0.0	
Academic year							
First year n= (193)	185	95.9	8	4.1	0	0.0	FE <0.001**
Second year n= (330)	271	82.1	57	17.3	2	0.6	
Third year n= (311)	303	97.4	8	2.6	0	0.0	
Fourth year n= (311)	305	98.1	6	1.9	0	0.0	
Place of residence							
Rural n= (779)	723	92.8	54	6.9	2	0.3	FE 1.00
Urban n= (366)	341	93.2	25	6.8	0	0.0	
Family monthly income							
Enough and save n= (143)	132	92.3	11	7.7	0	0.0	FE 0.786
Enough n= (796)	743	93.3	51	6.4	2	0.3	
Not enough n= (206)	189	91.7	17	8.3	0	0.0	
Previous hearing about black fungus infection							
Yes n= (927)	852	91.9	73	7.9	2	0.2	FE 0.011*
No n= (218)	212	97.2	6	2.8	0	0.0	

p<0.05* significant p<0.01 highly significant FE (Fissure Exact test)**

Table (3): Relation between socio-demographic characteristics of nursing students and levels of reported practices to preventive measures of black fungus infection.

Socio-demographic characteristics of nursing students	The studied nursing students (n=1145) levels of reported practices				X^2 p
	Un-satisfactory practice (n= 475)		Satisfactory practice (n=670)		
	No	%	No	%	
Age					
Less than 20 n= (200)	138	69.0	62	31.0	101.411 0.001**
From 20-21 n= (757)	289	38.2	468	61.8	
More than 20 n= (188)	48	25.5	140	74.5	
Sex					36.119
Male n= (325)	180	55.4	145	44.6	
Female n= (820)	295	36.0	525	64.0	0.001**
Academic year					
First year n= (193)	137	71.0	56	29.0	167.439 0.001**
Second year n= (330)	181	54.8	149	45.2	
Third year n= (311)	63	20.3	248	79.7	
Fourth year n= (311)	94	30.2	217	69.8	
Place of residence					0.135 0.382
Rural n= (779)	326	41.8	453	58.2	
Urban n= (366)	149	40.7	217	59.3	
Family monthly income					
Enough and save n= (143)	52	36.4	91	63.6	1.870 0.393
Enough n= (796)	334	42.0	462	58.0	
Not enough n= (206)	89	43.2	117	56.8	
Previous hearing about black fungus infection					27.952 0.001**
Yes n= (927)	348	37.5	579	62.5	
No n= (218)	127	58.3	91	41.7	

p<0.05* significant p<0.01 highly significant FE (Fissure Exact test)**

Table (4): Relation between sources of nursing students' knowledge about black fungus infection and their levels of knowledge

Sources of nursing students' knowledge	The studied nursing students (n=1145)						X^2 p
	levels of knowledge						
	low level of knowledge (n=1064)		Moderate level of knowledge (n=79)		High level of knowledge (n=2)		
	No	%	No	%	No	%	
Books and medical magazine							
Yes	136	75.1	45	24.9	0	0.0	FE 0.001**
No	928	96.3	34	3.5	2	0.2	
Media (Radio and TV)							
Yes	229	83.0	47	17.0	0	0.0	FE 0.001**
No	835	96.1	32	3.7	2	0.2	
Friends							
Yes	129	83.8	25	16.2	0	0.0	FE 0.001**
No	935	94.3	54	5.4	2	0.2	
Family							
Yes	60	90.9	6	9.1	0	0.0	FE 0.512
No	1004	93.0	73	6.8	2	0.2	
Special training courses about infectious diseases							
Yes	71	95.9	3	4.1	0	0.0	FE 0.540
No	993	92.7	76	7.1	2	0.2	
Internet							
Yes	756	90.8	75	9.0	2	0.2	FE 0.001**
No	308	98.7	4	1.3	0	0.0	

p<0.05* significant p<0.01 highly significant FE (Fissure Exact test)**

Table (5): Relation between sources of nursing students' knowledge about black fungus infection and their levels of reported practices about preventive measures for black fungus infection

Sources of nursing students' knowledge	The studied nursing students (n=1145)				X^2 P
	levels of practice				
	Un-satisfactory practice (n=475)		Satisfactory practice (n=670)		
	No	%	No	%	
Books and medical magazine					
Yes	77	42.5	104	57.5	0.099
No	398	41.3	566	58.7	0.407
Media (radio and TV)					
Yes	114	41.3	162	58.7	0.005
No	361	41.5	508	58.5	0.501
Friends					
Yes	78	50.6	76	49.4	6.156
No	397	40.1	594	59.9	0.009**
Family					
Yes	36	54.5	30	45.5	4.922
No	439	40.7	640	59.3	0.019*
Special training courses about infectious diseases					
Yes	40	54.1	34	45.9	5.149
No	435	40.6	636	59.4	0.016*
Internet					
Yes	302	36.3	531	63.7	34.449
No	173	55.4	139	44.6	0.001**

p<0.05* significant p<0.01 highly significant FE (Fissure Exact test)**

Table (6): Correlation between age, academic years, total knowledge and total reported practices scores of nursing students

Variables	Total knowledge score	Total reported practices score
	R p value	R p value
Age of students	0.285 0.001**	0.338 0.001**
Academic year	0.282 0.001**	0.365 0.001**
Total reported practices score	0.126 0.001**	--

p<0. p<0.05* significant p<0.01 highly significant**

Discussion:

Mucormycosis largely affects people with existing health issues such as uncontrolled diabetes mellitus, accompanied by a compromised immune response because of drugs such as corticosteroids, which lessen the body's reaction to infections. Mucormycosis primarily affects the nasal and paranasal sinuses and the lungs. The entry point is via inhaling fungal spores from the environment. Additionally, following an injury, burn, cut, or abrasion, it may enter through the skin. **Khajotia., (2022).**

Information is crucial in preventing black fungus infections, as it helps in identifying risk elements, promotes early spotting, supports the treatment of underlying ailments such as diabetes, and encourages proper hygiene practices. Evaluating nursing students, public and healthcare professionals can significantly lower the occurrence of mucormycosis and improve patient results. **(Jayagayathri et al., 2022).** Thus, the present research sought to evaluate nursing students' understanding and precautionary actions concerning black fungus infection.

Regarding the scrutinized nursing students based on their overall levels of awareness about black fungus infection, this study observed that most nursing students demonstrated a low degree of knowledge regarding black fungus infection, whereas fewer than a tenth showed a moderate level, and only a small number possessed a high level of understanding. **(Figure 1)**.

This finding is similar to study conducted by **Khalil., (2022)** who conducted a study to assess health literacy and concerns among nursing staffs towards the COVID-19

vaccination and the associated mucormycosis: a quasi-experimental study and disclosed that the understanding scores of nursing personnel concerning black fungi were low. Conversely, this result is inconsistent with a study done by **Chongloi et al., (2022),** who disclosed that all the nursing students 100% (no=230) possessed good knowledge concerning mucormycosis. This may be due to the fact that Mucormycosis is a rare fungal infection, and while it is becoming more recognized due to increasing cases, particularly during the COVID-19 pandemic, it is still relatively uncommon in many regions. As a result, nursing programs may not dedicate much time to specific, less common diseases like black fungus, resulting in a gap in understanding regarding its causes, symptoms, transmission, and treatment.

Concerning the distribution of studied nursing students based on their levels of reported practices concerning preventive measures against black fungus infection, the present study demonstrated that a little more than half of the students display satisfactory practices, while the other half are in the unsatisfactory category. **(Figure 2)**.

This result is corresponding with **Elmetwaly, Esmat & Hassan, (2024),** who observed that, over half, 60.8% (no=162) of individuals, possessed sound practices concerning the prevention of Mucormycosis. On the other hand, this is conformable to the finding of a study done by **Gurjar, Kansagara, Chauhan & Savani, (2022),** who showed that over half 63.99% (no=503) of the participants had good practice. It can be linked to nursing students' thorough education in infection control, their awareness of the dangers associated with fungal infections, and their dedication to adopting preventive measures.

Regarding the relation between socio-demographic traits of nursing students and knowledge levels concerning black fungus infection, the present study showed that, there was a noteworthy relation between age, prior knowledge of black fungus infection, academic year and knowledge levels. Conversely, there was no considerable relation between sex, place of residence, family monthly income and nursing student's knowledge level. **(Table 2)**.

This is goes in the same line with **Kabir et al., (2021),** who discovered that there was a statistically significant association between participants' knowledge and their age. Furthermore, this is different with a study done by **Islam et al., (2022),** and demonstrated that, there was a substantial connection

between pupils' knowledge and their sex, living situation, and residence.

From the researcher's perspective, this could be a consequence of older students potentially having a better capacity to process and retain health data, leading to improved awareness and understanding of black fungus. Moreover, prior exposure and hearing about the illness allows students to forge connections between their learning and real-world concerns, which makes it simpler to recall specifics linked to black fungus infection.

Concerning the connection between socio-demographic traits of nursing students and levels of reported practices regarding preventive actions for black fungus infection, the current study indicated that there was a statistically significant relationship between all facets of socio-demographic characteristics and nursing students' levels of reported practices, aside from place of residence and family monthly income. **(Table 3)**.

This finding of the current study is supported by the result of **Islam et al., (2022),** study, who exhibited a noteworthy association between students' practice and their sex, living situation and residence. Furthermore, this result is corresponding with **Gurjar et al., (2022),** who asserted that there was no statistically significant connection between participants' practice and their place of residence?

From the researcher's perspective, this could be because nursing students generally experience continuous and comprehensive exposure to education and clinical training concerning infection control practices.

Concerning the connection between the origins of nursing students' information regarding black fungus infection and their understanding. It showed that, there was a very statistically significant association between all sources of nursing students' knowledge and their levels of knowledge apart from family source and special training programs concerning infectious diseases. **(Table 4)**.

Extensive media reporting, especially amid public health emergencies like the COVID-19 pandemic, turned black fungus infection into a subject of public conversation. Nursing students, as members of the general populace, are frequently exposed to this data, resulting in increased awareness and a higher understanding.

These findings disagreed to the **Ambiha et al., (2023)** study, that revealed the information source concerning mucormycosis hadn't demonstrated a statistically relevant

connection between knowledge levels about mucormycosis amongst nursing students. Those outcomes varied from the study carried out by **Khuntia & Thakur, (2023),** who disclosed that the connection between participants' knowledge and the source of information wasn't significant.

This could be due to media outlets, particularly news reports, documentaries, and public health initiatives, having a vital function in increasing consciousness concerning novel infectious illnesses such as black fungus.

Regarding the connection between nursing students' sources of information about black fungus infection and their reported practices of preventive measures for black fungus infection, the current study revealed that there was a significant link between students' reported practice levels and source of information, specifically friends, family, specific training courses on infectious diseases, and the internet. In contrast, no considerable association was found with books, medical journals, and media (radio and TV). **(Table 5)**.

Furthermore, the internet acts as an easily accessible and continually updated source of data. Nursing students often utilize online resources such as research papers, videos, and websites to augment their learning and remain current on present health matters. This platform permits them to access leading-edge information, research investigations, and expert views on novel topics, including black fungus infection. This result is different with **Islam et al., (2022),** who discovered that, the preventative practices of Black Fungus considerably differ among pupils considering media exposure.

This might be because it is common during any infection or pandemic of any infectious ailment. Family and friends are in constant encouragement to each other to implement preventive measures to avert disease infection.

Regarding the correlation between age, academic years, overall knowledge and total reported practices scores of nursing students, the current study indicated that, there was a highly statistically significant positive correlation between age, academic year and total knowledge score as well as total practices score. Furthermore, total knowledge score was positively correlated with the total reported practices score.

The finding of the current study is corroborative with **Elmetwaly et al., (2024)** study who found that, there was a statistically positive relationship between overall participant knowledge

and their reported practice. Furthermore, this result similar with a study done by **Zakaria & Alkuwaity, (2023),** who observed that the pupils' age and education was negligibly correlated with public knowledge level. This might be because knowledge provides the groundwork for informed action, empowering the nursing pupils to apply preventive measures.

Conclusion

Based on the findings of the present study, it can be inferred that, the majority of nursing students displayed low level of knowledge about black fungus infection, while minority of them exhibited a moderate to high levels of knowledge. Additionally, more than half of the students exhibited satisfactory practices, while less than half of them fall into the unsatisfactory category. Moreover, there was a highly statistically significant positive correlation between the total knowledge score and the total practices score.

Recommendations

The following recommendations are suggested in light of the results of the current study:

Organize workshops or webinars with infectious disease specialists or experts in mycology to update nursing students about emerging trends in the diagnosis, treatment, and prevention of mucormycosis.

Incorporate thorough, scientifically evidence-based information about mucormycosis, or black fungus, into nursing education programs. Make sure students comprehend the disease's biology, clinical signs, risk factors, and available treatments.

-Make clearly readable educational booklets and posters that emphasize the main symptoms and indicators of black fungus, along with the significance of prompt discovery and suitable treatment.

-Create online modules that describe preventive actions. These might be disseminated through educational platforms or institutional websites.

References:

Albaqawi, H. M., Alquwez, N., Balay-Odao, E., Bajet, J. B., Alabdulaziz, H., Alsolami, F., & Cruz, J. P. (2020). Nursing students' perceptions, knowledge, and preventive behaviors toward COVID-19: a multi-university study. *Frontiers in public health, 8*, 573390.

Albaqawi, M., Alquwez, N., Balay-Odao, E., Bajet, B., Alabdulaziz, H., Alsolami, F., & Cruz, J. P. (2020). Nursing students' perceptions, knowledge, and preventive behaviors toward COVID-19: a multi-university

study. Frontiers in public health, 8, 573390.

Alom, S., Ali, F., & Md, Z. K. (2021). A comprehensive review on mucormycosis (black fungus) and its association *with covid-19*. *Curr* Trends *Pharm Res, 8*(1), 11-40.

Alqarihi, A., Kontoyiannis, D. P., & Ibrahim, A. S. (2023). Mucormycosis in 2023: An update on pathogenesis and management. *Frontiers in Cellular and Infection Microbiology, 13*, 1254919.

Ambiha, R., Gopal, R., Subramanian, N. S., Bansi, G. P., Dhenu, G. P., Dharmik, B. P., & Janu, N. P. (2023). Knowledge on mucormycosis among nursing Indian students in the state of Gujarat. *Bioinformation, 19*(10), 1003.

Chander, J., Kaur, M., Singla, N., Punia, S., Singhal, K., Attri, K., & Guarro, J. (2018). Mucormycosis: battle with the deadly enemy over a five-year period in India. *Journal of fungi, 4*(2), 46.

Chongloi, N., Prashant, A., & Suthar, H. (2022). Knowledge of mucormycosis among undergraduate nursing students of AIIMS New Delhi. *Int J Nurs Educ, 14*, 171-176.

Dogra, S., Arora, A., Aggarwal, A., Passi, G., Sharma, A., Singh, G., &Barnwal, P. (2022). Mucormycosis amid COVID-19 crisis: pathogenesis, diagnosis, and novel treatment strategies to combat the spread. *Frontiers in microbiology, 12*, 794176.

Dumit, N. (2017). Role of the nurse as educator: Patient teaching. Revue de Rescherche *Scientifique de L'Université Antonine, 6*, 61-9.

Elmetwaly, E. E. A., Esmat, O. M., & Hassan, G. S. (2024). Women awareness regarding prevention of mucormycosis among their families. *Egyptian Journal of Health Care, 15(*1), 1528-1537.

Farghly, S. Y., Abdelrady, M. M., Thabet, A., Abdelhamed, A., Gad, A., Abu-Elfatth, A. M., ... & Kasem, M. (2022). COVID-19 associated mucormycosis in Assiut University Hospitals: A multidisciplinary dilemma. *Scientific Reports, 12*(1), 10494.

Gogineni, H., So, W., Mata, K., & Greene, J. N. (2022). Multidisciplinary approach in diagnosis and treatment of COVID-19-associated mucormycosis: a description of current reports. The *Egyptian journal of internal medicine, 34*(1), 58.

Gurjar, Y. J., Kansagara, T., Chauhan, M., & Savani, N. M. (2022). To Assess the Perception, Attitude, and Practice Related to Mucormycosis during COVID-19 Era: A Community-based Cross-Sectional Survey Using Online Platform among the Population of

Gujarat, India. *Nigerian Journal of Medicine, 31*(4), 406-409.

Haidry, N., Bhavana, K., Shivhare, P., Kumar, V., Vaidyanathan, A., &Shivhare ,P. (2022). A rare case of mandibular mucormycosis in a post-COVID-19 patient. *Cureus, 14*(8).

Islam, M. A., Nahar, M. T., Khan, M. N. A., Butt, Z. A., Monjur-Al-Hossain, A. S. M., Barna, S. D., & Hossain, M. T. (2022). Knowledge, attitudes, and practices concerning black fungus during COVID-19 pandemic among students of Bangladesh: An online-based cross-sectional survey. *International Journal of Environmental Research and Public Health, 19*(15), 9146.

Jayagayathri, R., Mohanty, P., Yadalla, D., Bakthavatchalam, J., Rangarajan, V., Maneksha, V., … Jayashree, S. (2022). Knowledge, attitude, and practice toward mucormycosis among patients presenting to six tertiary eye care hospitals in South India - A multicentre online questionnaire-based survey. *Indian journal of ophthalmology, 70*(6), 2158–2162. https://doi.org/10.4103/ijo.IJO_103_22.

Kabir, H., Rahman, M., Akter, S., Chowdhury, G. I., Bhuya, T. R., & Mitra, D. K. (2021). Black fungus or mucormycosis: a cross-sectional knowledge assessment among the Bangladeshi health care workers during COVID-19 pandemic.

Khajotia R. (2022). COVID-19 and the alarming rise of "black fungus" (mucormycosis) infection. *The Pan African medical journal, 41*, 318. https://doi.org/10.11604/pamj.2022.41.318.30147.

Khalil, A. I. (2022). Health literacy and concerns among nursing staffs towards the COVID-19 vaccination and the associated mucormycosis: a quasi-experimental study. *Indian Journal of Natural Sciences, 12*(70), 38430-38446.

Khuntia, S. K., & Thakur, R. (2023). The effect of video assisted teaching programme on knowledge regarding prevention and management of black fungus among staff nurse. *International Journal of Clinical Biochemistry and Research, 10(*1), 14-18.

Lewis, R. E., &Kontoyiannis, D. P. (2019). Epidemiology and treatment of mucormycosis. *Future microbiology, 8*(9), 1163-1175.

Muthu, V., Rudramurthy, M., Chakrabarti, A., & Agarwal, R. (2021). Epidemiology and pathophysiology of COVID-19-associated mucormycosis: India versus the rest of the world. *Mycopathologia, 186*(6), 739-754.

Narayanan, S., Chua, J. V., & Baddley, J. W. (2022). Coronavirus disease 2019–associated mucormycosis: risk factors and mechanisms of disease. *Clinical Infectious Diseases, 74*(7), 1279-1283.

Prakash, H., Singh, S., Rudramurthy, M., Singh, P., Mehta, N., Shaw, D., & Ghosh, K. (2020). An aero mycological analysis of Mucormycetes in indoor and outdoor environments of northern India. *Medical mycology, 58*(1), 118-123.

Rahman, F. I., Islam, M. R., & Bhuiyan, M. A. (2021). Mucormycosis or black fungus infection is a new scare in South Asian countries during the COVID□19 pandemic: Associated risk factors and preventive measures. *Journal of Medical Virology, 93*(12), 6447.

Rajshekhar, M. (2024). Despite the state: why India lets its people down and how they cope. Westland.

Rautemaa-Richardson, R., & Richardson, M. D. (2021). Systemic fungal infections. *Medicine, 49*(12), 760-765.

Rocha, N., Hasan, M., Goyal, S., Patel, T., Jain, S., Ghosh, A., & Cedeño, D. (2021). COVID□19 and mucormycosissyndemic: double health threat to a collapsing healthcare system in India. *Tropical Medicine & International Health, 26*(9), 1016-1018.

Sholly, C. K. (2021). An evaluation of Mucormycosis, Outburst. *Asian Journal of Nursing Education and Research, 11*(4), 591-593.

Simijaca, D., Mueller, G., & Vasco-Palacios, A. M. (2022). Fungal conservation in Colombia. Catalogue of Fungi of Colombia Kew: *Royal Botanical Gardens*, 175-187.

Skiada, A., Pavleas, I., & Drogari-Apiranthitou, M. (2020). Epidemiology and diagnosis of mucormycosis: an update. *Journal of fungi, 6*(4), 265.

World Health Organization. (2024). Rehabilitation in health financing: opportunities on the way to universal health coverage. World Health Organization.

Zakaria, O. M., & Alkuwaity, D. W. (2023). View of mucormycosis during the era of COVID-19 infection: A cross-sectional study. *Journal of Family Medicine and Primary Care, 12*(11), 2608-2613.