



BLACK FUNGUS WHAT DO WE KNOW ABOUT IT? KNOWLEDGE, ATTITUDE AND PRACTICE OF HEALTH CARE PROFESSIONALS IN IRAQ

Zainab Mohammed Al-Shamaa* and Luma M Al-Obaidy

Department of Clinical Pharmacy, College of Pharmacy, University of Mosul, Ninevah 41002, Iraq

Background: Black fungus is a serious infectious disease caused by mucoromycetes. The first cases of black fungus among patients with COVID-19 were reported in India in December 2020, followed by new cases in other countries like Iraq. This study aimed to assess the knowledge, attitude, and practice of healthcare professionals (HCPs) toward black fungus.

Methods: This was a cross-sectional study, in which HCPs who are members of the Iraqi syndicate of physicians, dentists, and pharmacists from different Iraqi cities participated in this online survey between the 11th of September and the 11th of November 2021. **Results:** In total 340 HCPs participated in this study. 55% of participating HCPs had a poor level of knowledge. 52% of participating HCPs thought that COVID-19 vaccination could protect the person from black fungus disease. 44% of the participating HCPs thought that black fungus can be prevented in COVID-19 patients through the wise use of steroids and good glycemic control in diabetic patients. 96% of HCPs thought that the best management plan for black fungus includes antifungal therapy plus surgery. **Conclusions:** Although the majority of HCPs have general information about black fungus, the level of knowledge regarding different aspects of the disease is poor. Iraqi HCPs required more comprehensive educational programs to increase their knowledge of black fungus and other infectious diseases.

Keywords: Black fungus; COVID-19; Knowledge; Attitude; Practice

INTRODUCTION

Black fungus is a serious infectious disease caused by mucoromycete. It predominantly affects individuals with immune defects or those on immunosuppressants¹. Black fungus is still one of the most complicated fungal infections around the world although it was known since the 19th century, and in general, individuals' knowledge toward it is still limited². At the end of 2019, many individuals in China suffered from complicated pneumonia of mysterious origin which was thereafter known as COVID-19³. The exponential increase in the number of infected cases throughout the world led the world health organization (WHO) to declare COVID-19 as a pandemic disease⁴. Severe cases of COVID-19

required emergent admission to hospitals for mechanical ventilation and oxygenation. Opportunistic infection by yeasts, molds, and fungi, may arise from the admission of patients to hospitals⁵. Many patients with COVID-19 also suffered from black fungus especially those with diabetes mellitus, kidney diseases, cancer, or patients who used corticosteroids in the treatment of COVID-19¹. Other factors increased the susceptibility of patients with COVID-19 to getting black fungus infection such as overuse of immunosuppressant medications, and misuse of preventive measures, like the reuse of disposable masks or even unwashed masks⁶. The first cases of black fungus among patients with COVID-19 were reported in India in December 2020⁷. Shortly, the black fungus infection associated with COVID-19 then spread to other countries like

Bangladesh, Brazil, Iran, Pakistan and Russia⁴. In conformity with the Centre for Disease Control and Prevention (CDC) report, the mortality rate associated with the black fungus was more than fifty percent⁷. Both internal organs, as well as body surfaces, are affected by black fungus including the brain, sinuses, eyes, lungs, bones, body tissues, and nerves⁶. Unfortunately, there is no definitive treatment for black fungus co-infection associated with COVID-19, therefore, the avoidance of risk factors should be considered to prevent its occurrence⁴. Insufficient knowledge about black fungus can affect its control during this ongoing pandemic. On the other hand, adequate awareness and knowledge about black fungus could limit its spread⁶. Because of the busy nature of their work, HCPs were highly susceptible to any kind of infections including black fungus, and therefore, they should have adequate information about the causes and management of this fatal disease⁴. The most important causes of fear among HCPs during any outbreak are insufficient prevention interventions in hospitals, and safety at the workplace, in addition to inadequate control policies used to defeat it^{4&8}.

In Iraq, there were more than one million infected cases of COVID-19⁹. Several cases of black fungus associated with COVID-19 were also reported. In general, several studies were conducted to evaluate the level of knowledge of HCPs in many infectious diseases, but studies about black fungus were limited^{4&8}. To the best of our knowledge, there were also limited studies about knowledge, attitude, and practice toward black fungus. Hence, this study aimed to assess the knowledge, attitude, and practice of HCPs toward black fungus.

METHODS

This was a cross-sectional study, in which HCPs from different Iraqi cities were invited to participate using an online survey. Members of the Iraqi syndicate of physicians, dentists, and pharmacists received the link to the survey. Two reminders were sent after two weeks. The data collection started on the 11th of September until the 11th of November 2021. The survey questionnaire was loaded on the Google form platform to collect the data from the participants. The first page of the survey included a brief description of the survey in

addition to a question asking for their voluntary participation.

The survey consisted of two main sections, the first section was asking for the demographic information of the participants including (age, gender, occupation, workplace, specialty, educational level, and years of experience). The second section consisted of three domains; knowledge, attitude, and practice about black fungus. The questionnaire was adopted from WHO and CDC recommendations and publications¹⁰.

The knowledge domain included 17 items aimed to explore the participants' knowledge about black fungus. The attitude domain included 4 items aimed to explore the participants' attitudes about black fungus, its management, and its association with COVID-19. The last domain included 5 items asking about the practice of HCPs toward the black fungus (their recommendations in addition to the prophylactic and preventive measures used to treat the black fungus).

This study was approved by Collegiate Committee for Medical Research Ethics at the University of Mosul (Code number: CCMRE-phA-21-9, date: 29/6/2021).

Validity

The validity of the questionnaire was assessed by measuring the internal consistency (Cronbach's alpha test). In which the questionnaire was distributed to 35 HCPs (who did not participate in the main study). The overall Cronbach's alpha coefficient of the questionnaire was 0.705, 0.786, and 0.765 for the knowledge, attitude, and practice sections respectively.

Statistical analysis

The data were coded and analyzed using Microsoft Excel and SPSS version 25. Descriptive statistics including mean \pm standard deviation were used to describe different demographic groups, while frequencies and percentages were used to describe the distribution of correct answers to each question of knowledge, attitude, and practice domains. The Kolmogorov-Smirnov test was used to determine the normality of the data, in which all variables were non-normally distributed. The knowledge score was categorized into low and high using the median

split method. The Chi-square test was used to find out the association between knowledge levels and the demographic variables of the participants. A p-value of less than 0.05 was considered to be significant.

RESULTS AND DISCUSSION

Results

Overall 340 HCPs participated in this study. About two-thirds (66%) of the

participants were females. The majority (77%) of the participants were aged between 20-39 years. More than one-half (53%) of the participants were pharmacists. The workplaces of the participants were widely distributed in the following order academia, primary care, community pharmacy, and secondary care settings. More than one-half (54%) of the participants have a bachelor's degree. More than one quarter have 1-5 years of experience (**Table 1**).

Table 1: Participants' characteristics.

Variables		Frequency (%)
Gender	Female	224(65.88%)
	Male	116(34.11%)
Age	Between 20-29	120(35.29%)
	Between 30-39	143(42.05%)
	Between 40-49	67(19.7%)
	Between 50-59	7(2.05%)
	Over 60	3(0.88%)
Profession	Consultant	27(7.94%)
	Registrar	18(5.29%)
	General practitioner	79(23.23%)
	Dentist	36(10.58%)
	Pharmacist	180(52.94%)
workplace	Academia	115(33.82%)
	Primary care	77(22.64%)
	Secondary care	46(13.52%)
	Tertiary care	15(4.41%)
	Private clinic	22(6.47%)
	Community pharmacy	65(19.11%)
Educational level	Bachelor degree	183(53.82%)
	Diploma	19(5.58%)
	Master	66(19.41%)
	PhD	44(12.94%)
	Physician with specialization	28(8.23%)
Years of experience	Less than year	78(22.94%)
	1-5 years	96(28.23%)
	6-10 years	78(22.94%)
	11-20 years	67(19.7%)
	More than 20 years	21(6.17%)

Knowledge domain

The vast majority (94%) of HCPs stated that black fungus is a fungal infection and the majority (71%) of them were aware that the causative agent of black fungus is *mucoromycete*. However, only 22% of HCPs identified that the most commonly affected body sites with black fungus are the head and lungs. The majority (71%) of HCPs thought that the first cases of black fungus in patients with COVID-19 were diagnosed in India. A minority (12%) of HCPs thought that the incubation period of black fungus in humans is between 2 and 28 days. More than 70% of HCPs identified that the mode of transmission of black fungus is through inhaled fungal spores or broken skin. About 28% of HCPs listed the most common signs and symptoms of black fungus as facial swelling on one side of the brain, nose or sinus congestion or discharge, headache and fever, and black sore on the nose or inside the mouth. More than 75% of HCPs recognized that black fungus disease had been diagnosed before the emergence of COVID-19 and still occurring. Similarly, they listed subjects that are at higher risk of getting black fungus, are immunocompromised subjects, diabetic, and COVID-19 patients on steroids. The majority (72%) of HCPs stated that they have heard about black fungus infection cases in their cities. About 45% of HCPs have realized that black fungus is not a contagious disease. Only 17% of HCPs identified the right method of diagnosis of black fungus which includes tissue biopsy, CT scan, respiratory fluid examination, and /or physical examination. Similarly, 18% of HCPs thought that patients with black fungus should not be isolated as it is not a contagious disease. Only a quarter of HCPs believed that Iraqi hospitals have the facilities

for diagnosing, dealing with, and treating suspected /confirmed cases. Similarly, 24% of HCPs have read the published guideline/recommendations for the management of black fungus announced by the Ministry of Health in primary and secondary care settings. The majority (84%) of HCPs identified the black fungus as a fatal disease (**Table 2**). The overall knowledge of more than one-half (55%) of HCPs was poor (**Table 3**).

Attitude domain

Fifty-two percent of HCPs thought that the COVID-19 vaccine could protect the person from black fungus infection. The majority (76%) of HCPs thought that not all COVID-19 patients would develop black fungus disease. About 44% of HCPs thought that black fungus infection is preventable in COVID-19 patients through the wise use of steroids and good glycemic control of diabetic patients. More than 70% of HCPs thought that HCPs have a great role in preventing COVID-19 through education and promoting vaccination (Table 2).

Practice Domain

The majority (77%) of HCPs thought that amphotericin B is the antifungal of choice for the management of black fungus and the vast majority (96%) of HCPs thought that the best management plan for black fungus includes antifungal therapy plus surgery. About half of HCPs identified that there is no prophylactic antifungal therapy that can be given to COVID-19 patients to prevent black fungus disease. The majority (77%) of HCPs recommended diabetic patients thoroughly control their blood glucose level to avoid black fungus disease and about two-thirds (64%) of them recommended all persons use immune boosters like vitamin C, vitamin D, and Zinc supplements (**Table 2**).

Table 2: Frequencies of right answers.

Question	Frequency	Percent (%)
Knowledge domain		
A black fungus is a fungal disease	321	94.41
The causative agent of black fungus infection is mucoromycete	240	70.59
The most commonly affected body sites with black fungus are the head and lungs	76	22.35
The first case of “black fungus” in patients with COVID-19 was diagnosed in India	242	71.18
The incubation period of black fungus in humans is 2-28 days	43	12.6
The mode of transmission of black fungus is through inhalation of fungal spores or broken skin.	241	70.88
The most common signs and symptoms are facial swellings on one side of the brain, nose or sinus congestion or discharge, headache and fever, and black sore on the nose or inside the mouth.	95	27.94
The black fungus had been diagnosed before and still occurring	257	75.58
High-risk subjects are immunocompromised subjects, diabetics, and COVID-19 patients on steroids medications	259	76.17
The diagnosis of black fungus is made via tissue biopsy, respiratory fluid examination, CT scan, and physical examination.	59	17.35
Black fungus is a contagious disease	154	45.29
The suspected patient should not be isolated	64	18.82
Black fungus is a fatal disease	285	83.8
Have you heard of any infection(s) of black fungus in your city?	246	72.35
Do Iraqi hospitals have the facilities for diagnosing, dealing with, and treating suspected/confirmed cases?	91	26.76
The Ministry of Health has published a guideline/recommendation for the management of black fungus in hospitals.	82	24.11
Attitude domain		
I think that the COVID-19 vaccine would protect me from black fungus disease	178	52.4
I think that all COVID-19 patients would develop black fungus disease	259	76.2
I think that the black fungus infection is preventable in COVID-19 patients.	148	43.5
I think that healthcare professionals have a great role in preventing COVID-19 through education and promoting vaccination.	241	70.9
Practice domain		
I think that the antifungal first choice for the management of black fungus is	260	76.5
I think that the best management plan for black fungus include	326	95.9
A prophylactic antifungal can be given for COVID-19 to prevent the black fungus disease	175	51.5
I do recommend diabetic patients thoroughly control their blood sugar to avoid black fungus disease	263	77.4
I do recommend all persons to use immune boosters like vitamin C, vitamin D, and Zinc supplement	216	63.5

Table 3: Knowledge levels among participants.

Knowledge level	Frequency	Percent (%)
Poor knowledge	186	54.70%
High knowledge	154	45.30%

Associations between the participants' knowledge level and the demographic characteristics

The results of the Chi-square test showed that statistically significant associations were found between the knowledge levels and gender, age groups, professions, and workplaces of the participants (*p*-values 0.004, 0.014, 0.001, and 0.022 respectively)(**Table 4**).

Table 4: Associations between the participants' knowledge level and the demographic characteristics.

Demographic groups	Low (%)	High (%)	<i>p</i> -value
Gender*			
Female	135 (60.3)	89 (39.7)	0.004
Male	51 (44.0)	65 (56.0)	
Age*			
Between 20-29	80 (66.7)	40 (33.3)	0.014
Between 30-39	72 (50.3)	71 (49.7)	
Between 40-49	31 (46.3)	36 (53.7)	
Between 50-59	2 (28.6)	5 (71.4)	
Over 60	1 (33.3)	2 (66.7)	
Profession*			
Consultant	10 (37)	17 (63)	0.001
Registrar	6 (33.3)	12 (66.7)	
General practitioner	36 (45.6)	43 (54.4)	
Dentist	15 (41.7)	21 (58.3)	
Pharmacist	119 (66.1)	61 (33.9)	
Workplace*			
Academia	61 (53)	54 (47)	0.022
Primary care	42 (54.5)	35 (45.5)	
Secondary care	19 (41.3)	27 (58.7)	
Tertiary care	5 (33.3)	10 (66.7)	
Private clinic	13 (59.1)	9 (40.9)	
Community pharmacy	46 (70.8)	19 (29.2)	
Education level*			
Bachelor	102 (55.7)	81 (44.3)	0.201
Diploma	14 (73.7)	5 (26.3)	
Master	37 (56.1)	29 (43.9)	
PhD	22 (50)	22 (50)	
Physician with specialization	11 (39.3)	17 (60.7)	
Years of experience*			
Less than year	48 (61.5)	30 (38.5)	0.073
1-5 years	59 (61.5)	37 (38.5)	
6-10 years	33 (42.3)	45 (57.7)	
11-20 years	34 (50.7)	33 (49.3)	
More than 20 years	12 (57.1)	9 (42.9)	

* Chi-square test.

Discussion

Black fungus is a rare but dangerous fungal infection. During the COVID-19 pandemic, a superinfection with mucormycosis has emerged among diabetic COVID-19 patients who were on steroids. This study showed a general weakness in the level of knowledge about black fungus disease. The level of knowledge varied among gender, age groups, professional level, and working places.

In this study, the results revealed that Iraqi HCPs knew that black fungus is a fungal infection and the causative agent is mucoromycete and the first cases of black fungus were recorded in India during the second wave of COVID-19 that hit many countries including Iraq. The disease was called black fungus due to the black color of the affected tissue that is seen inside the mouth, nose, and eye, however, the fungus itself is not black.

Participated HCPs were less confident about the incubation period of black fungus, in which only 12% of them knew that the incubation period was 2-28 days. This could be due to the controversies in the literature about the exact incubation period and the that black fungus is newly reemerged during the COVID-19 pandemic. A systematic review by Smith *et al.*, (2015) indicated that the incubation period was 2-28 days¹¹, however, Girdhar and Manocha (2022) study showed that the incubation period of mucormycosis is 2–5 days¹². On the other hand, Mishra *et al.*, 2021 suggested that determining the incubation period is difficult when occurred with COVID-19 and could be 7-10 days after percutaneous exposure to the spores¹³. Around three-quarters of participating HCPs have recognized that the mode of transmission of black fungus is through inhalation of spores or contaminated broken skin. Gupta *et al.*, (2020) study showed that patients might get the infection by inhaling the spores or contaminated wounds or damaged skin¹⁴. A minority of Iraqi HCPs listed facial swelling on one side of the brain, nose or sinus congestion or discharge, headache and fever, and black sore on the nose or inside the mouth as the most common signs and symptoms of black fungus. This result was in line with Choudhary *et al.*, (2021) study that listed the above-mentioned sign and symptoms as the most common signs and symptoms¹⁵, whereas,

ocular problems like eye edema and visual disturbances may also occur but less commonly. About three-quarters of Iraqi HCPs knew that black fungus had been diagnosed before the emergence of COVID-19 and still occurring. This result was in line with Bhadra *et al.*, (2021) study which concluded that it is not a new disease but the number of infected patients increased recently during the COVID-19 pandemic¹⁶. They listed subjects who are at higher risk of getting black fungus immunocompromised patients, uncontrolled diabetes, and COVID-19 patients on steroids. Gambhir *et al.*, (2021) concluded that patients with an extended stay in intensive care units, organ transplantation, cancer, and other comorbidities could be added to the high-risk groups mentioned above¹⁷. The Iraqi HCPs stated that they have heard about the infection in Iraq which was in line with Devnath *et al.*,(2021) study that found that five cases of black fungus disease were recorded in Iraq and one case died so far¹⁸. About half of the participated HCPs identified that the disease is not contagious, this means that it cannot be transmitted between persons and animals as confirmed by Selvamurugan (2021) and Mondal *et al.*, (2022) studies^{19&20}. The co-existence of predisposing conditions makes the exact detection and diagnosis of mucormycosis challenging during the COVID-19 pandemic therefore, only a minority of HCPs recognized the exact ways of diagnosis of the disease which include the tissue biopsy, CT scan, respiratory fluid examination, and /or physical examination. This result was in line with Rawlani *et al.*, (2021) who added molecular assay for precise detection of the disease in addition to the methods mentioned above²¹. Although participating HCPs had negative perceptions about the inability of Iraqi hospitals to deal with black fungus cases, the Iraqi Ministry of Health reassured the people that black fungus can be easily diagnosed and can be treated in Iraqi hospitals and they have the facilities to deal with emerging cases of black fungus²². The Ministry of Health utilized the available media to share reassuring information about black fungus via Facebook and social media, local radio stations, and brochures²³. The majority of the Iraqi HCPs recognized that black fungus is a fatal disease with an average rate of mortality of about

54%²⁰. Divakar (2021) study reported that the mortality rate is about 50% and may reach 90% if the infected cases were not treated²⁴.

About half of HCPs thought that the COVID-19 vaccine could protect the person from black fungus disease. Roy and Ghosh (2021) study found that the COVID-19 vaccine, and prophylactic measures like social distancing, and personal hygiene would decrease the spread of COVID-19 and associated co-morbidities like black fungus infection²⁵. The majority of HCPs thought that not all COVID-19 patients would develop black fungus disease, this result was in line with Gupta *et al.*, (2021) study, that listed susceptible persons for mucormycosis who were immunocompromised subject, uncontrolled diabetes mellitus, steroids treatment, blood cancers, bone marrow transplantation, and iron chelating therapies users¹⁴.

The results of this study showed that about three-quarters of participating HCPs thought that HCPs themselves have a great role in preventing COVID-19 through education and promoting vaccination which was in line with Xiong and Peng (2020) study which found that HCPs were on the front lines fighting COVID-19 with its all complications and challenges²⁶.

The vast majority of HCPs thought that the best management plan for black fungus include antifungal therapy (amphotericin B) plus surgery. This result was in line with Yasmin *et al.*, (2021) study which concluded that the best management of mucormycosis composed of antifungal amphotericin B in addition to surgical debridement of the infected tissues and subsequently reduces mortality²⁷. About half of HCPs identified that there is no prophylactic antifungal therapy that can be given to COVID-19 patients to prevent black fungus disease. This result was in line with Bhat *et al.*; (2021) study which mentioned five steps for the prevention of black fungus including overall hygiene, control of blood glucose, judicious use of steroids, usage of fresh hygienic water in humidifiers equipment for persons on oxygen and thorough treatments of mouth aphthous⁷. More than three-quarters of HCPs recommended diabetic patients carefully control their blood glucose level to avoid black fungus disease which was consistent with Gandra *et al.* (2021) study

which recommended tight control of blood glucose levels, especially in diabetic patients or those patients who were on corticosteroids to treat COVID-19²⁸. About two-thirds of HCPs have recommended their patients and relatives use immune boosters like vitamin C, vitamin D, and Zinc supplements. Name *et al.*, (2020) study suggested the crucial role of these immunomodulatory micronutrients in conserving the integrity of the skin and the mucous membrane which were the first line barrier against viral infections like COVID-19 infection, while the deficiency of these micronutrients would impose patients to viruses with worse prognosis²⁹.

The results of this study found a significant association between gender and knowledge level, in which male HCPs expressed higher levels of knowledge than female HCPs about black fungus. This result was against the results of many studies that explored the knowledge, attitude, and practice of HCPs toward COVID-19^{10,30}. The significant association between gender and knowledge level in this study might be due to the cultural variation of Iraqi society in which females specialized in the fields of gynecology and obstetrics, which contributed to their low level of knowledge about black fungus.

The association between age and knowledge level was found to be significant in this study. In which the higher age was also associated with a higher level of knowledge since these physicians have more time for reading and continuous education programs than young physicians who were busy with longer work time. This result was in line with Kasemy *et al.*, (2020) study³¹. Similarly, physicians with higher professional levels (e.g., consultants) have higher knowledge levels than general practitioners, dentists, and pharmacists since consultants have more time for reading and less busy working times³². This result was in line with Bhagavathula *et al.*, (2020), Jindal *et al.*, (2020), and Malaekah *et al.*, (2022) studies^{33, 34,32}. This was further confirmed by the higher level of knowledge in HCPs working in academia, secondary care, and tertiary care settings since consultants and senior HCPs with higher education were working in these institutions compared with community pharmacies and primary care centers.

Strengths and limitations of the study

This study was one of the limited studies that explored the knowledge, attitude, and practice of HCPs toward black fungus in Iraq and other countries. The studied sample was collected from different cities in Iraq, so it is representative of HCPs in the whole country. However, there were some limitations associated with this study. Since it was a cross-sectional study using an online survey, individuals who frequently used social media had a greater chance to participate in this study and the low response rate of online surveys.

Conclusions

Although the majority of HCPs have general information about black fungus, the level of knowledge regarding different aspects of the disease is poor. Continuous learning programs should be directed toward younger physicians, dentists, and pharmacists to increase the awareness of these HCPs and gain more experience with newly emerging medical conditions since HCPs were the frontline army against diseases in the community.

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نشرة العلوم الصيدلانية جامعة أسيوط



الفطر الاسود ماذا نعرف عنه؟ المعرفة والسلوك والممارسة لدى مقدمي الرعاية الصحية في العراق

زينب محمد الشماع – لى مؤيد العبيدي*

قسم الصيدلة السريرية، كلية الصيدلة، جامعة الموصل، نينوى، العراق، ٤١٠٠٢

مقدمة: الفطر الاسود هو مرض معدي وخطير سببه هو الفطار العفني. ظهرت الحالات الاولى للإصابة بالفطر الاسود لدى مرضى كوفيد-١٩ في الهند في شهر كانون الاول عام ٢٠٢٠ تبعتها عدد من الحالات الجديدة في دول اخرى مثل العراق. هدفت هذه الدراسة إلى تقييم معرفة وموقف وممارسة المتخصصين في الرعاية الصحية تجاه الفطريات السوداء.

الطرق: كانت هذه دراسة مقطعية، شارك فيها ممارسو الرعاية الصحية من أعضاء النقابة العراقية للأطباء وأطباء الأسنان والصيدلة من مختلف المدن العراقية في هذا الاستطلاع عبر الإنترنت بين ١١ أيلول و ١١ تشرين الثاني ٢٠٢١.

النتائج: في المجموع شارك ٣٤٠ طبيب رعاية صحية في هذه الدراسة. ٥٥٪ من مقدمي الرعاية الصحية المشاركين لديهم مستوى ضعيف من المعرفة. اعتقد ٥٢٪ من مقدمي الرعاية الصحية المشاركين أن لقاح كوفيد-١٩ يمكن أن يحمي الشخص من مرض الفطريات السوداء. يعتقد ٤٤٪ من مقدمي الرعاية الصحية المشاركين أنه يمكن الوقاية من الفطريات السوداء في مرضى كوفيد-١٩ من خلال الاستخدام الحكيم للمنشطات والتحكم الجيد في نسبة السكر في الدم لدى مرضى السكري. يعتقد ٩٦٪ من أطباء الرعاية الصحية أن أفضل خطة إدارة للفطر الأسود تشمل العلاج المضاد للفطريات بالإضافة إلى الجراحة.

الاستنتاج: على الرغم من أن غالبية مقدمي الرعاية الصحية لديهم معلومات عامة عن الفطريات السوداء، إلا أن مستوى المعرفة فيما يتعلق بالجوانب المختلفة للمرض ضعيف. احتاج الأطباء العراقيون إلى برامج تعليمية أكثر شمولاً لزيادة معرفتهم بالفطر الأسود والأمراض المعدية الأخرى.