

# To Describe the Epidemiology, Management and Outcome of Black Fungus and To Minimize the Risk Factor Associated with Black Fungus Disease: A Review

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**Abstract:** - The disorder Mucorales, a type of filamentous moulds, is what causes the disease known as mucormycosis. Infections may be brought on by contaminated food, spore inhalation into the nose or lungs, or injection into open wounds or damaged skin. In industrialised countries, mucormycosis primarily affects hosts who are severely immunocompromised (such as those who have haematological malignancies, organ transplants, neutropenia, autoimmune diseases, or other immune system deficits). The estimated prevalence of mucormycosis in India is over 70 times higher than it is worldwide. Diabetes mellitus is the most frequent risk factor, followed by solid-organ transplant and haematological cancer. In this country, people with postpulmonary TB and chronic renal disease are more likely to develop mucormycosis. Trauma is a risk factor for cutaneous mucormycosis. renalmucormycosis in one occurrence. An immunocompetent host is a distinct species in India. Even though Rhizopusarrhizus is the most common etiological agent of mucormycosis in this country, Rhizopusothallicus, Rhizopusmicrosporus, and Apophysomycesvariabilis infections are on the rise. Despite being a long-standing disease, mucormycosis has recently attracted attention because to its widespread occurrence in COVID-19 patients in India. Disposable face masks constructed of polymer materials have been widely used by the public as effective and reasonably priced personal protective equipment (PPE) to halt the spread of infectious diseases. A N95 respirator is a type of respiratory protective equipment that is designed to fit the user's face tightly and to filter airborne particles very efficiently. Be mindful that the corners of the respirator are designed to shut out the nose and mouth. surgical N95.

**Key Words:** - *Mucormycosis, Covid19, N95 Mask.*

## I. INTRODUCTION

It is a dangerous fungal illness that falls under fulminant fungal sinusitis and is also referred to as black fungus and zygomycosis.

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It is caused by a mould that develops on rotting and decaying organic waste. These fungi are widespread in soils, rotting organic materials (such fruit and vegetables), and animal dung, yet they typically have no negative effects on humans.[1]

It is caused by members of the filamentous mold fungus, the Mucorales (ranging from 3 to 11  $\mu\text{m}$  in diameter and are easily aerosolized) such as Apophysomyces, Cokeromyces, Cunninghamella, Lichtheimia, Mortierella, Mucor, Rhizopus, Rhizomucor, Saksenaea, Syncephalastrum, Thamnostylum and Mucormycetes that causes the infection and affects peoples.[2] It most commonly infects thenose, sinuses, brain (rhinocerebral mucormycosis), and eyes resulting in arunny nose, one-sided facial swelling and pain, headache, fever, blurred vision,

bulging or displacement of the eye (proptosis), and tissue death Other forms of disease may infect the lungs (pulmonary mucormycosis), stomach and intestines (gastrointestinal mucormycosis), and skin (cutaneous mucormycosis) .[3]

“Black Fungus” is applied to human pathogenic Mucorales species due to the formation of black-colored sporangium and these spores are airborne and found in indoor and outdoor air, and in dust and also found in hospital environments such as hospital bed sheets, negative-pressure rooms, water leaks, contaminated medical equipment, and building works. [4].

### 1.1 Case Report

YEAR	GLOBAL			INDIAN		
	TP	TP	%TP	CITATIONS	CPP	%ICP
1998	104	11	10.5	148	13.4	0
1999	121	12	9.9	175	14.5	1
2000	99	7	7	54	7.7	2
2001	121	10	8.2	193	19.3	0
2002	115	10	8.7	80	8	0
2003	119	13	10.9	373	28.7	0
2004	161	15	9.3	261	17.4	1
2005	191	19	9.9	682	35.9	2
2006	219	27	12.3	592	21.9	2
2007	223	33	14.8	527	15.9	0
2008	252	24	9.5	316	13.1	1
2009	277	32	11.5	737	23	5
2010	276	38	13.7	453	11.9	5
2011	273	38	13.9	374	9.8	4
2012	317	47	14.8	299	6.3	7
2013	296	48	16.2	239	4.9	3
2014	347	52	14.9	662	12.7	2
2015	305	57	18.7	326	5.7	6
2016	300	52	17.6	506	9.7	6
2017	304	40	13.1	152	3.8	2

2018	326	49	15	160	3.2	6	12.2
2019	392	66	16.8	333	5	5	7.5
2020	355	60	16.9	57	0.9	6	10
2021	165	39	23.6	12	0.3	4	10.2

ABBREVIATION: TP =Total publications; CPP =Citations per publications; ICP=International collaborative publications

## II. TYPES OF MUCORMYCOSIS

**ROCM (rhino-orbital-cerebral mucormycosis):** The most prevalent type of mucormycosis is which affects 45-74% of people.

**GASTROINTESTINAL (0.8%):** Young children are more likely to experience it than adults. Infants who are premature or low birth weight and are younger than one month of age are at risk if they have undergone surgery, received antibiotics, or are taking drugs that impair the body's defences against infection.

**CUTANEOUS [ Skin] (6.1%):** It happens once the fungi get inside the body through a skin breach. After a burn, scrape, cut, surgery, or other sort of skin trauma, this kind of infection may develop. Among those who do not have compromised immune systems, this is the most prevalent type of mucormycosis.

**RHINOCEREBRAL (Sinus and Brain) (3.5%):** It is an infection in the sinuses that can spread to the brain. This is most common in people with uncontrolled diabetes and in people who have had a kidney transplant.

**DISSEMINATED FORM (1.4%):** It happens when the illness travels to another area of the body through the bloodstream. The infection typically affects the brain, but it can also harm the spleen, heart, and skin, among other organs.

**PULMONARY [ Lung] (3-22%):** It is the most prevalent kind of mucormycosis in cancer patients, transplant recipients, and stem cell recipients.

**OTHER INFECTIONS:** such as Bone, Beat, Spine, And Heart Infections.

**SYMPTOMS [7]:**

Symptoms mainly depend on the location in the body of the infection. The Infection usually begins in the mouth or nose and enters the central nervous system via the eyes.

- Stuffy (Nasal and blood vessels become swollen with excess fluids) and bleeding nose;
- Swelling of and pain in the eye;
- Drooping of eyelids (excess sagging of upper eyelids)
- Blurred or loss of vision.

- Change in Mental status
- Lapse into coma

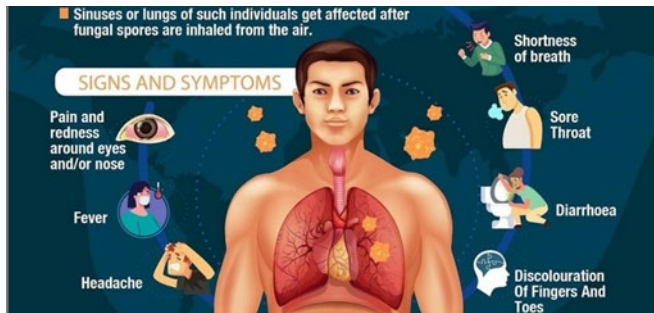


Fig.1. Signs and Symptoms

### III. RISK FACTORS

**DIABETES MELLITUS:** Diabetes mellitus leads to tremendous health problem Excess glucose in blood impairs the defence mechanism by suppressing cytokine (IL – 6) production and phagocytises which is responsible for antibiotics production. High level of glucose level causes disfunction and Fc- $\gamma$  receptors present on monocyts resulting in suppression of cytokine. (8)

**DIABETIC KETOACIDSIS:** Excess ketones make our blood more acidic which decreases the binding of iron to the transferritin, these free iron ions in blood increase the growth of black fungus. (8)

**EXCESS IRON:** Peoples with Thalassemia and Leukaemia are more prone to develop iron overload. Black fungus absorbs iron in the form of haem and free iron ions for cellular process and produce energy for their growth. High amount of free iron leads to destruction of heamostasis.(9)

**KAWASAKI DISEASE (KD):** People with KD disease has low level of T cells and B cells which triggers prolong self-directed immune response. (10)

**STEROIDS:** Prolonged use of steroids causes excess stimulation of glucocorticoid and mineralocorticoid receptors, which suppresses the immune by segregating CD4+ T-lymphocytes, resulting mucormycosis. (11)

**UNSTERILIZED MEDICAL DEVICES:** Unsterilized medical devices, contaminated equipment's and impure water increases

the growth of infections. Dry nose with oxygen therapy leads to invasion of black fungus in the body. (12)

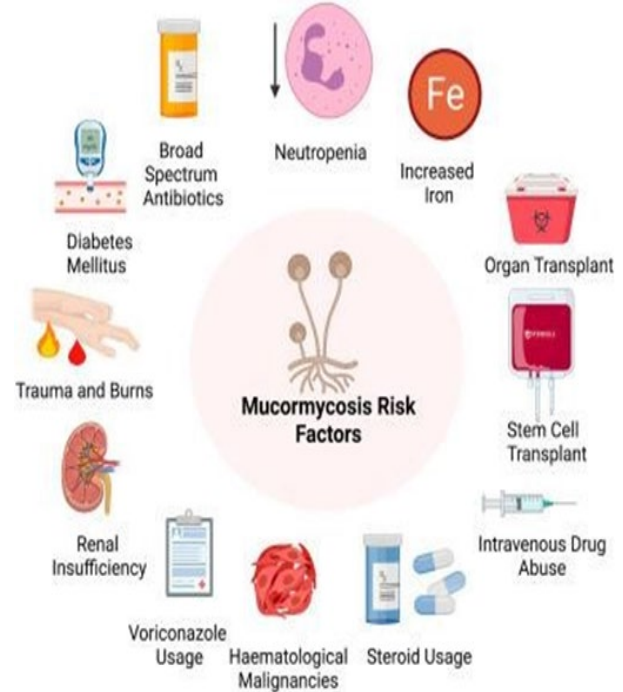


Fig.2. Mucormycosis Risk Factors

#### 3.1 Mode of Action of Black Fungus

Mucormycetes mould can invade in the susceptible host through nose, mouth or burned /disrupted skin which results in rhino-orbito-cerebral, gastrointestinal or cutaneous wound infections[13]. Studies proposed that Rhino cerebral Mucormycosis is most common among all other cases progression of this rhino-cerebral Mucormycosis may leads to central nervous system and it becomes dangerous , the second most preferred site of infection are lungs and sinuses[14]. Physicians suggested that immunosuppressed patients are more likely to be affected with Mucormycosis or Black fungus. Patients with hyperglycemia( High Blood Glucose ) and ketoacidosis(Lack of Insulin level ) are more susceptible to get attacked by Mucormycosis moulds[15]. Covid-19 patients develop dysfunction of immune system with decrease in lymphocyte counts and increment in inflammatory cytokines such as IL-6, IL-1 $\beta$ , IFN-  $\gamma$  etc . and Tumor necrosis factor(TNF) that leads to hyperinflammation in the lungs[16]. Covid-19 patient with immunosuppressant may leads to dysfunctional phagocytes causes impaired intracellular killing by oxidative and nonoxidative mechanism. [ 17]

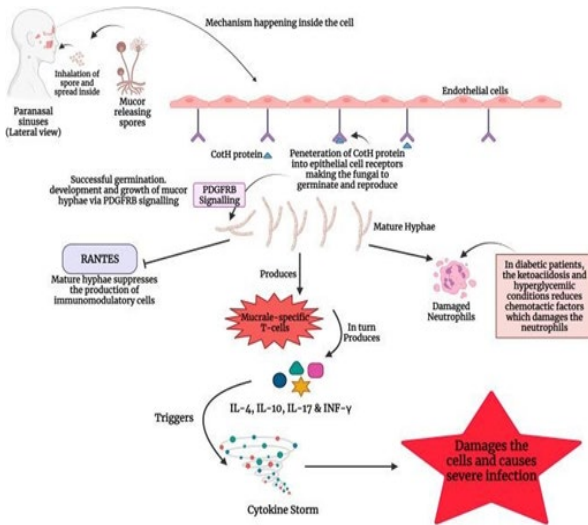


Fig.3. Rantes

### 3.2 Co-Relation Between Covid and Black Fungus

A lack of oxygen (hypoxia), an increase in glucose (diabetes, new-onset hyperglycemia, and steroid-induced hyperglycemia), an acidic environment (metabolic acidosis, diabetic ketoacidosis (DKA)), and a higher level of iron (high ferritins) are among the conditions that have recently been linked to mucormycosis in COVID-19 patients. Low white blood cell phagocytic activity (WBC) in COVID-19-infected individuals appears to aid Mucorales spore germination [18].

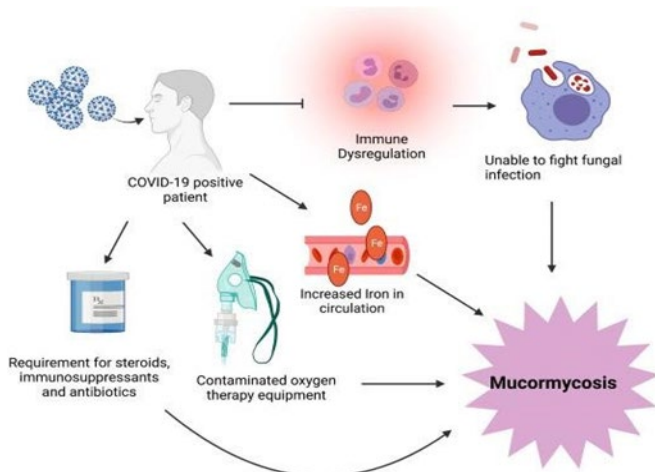


Fig.4. Mucormycosis

These infections could be caused by fungi, bacteria, viruses, parasites, or even bacteria. COVID - 19 Patients with SARS-CoV-2 infection are more susceptible to develop opportunistic infections.

### 3.3 Protective Methods for Black Fungus

Patients must bear in mind the following behaviours to prevent contracting mucormycosis; some of these activities are unique to COVID patients, while others are general advice to prevent the COVID symptoms of mucormycosis.

- Wear a face mask when visiting dusty locations or construction sites to lessen mucus production and prevent mistakenly breathing in fungi that could cause symptoms of mucormycosis.
- Mucormycosis is brought on by a substance called mucor, which is found in rotting plants, fruits, and vegetables as well as in gardens that are exposed to dirt, manure, and plants. When outdoors or working with dirt and manure, put on the proper footwear, long trousers, full-sleeved shirts and gardening gloves to stay safe and avoid the symptoms of black fungus.
- Consistently exercise proper hygiene and take full baths.

### 3.4 Use of Fack Mask

They are used in community and clinical settings as source control to reduce viral spread and for individual safety to avoid infection. Masks that are worn properly both reduce the number of respiratory droplets and aerosols that are transferred by infected people and aid in preventing infection in healthy people. [20]

A face mask acts as a shield to shield the respiratory tract from airborne droplets and particles. One may trace the development of mouth and nose covering to the turn of the 20th century. Examples include mouth guards, face veils, face masks, and mouth bandages.

By lowering the rates of infection by airborne transmission, face mask use has been crucial in protecting both HCWs (Healthcare Workers) and the general public. A patient's face mask might lower not only the release of virus carrying droplets into the open air but both the intake of virus-carrying droplets from the open air as well as the discharge of virus-carrying droplets into the open environment. The wearing of a mask can protect an infected but asymptomatic healthcare provider from dispersing viruses into the open air. The mask can also shield users from airborne infections at the same time. Wearing a mask in a clinical setting can help lower the risk of infection spread via airborne contact between patients and medical personnel. [ 21]

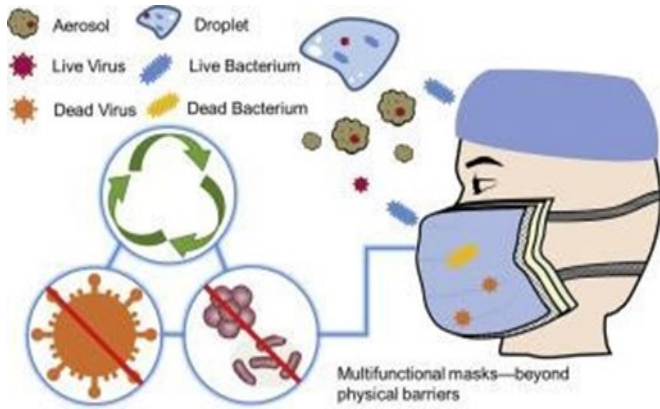


Fig.5. Multifunctional Masks

**CHOICE OF MASK [22]**

GOOD	BETTER	BEST
<p><b>Cloth mask</b></p> <ul style="list-style-type: none"> <li>Typically offers two to three layers of protection</li> <li>Can be made at home and</li> </ul>	<p><b>Surgical mask</b></p> <ul style="list-style-type: none"> <li>Filters 85-92% of air particles</li> <li>Can be purchased at your local drug or retail store</li> </ul>	<p><b>N-95 mask</b></p> <ul style="list-style-type: none"> <li>Filters 95% of air particles</li> <li>Reserved for health care workers</li> </ul>

Fig.6. Different types Masks

COMPARISON		
<p><b>HYPASHIELD W95</b> For protection against bacteria, viruses and aerosols</p> <p>Bacteria Filtration: 99.99% Virus Filtration: 99.99% Squash/Spore Resistance: 99.99% Dead Filtration: 99.99%</p> <p>Flow rate: 30 L/min Max Particle Size: 0.3 µm Max Particle Size: 0.3 µm</p>	<p><b>N95</b> For medication</p> <p>Bacteria Filtration: 95% Particle Filtration: 95% Squash/Spore Resistance: 95% Dead Filtration: 95%</p> <p>Flow rate: 30 L/min Max Particle Size: 0.3 µm Max Particle Size: 0.3 µm</p>	<p><b>Surgical Mask</b> For medication</p> <p>Bacteria Filtration: 95% Particle Filtration: 95% Squash/Spore Resistance: 95% Dead Filtration: 95%</p>
<p><b>FFP1 Mask</b> For protection against bacteria</p> <p>Bacteria Filtration: 95% Particle Filtration: 95% Squash/Spore Resistance: 95% Dead Filtration: 95%</p>	<p><b>Cloth Mask</b> For medication</p> <p>Bacteria Filtration: 95% Particle Filtration: 95% Squash/Spore Resistance: 95% Dead Filtration: 95%</p>	<p><b>Sponge Mask</b> For medication</p> <p>Bacteria Filtration: 95% Particle Filtration: 95% Squash/Spore Resistance: 95% Dead Filtration: 95%</p>

Fig.7. Different types Masks

**3.5 N 95 Mask [23,24,25]**

Peter Tsai, a Taiwanese-American, and his colleagues created the N95 mask filter, which was granted a U.S. patent in 1995. A particulate-filtering facepiece respirator that filters at least 95% of airborne particles is known as a N95 filtering facepiece

respirator, or simply a N95 respirator. It serves as an illustration of a mechanical filter respirator, which offers protection from particulates but not from gases or vapours.

The words "NIOSH" or the NIOSH emblem, as well as the filter class, are stamped on an official N95 respirator ("N95"). A tiny mesh of synthetic polymer fibres, specifically a nonwoven polypropylene fabric, is necessary for the N95 respirator. It is created by melt blowing and serves as the primary filter for dangerous particles.



Fig.8. 5 Layer Protection

**3.6 Misinformation's about Mucormycosis: [32]**

- Mucorales are not a type of dark fungi. They are many fungal species where melanin is found in the cell walls.
- Mucormycosis is not a dangerous condition. No body can catch it from another person.
- Water, humidifiers, and oxygenation do not spread micorycosis. Both the indoor and outdoor environments still contain the fungi. The respiratory system is exposed to the spores through the air.
- It is not advised to use antifungal prophylaxis because the incidence is not more than.

**IV. DISCUSSION**

Mucormycosis is an uncommon condition that almost exclusively affects patients with compromised immune systems.8 Following the COVID-19 pandemic, there has been a sharp rise in CAM cases, which suggests the possibility that COVID-19 infection is already a risk factor for mucormycosis. This may occur directly as a result of its immune system-damaging effects or indirectly as a result of COVID-19

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prevention and control measures. Even before the COVID-19 period, India had the highest prevalence of mucormycosis in the world, at nearly 70 times the average.<sup>2</sup> This disproportionate burden has been associated with the high prevalence of both patient variables (diabetes) and environmental factors (hot, humid environment).<sup>9</sup> Due to a bias in referrals for a difficult disease, CAM patients were more likely to live in rural areas to treat the conditions.

The disease reportedly struck three weeks after the onset of COVID-19 symptoms and primarily impacted the rhino-orbital regions.<sup>1</sup> Poor glycemic control, systemic steroid therapy, and the presence of diabetes all increase the risk of CAM. The Occupational Safety and Health Administration (OSHA) mandates that healthcare workers in the US wear respiratory protection, such as a N95 respirator, when performing patient activities with people who are known or suspected to be COVID-19 infected. The CDC (Centres for Disease Control and Prevention) suggests using respirators with at least N95 certification to shield the wearer from inhaling infectious particles such as *Mycobacterium tuberculosis*, avian influenza, severe acute respiratory syndrome (SARS), pandemic influenza, and Ebola virus.

## V. RESULTS AND CONCLUSION

Because with COVID-19, the entire world's population is now in risk. Lack of a specific cure for the lethal viral infection and the arrival of the second wave in India caused the situation to spiral out of control. With their limited access to medical resources, frontline health professionals and paramedical staff were unable to contain the pandemic because the infection rate was increasing everyday. The management problem during the handling of COVID-19 has been made worse by the frequent use of steroids, antibiotics, and supportive therapy (supportive oxygen and ventilators) for patients with known comorbidities such diabetes and cardiovascular problems. Patients with comorbid illnesses are more likely to get later coinfections such mucormycosis. Due to their weakened systems, people with a history of comorbidities are more likely to contract a virus that might cause a potentially fatal fungal infection. An N-95 mask or respirator provides additional protection since it fits the face securely and more effectively filters airborne germs. It filters at least 95% of airborne pollutants. The N-95 mask comes in a variety of varieties. A one with valves is widely used. There is a one-way filtering mechanism in these masks.

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