Int. J. Agriworld, Vol. 2 [2] August- 2021

Online ISSN: 2582-7537
Journal's URL:http://www.svpss.in

Received 16.06.2021 Revised 26.06.2021 Accepted 29.06.2021
REVIEW ARTICLE OPEN ACCESS

Spatial Distribution of Post Covid-19 Fungal Infection (Mucormycosis) and Influence on Human Health in India Utilizing Geospatial Technology

Jai Kumar[1]*, Binod Kumar Bharti[2] and Sakshi Walker[3]

[1]Centre for Geospatial Technologies, Vaugh Institute of Agriculture Engineering and Technology, SHUATS, Prayagraj, Uttar Pradesh, India
[2]SanjayGandhi Institute of Dairy Technology (Bihar Animal Sciences University), Patna, Bihar, India
[3]Department of Botany, St. John's College, Agra, Uttar Pradesh, India
***Corresponding Author: jaikumar0070@gmail.com**

ABSTRACT

The prevailing post Covid disease, called Mucormycosis or Black Fungus, is the most infectious disease. Mucormycosis has affected human life, socio-economic development and national relations to a great extent. It is a risk for senior citizens and people with several health issues such as cancer, diabetes, heart related problems. Mucormycosis is an angio-invasive infection caused by the Mucorales fungus. Although it is an uncommon condition, it is becoming more common among immune-compromised people. Rhino-orbitocerebral, cutaneous, disseminated, gastrointestinal, and pulmonary forms can all be found. Despite the vigorous therapy, there is an overall higher death rate. The World Health Organization (WHO) has formally declared Mucormycosis to be a public health emergency at the global level. As of 22nd May 2021, Maharashtra was found to be the most affected state in India, followed by Gujarat and Madhya Pradesh. The aim of the research is to analyze the spatial distribution and impact assessment of Mucormycosis on human health using GIS software. Geographic Information Systems (GIS) technologies have played an important role in spatial information, spatial tracking of active cases and dairy and food items. As a result, monitoring and planning using geospatial analysis is critical for controlling the spread of Mucormycosis in the country.

Keywords: Mucormycosis, Geographical Information System, Human resources, Human health

Introduction

1.1 Mucormycosis:

The fungi that causes Mucormycosis is found in the soil and in dead, decaying things such as vegetables, fruits, leaves, compost piles, rotting timbers, animal dung, and so on. fungal spores are everywhere, and it's hard to avoid coming into touch with them. However, a weakened immune system invites infection in the lungs or sinuses, which can spread to other regions of the body. Mucormycosis-causing fungi belong to the Mucorales scientific order. Mucormycosis is caused mostly by Rhizopus and Mucor species. Rhizomucor species, Syncephalastrum species, Cunninghamella bertholletie, Apophysomyces, Lichtheimia (formerly Absidia), Saksenaea, and Rhizomucor are among the others.Areas through which Mucormycosis spreads are Rhinocerebral (sinus and brain), Pulmonary (lung), Gastrointestinal, Cutaneous (skin), and Disseminated. Mucormycosis (infection that spreads through the blood stream). Only a good diagnosis of mucormycosis based on the

appearance of symptoms can lead to adequate therapy. Symptoms include headaches, nasal or sinus congestion, chest discomfort, shortness of breath, fever, blisters or ulcers, stomach discomfort, and gastrointestinal bleeding, depending on the region of infection. In the case of disseminated mucormycosis, however, determining the symptoms might be challenging because individuals are already suffering from a medical condition. Patients with brain diseases may have changes in their mental state or possibly go into a coma. Medical history, symptoms, physical examinations, and laboratory testing are all taken into consideration by healthcare professionals.

1.2 COVID-19Associated Mucormycosis

COVID-19 associated mucormycosis, or black fungus, is a kind of mucormycosis (an aggressive fungal infection) linked to COVID-19. It has been found in rhino-orbital-cerebral (ROC) mucormycosis, a disorder that affects the nose, eyes, and brain. Mucormycosis linked to COVID-19 has been reported occasionally. According to a review of the medical literature, there had been eight cases reported worldwide by January 9th, 2021. In these trials, diabetes was the most frequent risk factor for mucormycosis. (Garg et al, 2021).The bulk of the instances developed while the patients were in the hospital (typically 10–14 days after admission), and all but one of them died (Garg et al, 2021).It is assumed that starting vigorous treatment as soon as possible is crucial (Garg et al, 2021). It is believed that 40 percent to 80 percent of patients who get any kind of mucormycosis die from the disease, depending on the location of the infection and the underlying health factors. COVID-19 associated mucormycosis has been particularly prevalent in India (Biswas, Soutik 2021). While making a diagnosis. A sample of fluid from the respiratory system is taken and submitted to the laboratory for detection of mucormycosis in the lungs or sinuses. Under a microscope or in a fungal culture, a tissue biopsy can be used to look for indications of mucormycosis. Depending on the location of the suspected infection, a CT scan of the lungs, sinuses, and other regions of the body may be conducted. Mucormycosis is a dangerous infection that requires treatment with antifungal medications such as amphotericin B, posaconazole, or isavuconazole. Amphotericin B, Posaconazole and isavuconazole are administered intravenously or orally (posaconazole, isavuconazole). Fluconazole, voriconazole, and echinocandins are not effective against the fungi that cause mucormycosis. Mucormycosis frequently needs surgery to remove the diseased tissue. The country's high prevalence of COVID-19 infection and diabetes may explain why the relationship has arisen so significantly in India (Runwal 2021-05-14). In May 2021, the Indian Council of Medical Research issued guidelines for identifying and treating COVID-19 associated mucormycosis. (ICMR2021). Due to the growing number of cases, the government of Rajasthan declared an epidemic on May 19, 2021. The governments of Haryana, Tamil Nadu, Telangana, Gujarat, and Bihar, as well as the Rajasthan administration, have declared there is an epidemic.

1.3 Types of Mucormycosis

• Rhinocerebral mucormycosis (sinus and brain) mucormycosis is a sinus infection that can extend to the brain. People with uncontrolled diabetes and those who have had a kidney transplant are more likely to develop this kind of mucormycosis.

• The most prevalent kind of mucormycosis among people with cancer and those who have undergone an organ transplant or a stem cell transplant is pulmonary (lung) mucormycosis.

• Gastrointestinal mucormycosis is more frequent in young children than in adults, particularly in preterm and low-birth-weight infants under one month of age who have had antibiotics, surgery, or drugs that reduce the body's capacity to fight germs and illness (India Today 2021).

• Cutaneous mucormycosis (skin mucormycosis): happens when fungus enters the body through a skin breach (for example, after surgery, a burn, or other type of skin trauma).

This is the most prevalent kind of mucormycosis in people who don't have a compromised immune system.

• Disseminated mucormycosis develops when an infection spreads from one region of the body to another through the circulation. The infection is most usually seen in the brain, although it can also damage the spleen, heart, and skin (Runwal 2021).

1.4 Symptoms and Signs

Mucormycosis is a fungal infection that commonly affects the sinuses, brain, and lungs. While mucormycosis is most commonly associated with infections of the mouth or brain, the fungus can also infect other parts of the body, including the gastrointestinal tract, skin, and other organ systems. Mucormycosis can damage the maxilla in rare situations. Although more aggressive fungi, such as those that cause mucormycosis, may sometimes overcome this obstacle, the strong blood vascular supply of the maxillofacial region typically prevents fungal infections. Mucormycosis can be identified by a number of critical indicators. The production of blood clots and surrounding tissue death owing to a loss of blood flow is one such symptom of fungal invasion into blood vessels. If the condition affects the brain, one-sided headaches behind the eyes, facial discomfort, fever, nasal congestion that leads to black discharge and severe sinusitis with eye edema may occur.

During the early stages of infection, the affected skin may seem normal. Due to tissue loss, the skin gets reddish and possibly swells before finally turning black. Other types of mucormycosis can affect the lungs, skin, or the entire body, with symptoms such as difficulties breathing and a chronic cough. There may be nausea and vomiting, as well as coughing up blood and stomach discomfort, in situations of tissue death. Mucormycosis symptoms vary depending on where the fungus is developing in the body.

• One-sided facial swelling
• Headache
• Nasal or sinus congestion
• Black lesions on the nasal bridge or upper inside of the mouth that soon grow more serious are all symptoms of rhinocerebral (sinus and brain) mucormycosis.

Fever, cough, chest discomfort, and shortness of breath are all symptoms of pulmonary (lung) mucormycosis. Cutaneous mucormycosis appears as blisters or ulcers on the skin, and the diseased region may turn black. Pain, warmth, extreme redness, and swelling surrounding a wound are some of the other symptoms. Gastrointestinal mucormycosis symptoms include:

• Abdominal discomfort
• Nausea and vomiting
• Gastrointestinal haemorrhage

Because disseminated mucormycosis usually affects patients who are already unwell with other illnesses, determining which symptoms are attributed to mucormycosis can be challenging. Patients with a disseminated infection in the brain may experience mental status changes or comas.

1.5 Factors That Are At Risk

AIDS, uncontrolled diabetes mellitus, malignancies such as lymphomas, renal failure, organ transplants, long-term corticosteroid and immunosuppressive medication, cirrhosis, energy malnutrition, and deferoxamine medication are all risk factors for mucormycosis. Despite this, instances of mucormycosis have been documented in which no obvious risk factors have been identified. In the treatment of COVID-19, corticosteroids are typically used to minimize the harm produced by the body's own immune system during a coronavirus infection. They inhibit the immune system and raise blood sugar levels in diabetic and non-diabetic people. Both of these effects are considered to have a role in mucormycosis patients. Because swabs of tissue or discharge are frequently inaccurate, mucormycosis is usually diagnosed with a biopsy specimen of the affected tissue. If mucormycosis is detected, amphotericin B medication should be started immediately, since the disease spreads quickly and has a high death rate. Amphotericin B is frequently

given for another 4–6 weeks following the initial treatment to guarantee complete eradication of the infection. The FDA has authorized avuconazole for the treatment of invasive aspergillosis and invasive mucormycosis. Surgical excision of the "fungus ball" is recommended after treatment with amphotericin B or posaconazole. Any indicators of the reemergence of the illness must be closely watched. The eyes, nose, skin, and lungs are frequently affected by this condition. This fungus can be deadly, especially if it spreads to the brain and kills the sufferer. If it affects the eye, the only way to stop it from spreading to the brain is to remove the eye.(India Today 2021).Surgical treatment can be extreme, and in severe cases of illness affecting the nasal cavity and the brain, infected brain tissue may need to be removed. Surgery that involves the removal of the palate, nasal cavity, or eye structures can be disfiguring in some situations. Surgery can be expanded to include many procedures. It's been proposed that hyperbaric oxygen might be useful as a supplementary treatment since increased oxygen pressure boosts neutrophils' capacity to destroy fungus. Prognosis Mucormycosis has a poor prognosis in most cases, though fatalities are uncommon.

Rates vary depending on the disease's type and severity. The death rate for rhinocerebral mucormycosis is between 30% and 70%, but disseminated mucormycosis has the greatest death rate in otherwise healthy patients, with a death rate of up to 90%.Patients with AIDS have a near-100 percent death rate. Partially lost neurological function, blindness, and clotting of brain or lung arteries are all possible consequences of mucormycosis. (ICMR2021).

1.6 Epidemiology

Mucormycosis is a fairly rare condition. It's difficult to keep track of case histories and infection rates. However, mucormycosis was discovered in 0.7 percent of autopsies and around 20 patients per 100,000 admissions to one American cancer facility. Mucormycosis is most usually diagnosed as the rhinocerebral type in the United States, virtually invariably accompanied by hyperglycemia and metabolic acidosis (e.g. DKA). Although the patient is normally immune compromised, there have been isolated cases where the subject is not; these are usually the result of a traumatic injection of fungal spores. Mucormycosis was discovered in 1% of individuals with acute leukaemia in an Italian study. In the United States, not every hospital is compelled to make information about infectious epidemics public. After television and media stories in response to a publication in a paediatric medical magazine in 2014, information about a deadly mucormycosis outbreak that happened in 2008 became public. The virus was discovered to be spread through contaminated hospital bedding. According to a 2018 study, many newly cleaned hospital linens shipped to transplant facilities in the United States were infected with Mucorales.

Study Area

India is part of Asia, the world's biggest continent, and is located in the southern half of the continent. India's latitude ranges from 8° 4' to 37° 6' N, and its longitude ranges from 68° 7' to 97° 25' E. It covers an area of 3287263 sq. km in total. It is surrounded by three oceans: the Bay of Bengal to the east, the Indian Ocean to the south, and the Arabian Sea to the west, as well as nations such as Myanmar, Nepal, Bhutan, Bangladesh, and Pakistan. India's capital is New Delhi. According to population estimates, India is the world's second most populous country, after China. There are 28 states and 8 union territories in the United States. Apart from being the world's most democratic country, it relies on agriculture and a number of industries, including iron and steel (Kumar et al, 2021).

Methodology

This study looked at research publications on geographic distribution and the influence of Mucormycosis on India's human resources. Mucormycosis concerns an excluded region. Mucormycosis is a state of India that deals with

cardiovascular disease, health concerns, and preventative services. The use of GIS and spatial analytic methodologies on monthly Mucormycosis active cases following COVID-19 to achieve a range of development activities by Indian states. Research publications that use GIS 10.4 Software as a speciality or that use it to implement any geospatial analytic techniques (Kumar et al, 2021; Kawo and Shankar 2018).The data used in this study The Mucormycosis illness in India from January to May 22, 2021 was received from the Indian Ministry of Health. The geographic distribution pattern of illness and human resources affected by Mucormycosis is being studied in this study. Geospatial methods such as Inverse Distance Weighted (IDW) and Kriging interpolation techniques are employed to anticipate active cases. The Inverse Distance Weighted IDW algorithm estimates or predicts the value of a known area (Shankar and Kawo 2019). Its key ramifications are as follows: First, the impact of a location point's space is well understood value is extended to point values that are near to the point in a particular range.

Second, the influence of the extended zone is proportional to the inverse of the distance between the spots. The equation for the geographical analysis is as follows (Balamurugan et al, 2020; Childs2004).

$$Z_p = \frac{\sum_{i=1}^{n}\left(\frac{z_i}{d_i^p}\right)}{\sum_{i=1}^{n}\left(\frac{1}{d_i^p}\right)}$$

Where,

1. Zp= interpolated value of the unknown point.
2. The weighting function which controls the significance of the control point Zi is the value observed at the control point ―i‖ which represents the nearest neighborhood of the interpolated point produced and ranges from 10 to 28.
3. "n"‖ is the nearest vicinity of the control points which is usually required to consume time, dip refers to the interpolated point.
4. "p"‖ is a weighting absolute value, where, p = 1 in inverse distance weighting.

Impact of Mucormycosis active cases Post COVID-19 on human resources which is one of the powerful resources of economy of every nation.

Results and Discussion

India has so far registered 8,848 instances of mucormycosis, according to the Union Minister of Chemicals and Fertilizers. Mucormycosis, often known as black fungus, is a fungal illness that has a 50% death rate. Gujarat was first on the list of states with the most mucormycosis cases. Gujarat has reported 2,281 instances of mucormycosis so far, according to Sadanad Gowada's numbers. Mucormycosis, a COVID-19-triggered fungal infection, was discovered in six patients at a Delhi hospital; learn more about this serious disease with a 50% mortality rate. With 2000 instances, Maharashtra has the second-highest number of black fungus cases. Mucormycosis cases in three figures were recorded in Delhi, Andhra Pradesh, Madhya Pradesh, Rajasthan, Uttar Pradesh, Haryana, and Telangana. The following is a list of states with the highest number of mucormycosis case

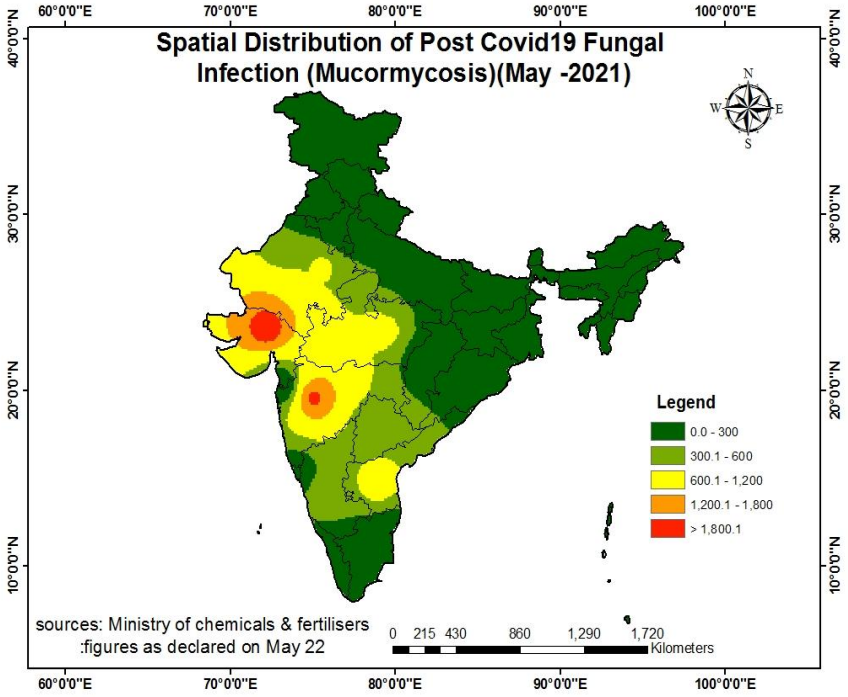

Table: List of States with Number of Mucormycosis Cases

State	No of Mucormycosis Cases
Maharashtra	2000
Gujarat	2281
Telangana	350
Madhya Pradesh	720
Karnataka	500
Delhi	197
Haryana	250
Uttar Pradesh	112
Rajasthan	700
Chhattisgarh	87
Bihar	56
Uttarakhand	2
Jharkhand	27
Odisha	15
Tamil Nadu	40
Kerala	36
Goa	12
West Bengal	1
Punjab	95
Assam	0

Himachal Pradesh	0
Mizoram	0
Nagaland	0
Puducherry	0
Ladakh	0
Sikkim	0
Jammu and Kashmir	0
Andaman and Nicobar	0
Daman and Diu, Dadra and Nagar Haveli	0
Arunachal Pradesh	0
Manipur	0
Meghalaya	0
Tripura	1
Lakshadweep	0
Andhra Pradesh	910
Chandigarh	8

Sources: Ministry of chemicals & Fertilizers: figures as declared on May 22, 2021

Due to the rising number of black fungus cases, distribution of Amphotericin- B vials, a vital the central government has prioritized the medicine for treating raging mucormycosis. He declared that states will get an additional 23,680 vials of Amphotericin-B.

Dairy and food safety precautions in Mucormycosis

Throughout the epidemic, the World Health Organization (WHO), the United Kingdom's National Health Service (NHS), and India's Ministry of Health and Family Welfare (MoHFW) have issued several dietary guidelines. A suitable recovery diet for COVID-19 patients should contain the following types of nutrients, based on all of these requirements.

Calories: Because the human body has been depleted of energy, calorie-dense foods are required to restore energy levels. Include rice, potatoes, bread, pasta, whole grains, and cereals in diet, but stay away from meals that are high in empty calories, such as fast food.

Protein: Without these life-giving building blocks, the human body won't be able to start feeling better. Therefore, consume more protein-rich meals to receive 75-100g of this nutrient each day. Incorporate as many whole grains, lentils, legumes, dairy, soy, nuts, and seeds as possible into the human diet. If human are not a vegetarian, make sure to eat lots of chicken, eggs, and fish. Fresh fruits and vegetables are excellent providers of dietary fibre, folate, vitamins, minerals, and antioxidants. Incorporate apples and bananas into the human diet, as well as gourds and green leafy vegetables.

Immune-boosters: Fruits, vegetables, herbs, and some spices are high in phytochemicals and bioactive substances, which help to improve the immune system. Include them in human diet, as well as immune-boosting herbal beverages such as in kadha, turmeric milk, green tea, herbal tea, and others.

Fluids: Infections can cause dehydration, so it's critical to be hydrated while recuperating. Include broths, soups, and other beverages in your daily diet, and drink 8-10 glasses of water per day. Things to Keep in Mind When It Comes to the Recovery Diet Apart from including all of these vital meals and beverages in your recovery diet, remember the following to make it more effective: Fresh produce, such as fruits, vegetables, and animal products, should be prioritised above pre-packaged foods. Instead of depending on fast food, make sure all of human body meals are simple and

freshly prepared at home. While preparing the meals, make sure that all hygienic procedures are followed to the letter. Hands should be washed before and after handling or eating. It may be difficult to eat large quantities during the early stages of recovery from COVID-19infection, so eat smaller, more frequent meals.

Conclusion

This research utilized geospatial technology to visualise the geographic spread of the Post COVID-19Fungal Infection (Mucormycosis) in India. From January to May 2021, the major goal was to assess the active instances of Post COVID-19Fungal Infection (Mucormycosis) across various state distribution assessments. By the end of May, it had been determined that Maharashtra, Gujarat, and Madhya Pradesh were the states most impacted by the Post COVID-19 Fungal Infection (Mucormycosis). Since May 22, 2021, the sickness has been spreading at a rapid rate, according to the IDW technique interpolation data. An attempt has been made to assist the organisations involved in the Post COVID-19Fungal Infection (Mucormycosis) effort in order to facilitate proper planning, prevention, and treatment. Aside from that, the importance of necessary nutrients and nutrients in the formation of immunity capable of combating such illnesses has been noted. The government should use the spatial distribution of the Post COVID-19Fungal Infection (Mucormycosis) analysis to supervise and forecast the vast further spread of the Post COVID-19Fungal Infection (Mucormycosis) in the most affected regions and adjacent regions, as well as to prevent lethal infection.

Acknowledgements

The authors are grateful to all of the data providers, including the Minister of Chemicals and Fertilizers of India, the World Health Organization, and the Centers for Disease Control and Prevention, for supplying us with useful Mucormycetes data that aided our research.

References

Adama Town, Oromia Region, Shankar K. and Kawo N.S.(2019)―Groundwater Ethiopial, Hydrospatial quality assessment using geospatial Analysis.2019;3(1):22-36. 11.

Balamurugan. P, Kumar P.S, Shankar K. (2020) ―Dataset on the suitability of groundwater for drinking and irrigation purposes in the Sarabanga River region, Tamil Nadu, India‖, Data in brief.

Bartier P.M, Keller C.P.(1996)―Multivariate interpolation to incorporate thematic surface data using inverse distance weighting (IDW)‖, Computers and Geosciences.22(7):795-799.

Biswas Soutik (2021). "Mucormycosis: The 'black fungus' maiming Covid patients in India". BBC News.

Black Fungus: Symptoms, (2021) IIMS & ICMR Guidelines PDF for Mucormycosis". S ANEWS.

Childs C. (2004) ―Interpolating surfaces in ArcGIS spatial analyst‖, ArcUser.

Cornely O.A., Alastruey-Izquierdo A., Arenz D., et al. (2021). "Global guideline for thediagnosis and management of mucormycosis: an initiative of the European Confederation of Medical Mycology in cooperation with the Mycoses Study Group Education and Research Consortium" (PDF). The Lancet. Infectious Diseases. 19 (12): e405–e421. doi:10.1016/S1473-3099(19)30312-3. PMID 31699664.

Delhi/Jaipur/Lucknow May 19 (2021), Dev Ankur Wadhawan Pankaj Jain Samarth Shrivastava Kumar Kunal New; May 19, 2021UPDATED; Ist, 2021 17:51. "Rajasthan declares black fungus an epidemic; cases pile up in several states | 10 points". *India Today. Retrieved* 2021-05-20.

Garg D., Muthu V., Sehgal I.S., Ramachandran R., Kaur H., Bhalla A., Puri G.D., Chakrabarti A. and Agarwal R. (2021). "Coronavirus Disease (Covid-19) Associated Mucormycosis (CAM): Case report and systematic review of literature". Mycopathologia. 186 (2): 289–298. doi:10.1007/s11046-021- 00528-2(inactive 2021-05-23). PMC 7862973. PMID 33544266.

Huang F.,Liu D.,TanX.,WangJ.,Chen Y., He B., et al.,(2011)―Explorations of the implementation of a parallel IDW interpolation algorithm in a Linux cluster-based parallel GIS‖, Computers and Geosciences.37(4):426-434.

Kawo N.S. and Shankar K. (2018)―Groundwater quality assessment using water quality index

and GIS technique in Modjo River Basin, Central Ethiopia‖, *Journal of African Earth Sciences*. 147:300-311.

Kumar, J. Sahoo S., Bharti B.K. and Walker S. (2021). Spatial distribution and impact assessment of Covid- 19 on human health using geospatial technologies in India. *International Journal of Multidisciplinary Research and Development*, 7(5), 57-64.

Runwal Priyanka (2021). "A rare black fungus is infecting many of India's COVID-19patients—why?" National Geographic.

Russia Confirms Rare, (2021) Deadly 'Black Fungus' Infections Seen in India". The Moscow Times.

Sen M. Honavar S.G. Sharma N. and Sachdev M.S. (2021). "COVID-19and Eye: A review of ophthalmic manifestations of COVID-19". *Indian Journal of Ophthalmology*. 69 (3): 488–509. doi:10.4103/ijo.IJO_297_21. Techniques and WQI in North East of PMC 7942063. PMID 33595463.

CITATION OF THIS ARTICLE

Kumar, J[1]*, Bharti, B.K.[2] and Walker, S.[3].(2021), spatial distribution of post covid-19fungal infection (mucormycosis) and influence on human health in India utilizing geospatial technology, *Int. J. Agriworld*, 2 [2]: 1-9.