

Social Determinants of Health Driving the Risk for Aspergillosis and Mucormycosis



11th Advances Against Aspergillosis and Mucormycosis Conference

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DukeHealth



Disclosures

- I have received grant funding from Astellas, F2G, and Pfizer – all unrelated to this talk



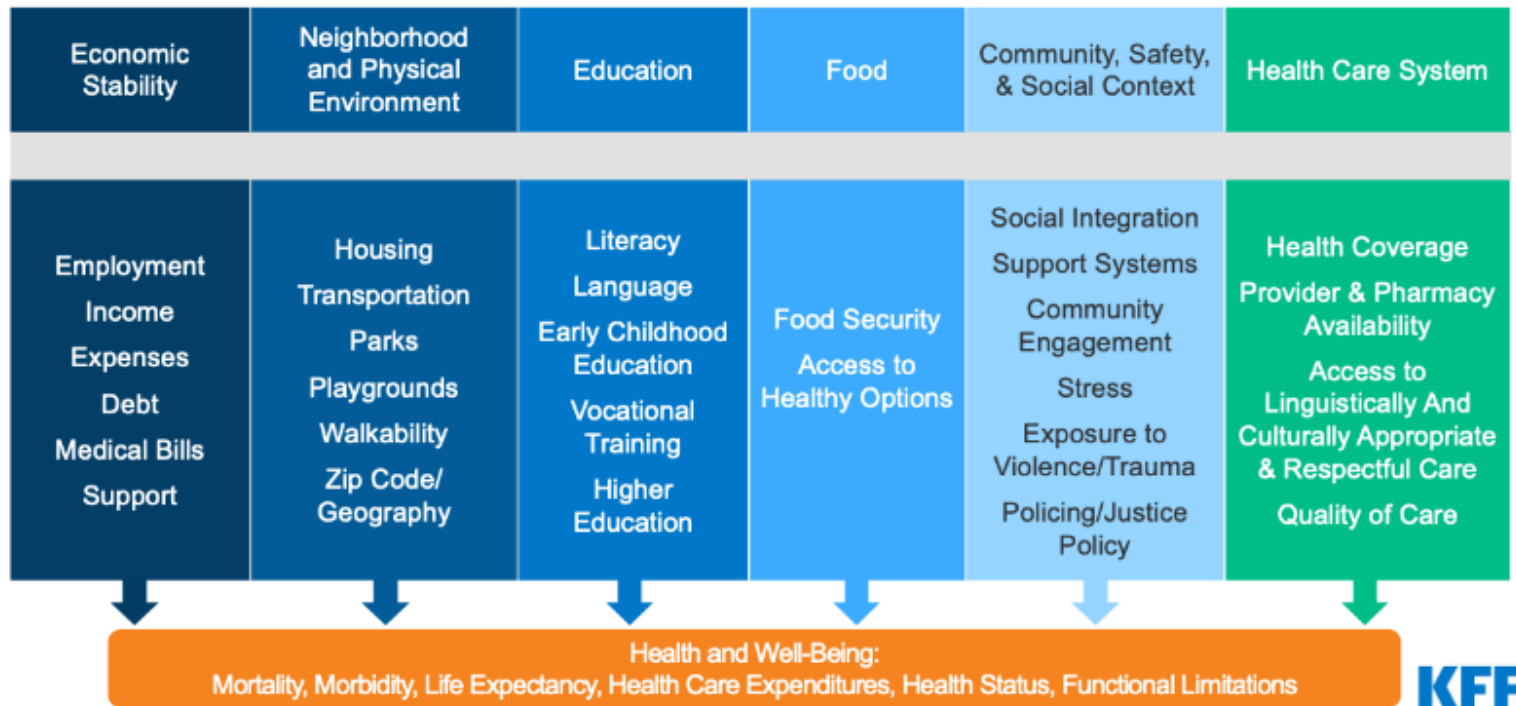
Contents

- Brief Introduction to SDOH
- SDOH and Aspergillosis
- SDOH and Mucormycosis
- Conclusion and Unanswered Questions



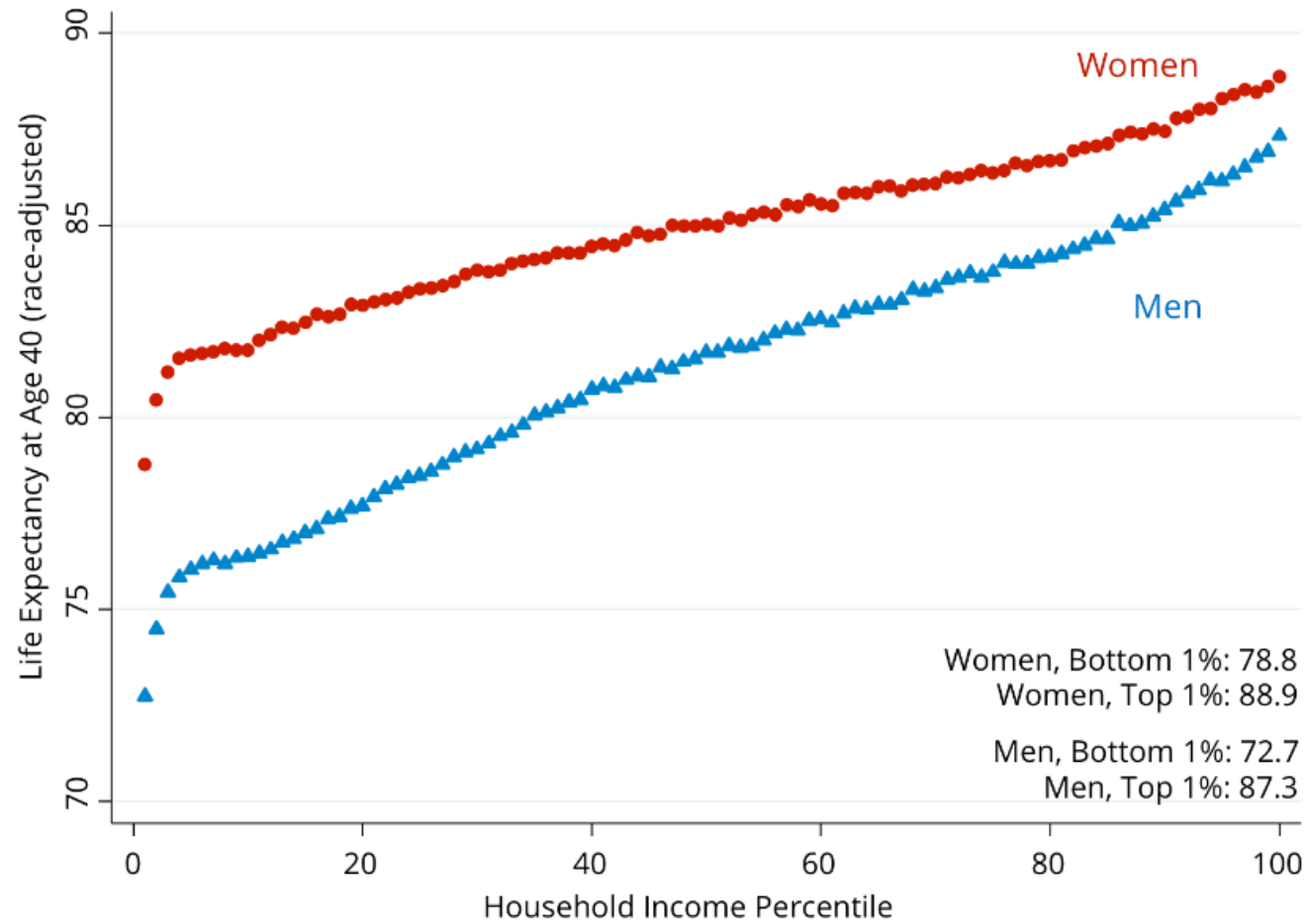
What are Social Determinants of Health?

Social Determinants of Health





Life Expectancy vs. Income in the United States

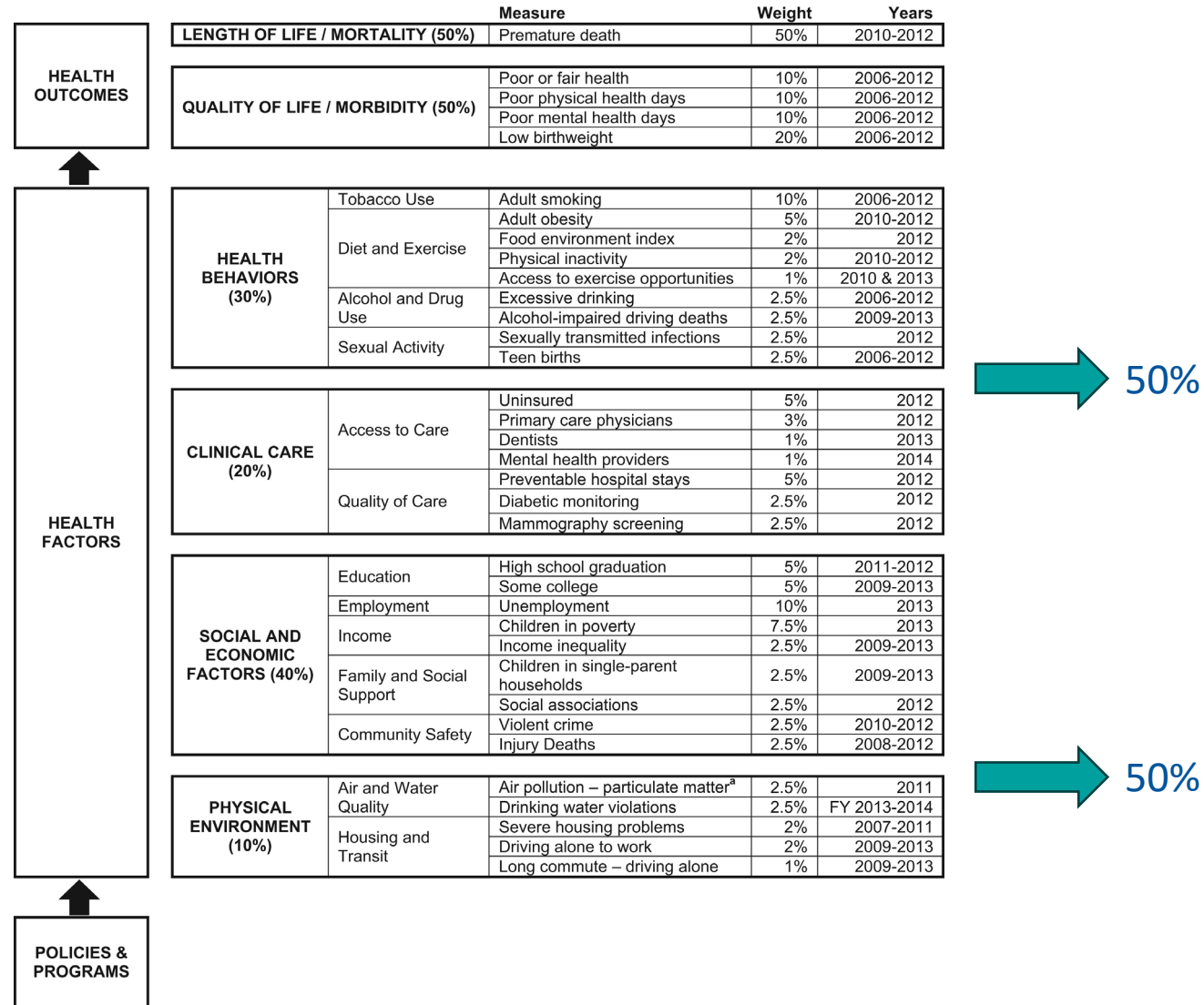




Education levels and life expectancy

Gap in life expectancy at age 30 between highest and lowest education level, 2015 (or nearest year)







Do SDOH Impact Risk for Fungal Infections?

- Yes, but there are caveats
 - This topic is poorly-researched – often only case studies or case series published
 - This data is not captured on a systematic level
 - We're not used to thinking of SDOH as risk factors so don't often ask the right questions
 - Very little data on this association in low-resource settings



How do SDOH Drive Risk for Aspergillosis?



Occupational Risk and Aspergillosis

MYCOSES **44**, 141–145 (2001)

ACCEPTED: OCTOBER 20, 1999

Sinocranial aspergillosis: a form of central nervous system aspergillosis in South India

Sinokraniale Aspergillose: Eine Form der ZNS-Aspergillose in Südindien

J. M. K. Murthy¹, C. Sundaram², V. S. S. V. Prasad³, A. K. Purohit³, S. Rammurti⁴ and V. Laxmi⁵

Key words. Aspergillosis, sinocranial infection, granuloma, India.

Schlüsselwörter. Aspergillose, sinokraniale Infektion, Granulom, Indien.



Occupational Risk and Aspergillosis

142 J. M. K. MURTHY ET AL.

Table 1. Presenting clinical features and predisposing factors

Occupation	Predisposing factors	Presenting clinical syndromes conditions
Agricultural workers 12 Manual workers 4	Diabetes 2	Proptosis with limitation of eye movements 2 Orbital apex syndrome 3 Cavernous sinus syndrome 4 Polyneuritis cranialis 5 Intracranial mass lesion 2



Occupational Risk and Aspergillosis

Thorax 1989;**44**:678–679

Locally invasive pulmonary aspergillosis occurring in a gardener: an occupational hazard?

J A ZUK, D KING, H D ZAKHOUR, J C DELANEY

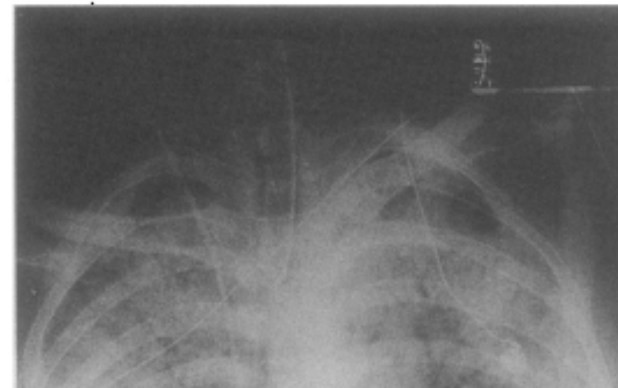
From the Departments of Histopathology and Medicine, Arrowe Park Hospital, Upton, Merseyside

ABSTRACT Fatal locally invasive pulmonary aspergillosis occurred in a previously fit young patient who had no predisposing factors other than exposure to fungal spores in his occupation as a gardener.

Invasive pulmonary aspergillosis is uncommon, usually occurring in immunocompromised patients or in those with abnormal lungs. We describe a fatal case occurring in a previously fit young man.

Case report

A 34 year old man was admitted as an emergency with a five





Occupational Risk and Aspergillosis

TABLE 3. Epidemiological characteristics of major fungal eye infections

Disease	Fungus	Patient characteristic(s)
Endogenous endophthalmitis	<i>Candida</i>	Intravenous catheters, broad-spectrum antibiotics, neutropenia, intravenous drug abuser
	<i>Aspergillus</i>	Intravenous drug abuser, corticosteroid use for lung disease, immunocompromised persons
	<i>H. capsulatum</i> , <i>B. dermatiditis</i> , <i>C. immitis</i>	Residence in areas of endemicity
Exogenous endophthalmitis	<i>Candida</i> , <i>Paecilomyces</i>	Postoperative infection after lens removal, lens implantation, or corneal transplant
Keratitis	Filamentous fungi, <i>Fusarium</i> ,	Vegetable matter introduced into the cornea by trauma
	<i>Aspergillus</i>	
	<i>Candida</i>	Superimposed infection on an abnormal cornea, e.g., chronic corneal ulceration; prolonged use of topical corticosteroids or anesthetics



Physical Environment and Aspergillosis

Arch. Dis. Childh., 1966, **41**, 34.

Fatal Acute Pulmonary Aspergillosis in Two Children of One Family

M. K. STRELLING, K. RHANEY, D. A. R. SIMMONS, and J. THOMSON

From the Royal Infirmary, Dundee, and the Departments of Child Health and of Bacteriology, Queen's College, University of St. Andrews

Invasive pulmonary aspergillosis is uncommon in man and is rare as a cause of death in children. When diffuse pulmonary infection with aspergillus has developed it has nearly always complicated a pre-existing disorder, either of the lungs themselves or one of a more generalized nature (Symmers, 1964). We present, therefore, an account of fatal pulmonary aspergillosis affecting a child and her infant sister, who had both previously been in normal health. The bacteriological investigation of the infected tissues and of the children's environment is also described.

Initial treatment was with penicillin (500,000 units i.m. 12-hourly) and sulphadimidine (5 g. over 6 days); the next day, methicillin (15 g. i.m. over 5 days) was substituted for penicillin, but no response was observed, so erythromycin (6 g. over six days), cloxacillin (3 g. over 3 days), and on the last day, a combination of tetracycline and nystatin ('Mysteclin', Squibb and Co.) were used empirically.

The child's clinical condition did not improve and her respiration remained rapid, fluctuating between 60 and 100/minute. Fever, however, was slight, the highest temperature recorded being 100° F. (37·8° C.). She finally collapsed and died with a bilateral spontaneous pneumothorax on the 14th day of her illness.



Income and Aspergillosis



[Emerg Infect Dis.](#) 2022 Oct; 28(10): 1955–1969.

doi: [10.3201/eid2810.220391](https://doi.org/10.3201/eid2810.220391)

PMCID: [PMC9514344](#)

PMID: [36149028](#)

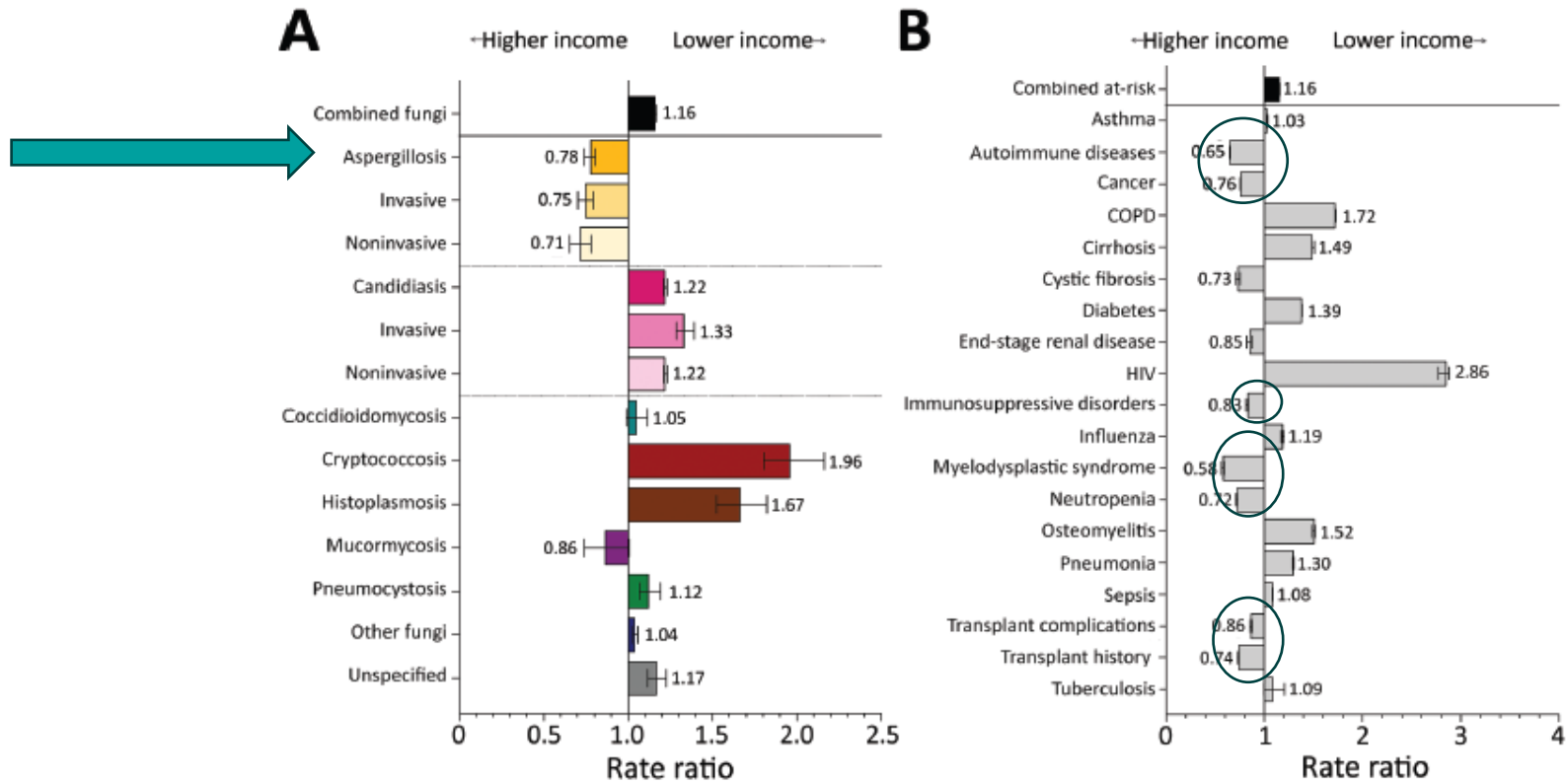
Demographic and Socioeconomic Factors Associated with Fungal Infection Risk, United States, 2019

[Emily Rayens](#), [Mary Kay Rayens](#), and [Karen A. Norris](#)

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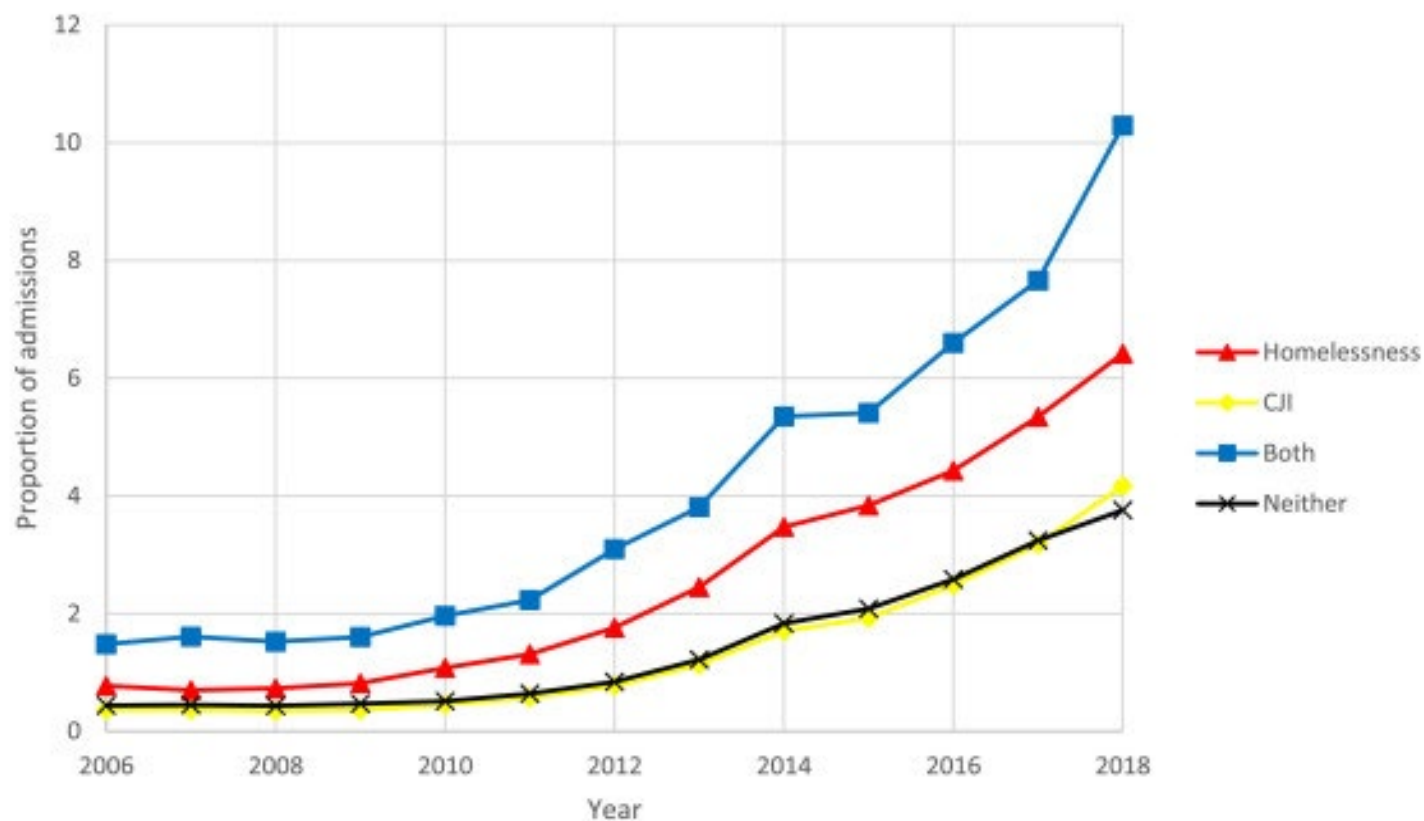


Income and Aspergillosis





Substance Use and Aspergillosis





Substance Use and Aspergillosis

Fungal Endocarditis

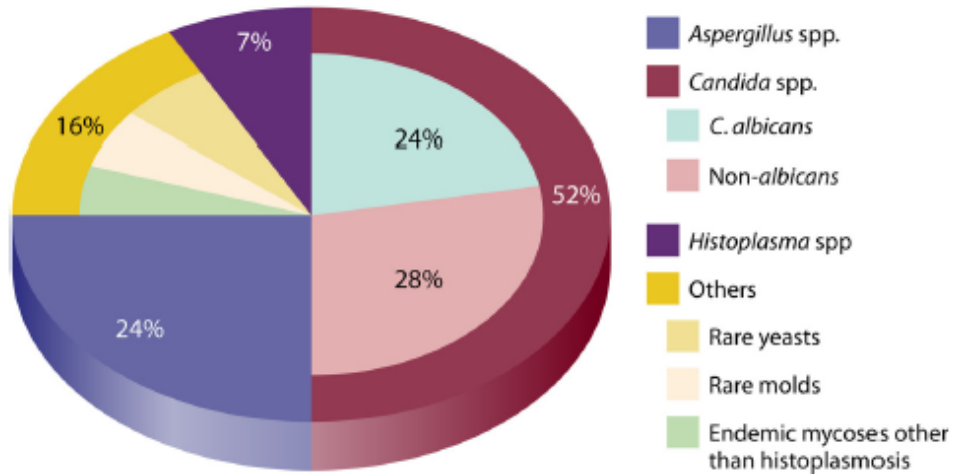
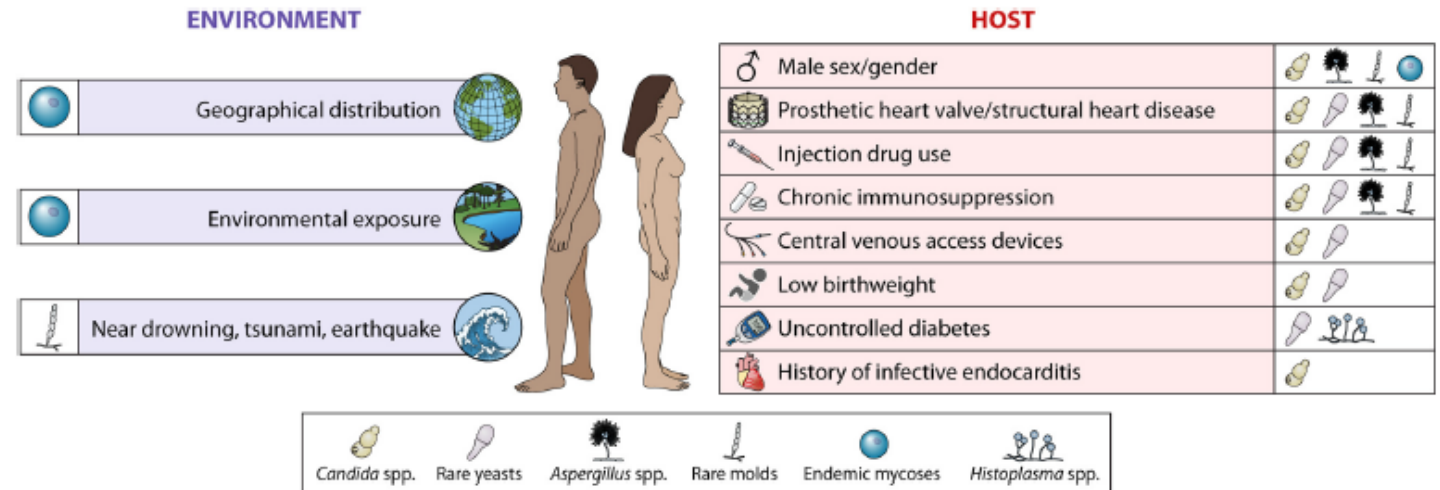


FIG 1 Causative pathogens of fungal endocarditis.





Substance Use and Aspergillosis

Case reports have identified invasive fungal diseases in persons who use cannabis, and fungal contamination of cannabis has been described. In a large health insurance claims database, persons who used cannabis were 3.5 (95% CI 2.6–4.8) times more likely than persons who did not use cannabis to have a fungal infection in 2016.

E-cigarette or Vaping Product Use-Associated Lung Injury Complicated by Pulmonary Aspergillosis

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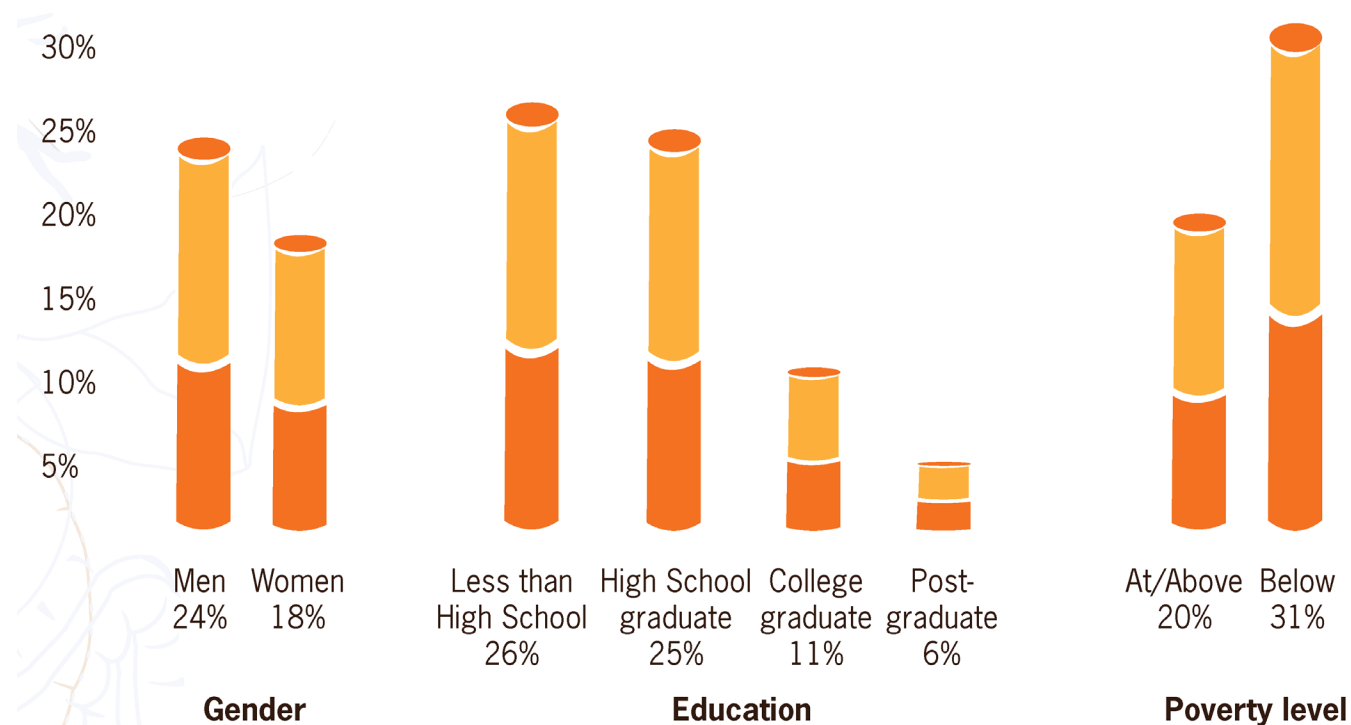
Abstract

Since the initial reports regarding the nationwide outbreak of e-cigarette or vaping product use-associated lung injury (EVALI) in August 2019 by the Centers for Disease Control and Prevention, a clear link has been established between EVALI and tetrahydrocannabinol (THC)-containing product use. We report a case of invasive pulmonary aspergillosis (IPA) as a complication of EVALI in an immunocompetent adolescent that resulted in a fatal outcome. We encourage physicians that are considering the diagnosis of EVALI be cognizant of the increased use of THC and other potential contaminants in vaping cartridges. IPA can be a fatal disease and early aggressive treatment is necessary.



Substance Use and Aspergillosis

Current smoking percentages by group





Combat and Aspergillosis

ORIGINAL ARTICLE

SUBSCRIBED

Early Complications and Outcomes in Combat Injury-Related Invasive Fungal Wound Infections: A Case-Control Analysis

Lewandowski, Louis R. MD; Weintrob, Amy C. MD; Tribble, David R. MD, DrPH; Rodriguez, Carlos J. DO; Petfield, Joseph MD; Lloyd, Bradley A. DO; Murray, Clinton K. MD; Stinner, Daniel MD; Aggarwal, Deepak MSE, MSPH; Shaikh, Faraz MS; Potter, Benjamin K. MD [Author Information](#) ▾

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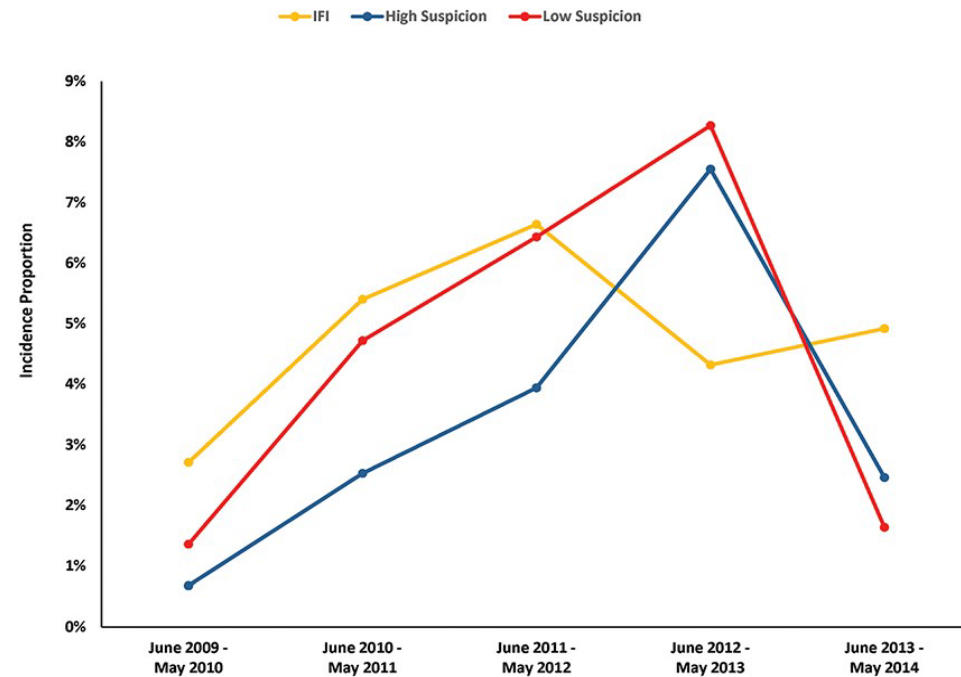
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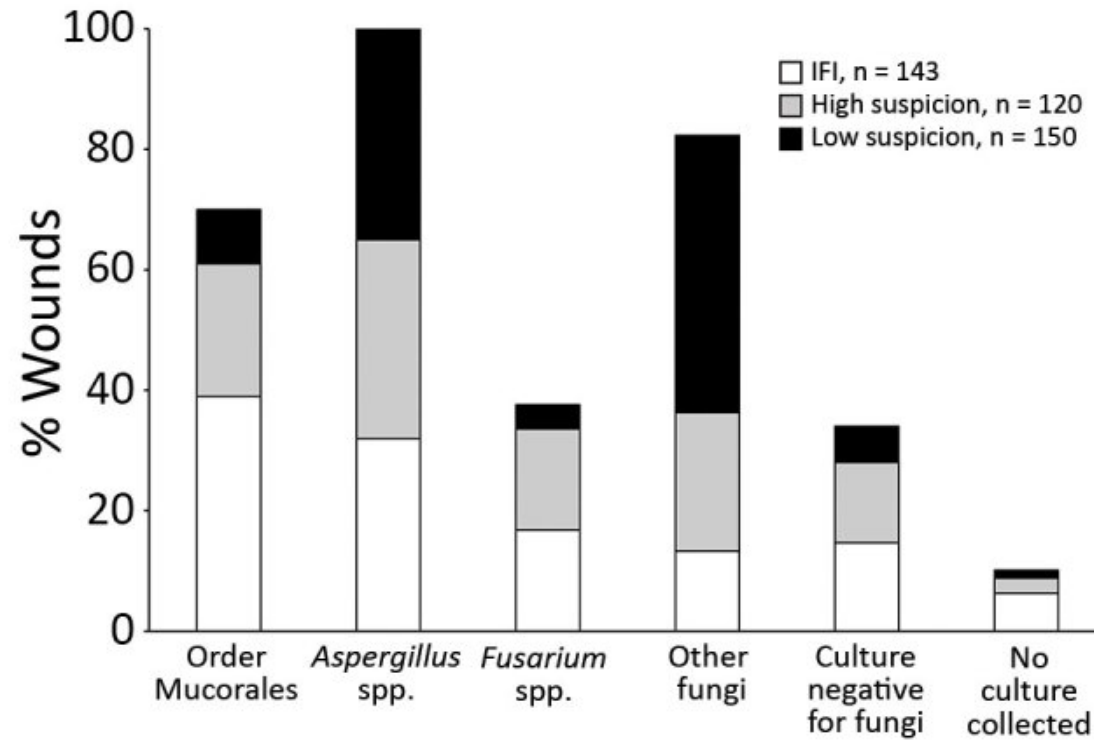
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Combat and Aspergillosis





How do SDOH Drive Risk for Mucormycosis?



Occupational Risk and Mucormycosis

He et al. *BMC Pulm Med* (2021) 21:138
<https://doi.org/10.1186/s12890-021-01504-8>

BMC Pulmonary Medicine

CASE REPORT

Open Access

Isolated pulmonary mucormycosis in an immunocompetent patient: a case report and systematic review of the literature



Jianhan He^{1†}, Gaohong Sheng^{2†}, Huihui Yue¹, Fengqin Zhang¹ and Hui-Lan Zhang^{1*} 

Abstract

Background: Pulmonary mucormycosis caused by Mucorales is a highly lethal invasive fungal infection usually found in immunocompromised patients. Isolated pulmonary mucormycosis in immunocompetent patients is very rare. Here, we present a case of a 32-year-old male who developed pulmonary mucormycosis without any known immunodeficiency.

Case presentation: The patient presented to our hospital because of cough and chest pain along with blood in the sputum. He was first treated for community-acquired pneumonia until bronchoalveolar lavage fluid culture confirmed the growth of *Absidia*. His symptoms were relieved with the use of amphotericin B, and he eventually recovered. We also provide a systematic review of relevant literature to summarize the characteristics of pulmonary mucormycosis in immunocompetent patients.

Conclusions: Pulmonary mucormycosis has variable clinical presentations and is difficult to identify. Due to its high fatality rate, clinicians should make judgements regarding suspected cases correctly and in a timely manner to avoid misdiagnosis and delayed treatment.

Keywords: Pulmonary mucormycosis, Immunocompetent host, Systematic review, Case report



Occupational Risk and Mucormycosis

A. R. Costa et al.: Mucormycosis due to *Mucor hiemalis*

mycoses 33 (5) 241-246

accepted/angenommen: April 25, 1990

CASE REPORT

Subcutaneous mucormycosis caused by *Mucor hiemalis* Wehmer f. *luteus* (Linnemann) Schipper 1973

Subkutane Mucormykose durch *Mucor hiemalis* Wehmer f. *luteus* (Linnemann) Schipper 1973

A. R. Costa¹, E. Porto², M. Tayah¹, N. Y. S. Valente¹, C. da Silva Lacaz², W. M. Maranhão¹, and M. C. Rodrigues³

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Key words. *Mucor hiemalis* forma *luteus*, mucormycosis.

Schlüsselwörter. *Mucor hiemalis* forma *luteus*, Mucormykose.

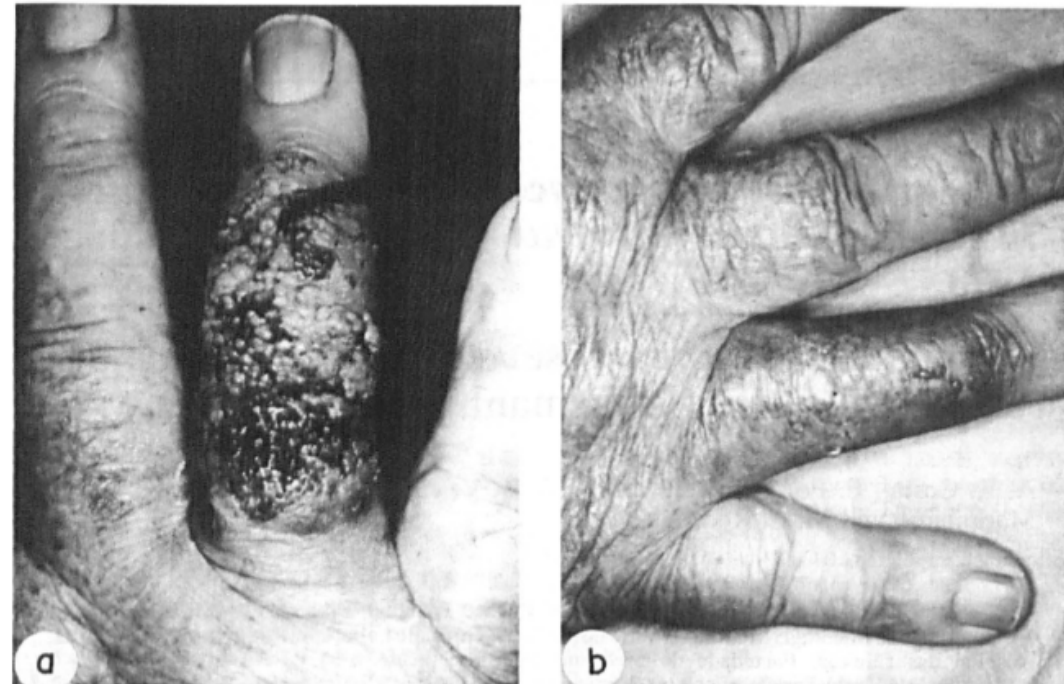


Figure 1. (a) Subcutaneous mucormycosis with verrucous lesions in the fourth finger of the right hand, caused by *Mucor hiemalis* f. *luteus*. (b) Healed lesion after 5 months of treatment with potassium iodide.



Housing and Mucormycosis

frontiers | Frontiers in Cellular and Infection Microbiology

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SPECIALTY SECTION
This article was submitted to
Fungal Pathogenesis,
a section of the journal

Evaluation of environmental Mucorales contamination in and around the residence of COVID-19-associated mucormycosis patients

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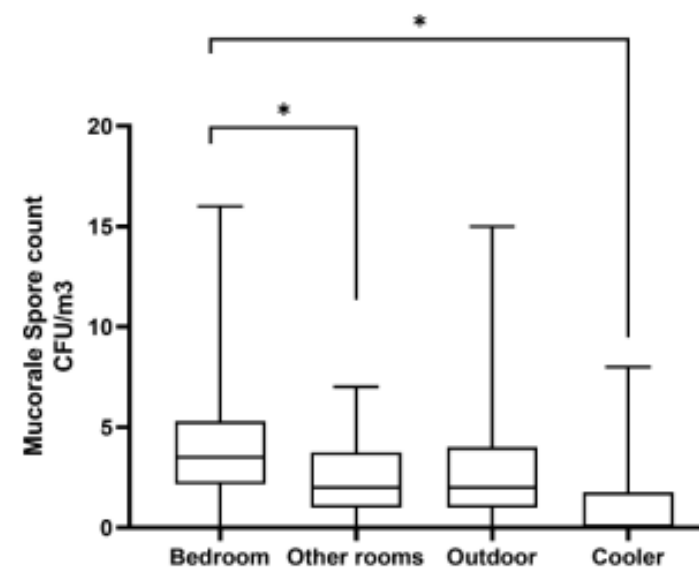


FIGURE 2
Comparison of Mucorales spore counts based on samples from the air of the residential environment. *p-value <0.05.



Health Care Access and Mucormycosis

Independent predictors	Odds Ratio	95% confidence interval	p-value
Analysis 1, including all CAM patients			
<i>Associated with higher risk of CAM</i>			
COVID-19 severity			
Mild or moderate	Reference		.004
Severe	4.09	1.42 to 15.45	
Cancer (any malignancy)	5.98	1.79 to infinite	.012
Previously or newly diagnosed diabetes mellitus	8.26	4.08 to 59.63	<.001
<i>Associated with lower risk of CAM</i>			
Supplemental oxygen	0.13	0.02 to 0.42	<.001
Remdesivir	0.40	0.12 to 0.97	.039
ICU admission for COVID-19	0.41	0.16 to 0.93	.030
Analysis 2, including only CAM patients with moderate and severe COVID-19			
<i>Associated with higher risk of CAM</i>			
Previously or newly diagnosed diabetes mellitus	5.67	2.16 to 37.36	<.001
Cancer (any malignancy)	5.68	1.91 to infinite	.006
<i>Associated with lower risk of CAM</i>			
Supplemental oxygen	0.17	0.02 to 0.53	<.001

TABLE 3 Multivariate comparison of patients with CAM and controls

Note: Boldface highlights the statistically significant p values.



Substance Use and Mucormycosis

Open Forum Infectious Diseases

MAJOR ARTICLE



Isolated Cerebral Mucormycosis in Immunocompetent Adults who Inject Drugs: Case Reports and Systematic Review of the Literature

Eric A. Meyerowitz,^{1,4} Sarimer Sanchez,¹ Michael K. Mansour,^{1,2} Virginia A. Triant,^{1,2,3,4} and Marcia B. Goldberg^{1,2,5,6}

¹Division of Infectious Diseases, Department of Medicine, Massachusetts General Hospital, Boston, Massachusetts, USA, ²Harvard Medical School, Boston, Massachusetts, USA, ³Division of General Internal Medicine, Massachusetts General Hospital, Boston, Massachusetts, USA, ⁴Mongan Institute, Massachusetts General Hospital, Boston, Massachusetts, USA, and ⁵Department of Microbiology, Harvard Medical School, Boston, Massachusetts, USA

Background. Mucormycosis involves life-threatening rapidly progressive angioinvasion with infiltration across tissue planes, resulting in necrosis and thrombosis, most commonly seen in the setting of immunocompromised states. We describe 2 cases of isolated cerebral mucormycosis in immunocompetent adults and describe this syndrome in detail in the context of a systematic literature review.

Methods. Using the criteria (1) isolated cerebral disease, (2) mucormycosis (by polymerase chain reaction, culture, or pathology), and (3) affected an immunocompetent individual, we identified 53 additional cases from 1969 to 2020.

Results. Of these 55 cases, ~60% occurred in men, >70% were in patients under age 35, 92% were associated with intravenous drug use, and >85% had infection centered in the basal ganglia. Many presented with cranial nerve deficits, headache, focal weakness, or altered mental status.

Conclusions. No patient survived without amphotericin, and steroid administration was associated with worse outcomes. Given the current opioid crisis, this syndrome may be seen more frequently.

Keywords. basal ganglia abscess; isolated cerebral mucormycosis; IVDU.

Meyerowitz EA, et al. Open Forum Infect Dis. 2020

Hazama A, et al. World Neurosurg. 2017

Woods KF and Hanna BJ. Am J Med. 1986.

CASE REPORT



Affinity of Mucormycosis for Basal Ganglia in Intravenous Drug Users: Case Illustration and Review of Literature

Ali Hazama¹, Michael Galgano¹, Joseph Fullmer², Walter Hall¹, Lawrence Chin¹

Brain Stem Mucormycosis in a Narcotic Addict with Eventual Recovery

KRISTY FREEMAN WOODS, M.D., MPH*

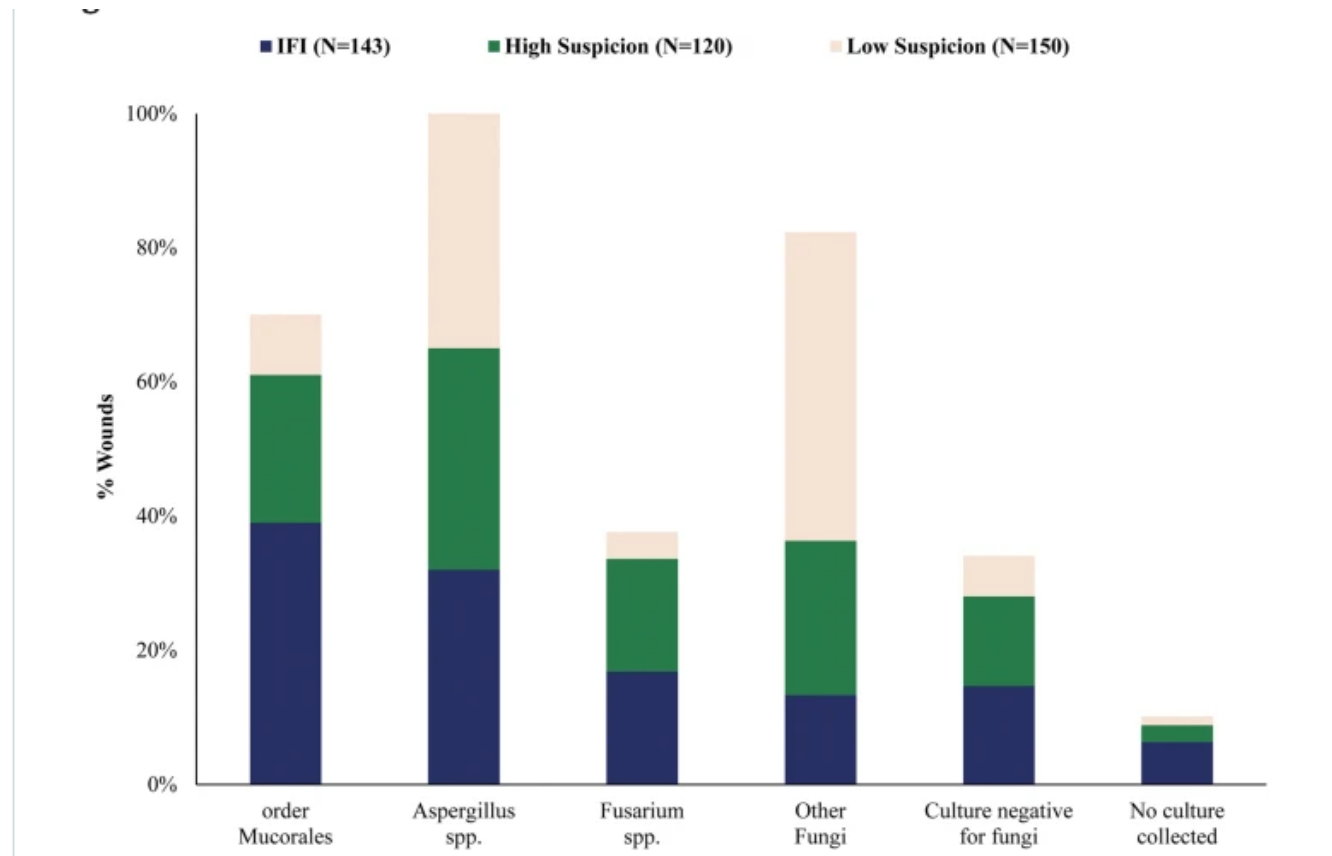
BARBARA J. HANNA, M.D.

New Orleans, Louisiana

In addition to the well-known infectious complications of intravenous narcotic abuse, a much rarer and more recently recognized association between intravenous narcotic addiction and mucormycotic abscesses of the central nervous system has been described. Only four cases have been cited in the literature, with a mortality rate of 100 percent in this group. This report describes a narcotic abuser who presented with obstructive hydrocephalus and a mucormycotic abscess of the brain stem, and recovered. Central nervous system mucormycosis should be included in the differential diagnosis of drug abusers who present with a rapid deterioration in neurologic status.



Combat and Mucormycosis





Conclusions

- Disparities in SDOH affect the health outcomes of individuals and populations
- Outdoor occupations, the physical environment, smoking, vaping, and combat injuries are risk factors for invasive aspergillosis
- Outdoor occupations, poor healthcare access, injection drug use, and combat injuries are risk factors for mucormycosis
 - Crowded living conditions may be a risk factor for CAM
- More research is needed in evaluating the association between SDOH and IFI's and implementing interventions to decrease fungal infection risk
- When evaluating patients for potential IFI's, consider SDOH as risk factors



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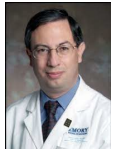
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