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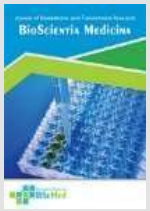

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Deep Mycosis in Central Java, Indonesia: Occupational Risk Factors and Diagnostic Challenges in a Single Center Dr. Moewardi General Hospital

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A B S T R A C T

Background: Deep mycosis, a spectrum of invasive fungal infections affecting deeper tissues, poses significant diagnostic and therapeutic challenges, particularly in tropical regions like Central Java, Indonesia. This study aimed to investigate the epidemiological trends, occupational risk factors, and diagnostic challenges associated with deep mycosis in this region. **Methods:** A retrospective study was conducted at a single center, Dr. Moewardi General Hospital, in Central Java, Indonesia, analyzing medical records of patients diagnosed with deep mycosis between 2019 and 2024. Data on demographics, occupation, clinical presentation, diagnostic methods, and treatment outcomes were collected and analyzed. **Results:** A total of 12 cases of deep mycosis were identified. The majority of patients were male (75%) and engaged in agricultural activities (50%). Chromoblastomycosis (66.7%) and maduromycosis (25%) were the most common clinical diagnoses. Diagnostic delays were frequent (mean delay: 5.1 months), primarily due to non-specific clinical presentations and limited access to diagnostic facilities. **Conclusion:** Deep mycosis predominantly affects individuals involved in agriculture in Central Java, highlighting the need for enhanced awareness and preventive strategies among high-risk occupational groups. Improved diagnostic facilities and healthcare infrastructure are crucial for timely diagnosis and effective management of deep mycosis in resource-constrained settings.

1. Introduction

Deep mycoses represent a spectrum of fungal infections that extend beyond the superficial layers of the skin and involve deeper tissues, including subcutaneous tissue, muscle, and bone. These infections pose a significant diagnostic and therapeutic challenge, particularly in tropical regions like Central Java, Indonesia, where environmental and occupational factors contribute to their prevalence. The diverse group of fungal pathogens responsible for deep mycoses are often found in soil and decaying vegetation. Infection typically occurs through traumatic inoculation, such as a puncture wound from contaminated thorns or splinters, introducing the fungi into the deeper tissues. Individuals engaged in agricultural practices, which are prevalent in Central Java, are particularly vulnerable to these infections due to their frequent contact with soil and vegetation.[1-4]

The clinical manifestations of deep mycoses are often non-specific, presenting as subcutaneous nodules, ulcers, abscesses, or draining sinuses. This lack of distinctive clinical features can lead to diagnostic delays and misdiagnosis, as the infections may mimic other skin conditions or even malignancies. Diagnostic delays are further compounded by limited access to diagnostic facilities in resource-constrained settings. Confirmation of deep mycoses relies on a combination of histopathological examination and fungal culture. However, these

facilities may not be readily available in rural areas or smaller healthcare centers, leading to delayed diagnosis and potentially poorer treatment outcomes.[5-7]

The therapeutic management of deep mycoses typically involves prolonged and aggressive antifungal therapy, often in conjunction with surgical debridement or even amputation in severe cases. The success of treatment is influenced by several factors, including the correct diagnosis, appropriate antifungal selection, and patient adherence to long-term therapy.[8-10] This study aimed to investigate the epidemiological trends, occupational risk factors, and diagnostic challenges associated with deep mycoses in Central Java, Indonesia.

2. Methods

This research employed a retrospective descriptive study design, utilizing secondary data extracted from medical records. The study was conducted at the Dr. Moewardi General Hospital in Surakarta, Central Java, Indonesia, and encompassed a five-year period from January 2019 to November 2024. The study population comprised all patients treated at the Dermatology and Venereology Outpatient Clinic of Dr. Moewardi General Hospital during the specified period. A total sampling technique was employed, wherein all available medical records of patients diagnosed with deep mycosis, as per the International Classification of Diseases, 10th Revision (ICD-10) code B49, were included in the analysis.

Data were collected from the medical records of the patients using a standardized data collection form. The form was designed to capture the following key variables; Sociodemographic characteristics: This included age, gender, occupation, and educational level; Clinical data: This encompassed the type of deep mycosis, location of the lesion, and duration of symptoms; Diagnostic information: This included the results of histopathological examinations, fungal cultures, and other relevant diagnostic tests; Treatment data: This encompassed the type of antifungal medication prescribed, dosage, duration of treatment, and any surgical interventions performed. The collected data were analyzed using descriptive statistics. Categorical variables, such as gender, occupation, and type of deep mycosis, were presented as frequencies and percentages. Continuous variables, such as age and duration of symptoms, were presented as means and standard deviations.

Ethical approval for this study was obtained from the Ethics Committee of Dr. Moewardi General Hospital. Patient confidentiality was maintained throughout the study by anonymizing all data and ensuring that no personal identifiers were included in the analysis or reporting of the results.

3. Results

Figure 1 illustrates the epidemiological trends of deep mycosis cases observed at Dr. Moewardi General Hospital in Surakarta, Central Java, Indonesia, from January 2019 to November 2024. The number of deep mycosis cases exhibited fluctuations over the years, with no clear pattern of consistent increase or decrease. A notable surge in cases is observed in 2024 (January to November), with the highest number of cases recorded during this period. The years 2019 and 2020 reported the lowest number of cases, indicating a relatively low incidence of deep mycosis during this time. A significant increase in the number of cases is evident in 2021 compared to the preceding years. The fluctuations in deep mycosis cases could be attributed to variations in environmental conditions, such as rainfall and humidity, which can influence the growth and spread of fungal pathogens. The surge in cases in 2024 may be linked to increased agricultural activity or changes in farming practices that heightened exposure to soil-borne fungi. Increased awareness among healthcare professionals and improved diagnostic capabilities might have contributed to the higher number of cases reported in certain years. The data represents a single-center experience and may not be generalizable to the entire population of Central Java. Additionally, the retrospective nature of the study may be subject to reporting biases.

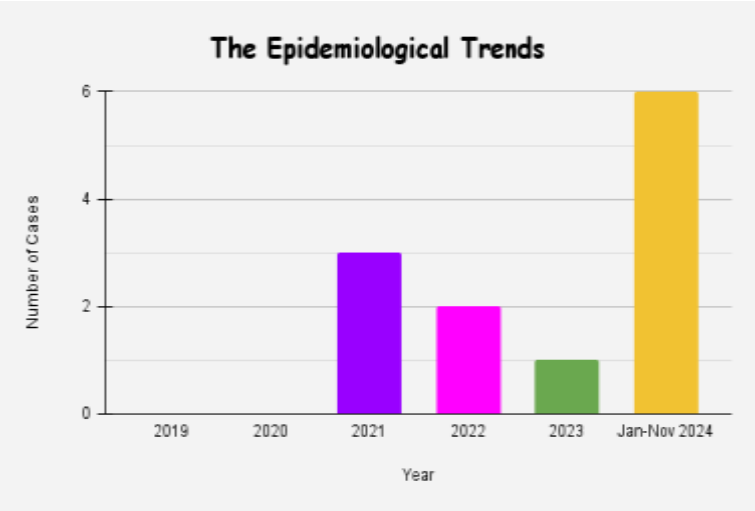

Figure 1. The epidemiological trends of deep mycosis.

Figure 2 presents the distribution of occupational risk factors among the deep mycosis patients identified in the study conducted at Dr. Moewardi General Hospital. Farmers constitute the largest proportion of patients (37.5%), highlighting a strong association between agricultural activities and the risk of deep mycosis. Laborers (18.8%) and housewives (18.8%) represent significant portions of the patient population, suggesting potential exposure to soil-borne fungi in their respective environments. Students, teachers, and merchants each account for a smaller percentage (6.3% each) of the cases, indicating a comparatively lower risk of deep mycosis in these professions. The high prevalence of deep mycosis among farmers and laborers likely reflects their direct and frequent contact with soil, which harbors the fungal pathogens responsible for these infections. Housewives may be exposed to fungal pathogens through activities such as gardening or handling soil-contaminated produce. Students, teachers, and merchants generally have less direct contact with soil and outdoor environments compared to farmers and laborers, which may explain their lower risk. The findings underscore the need for targeted awareness campaigns and preventive measures, such as the use of protective footwear and gloves, among high-risk occupational groups.

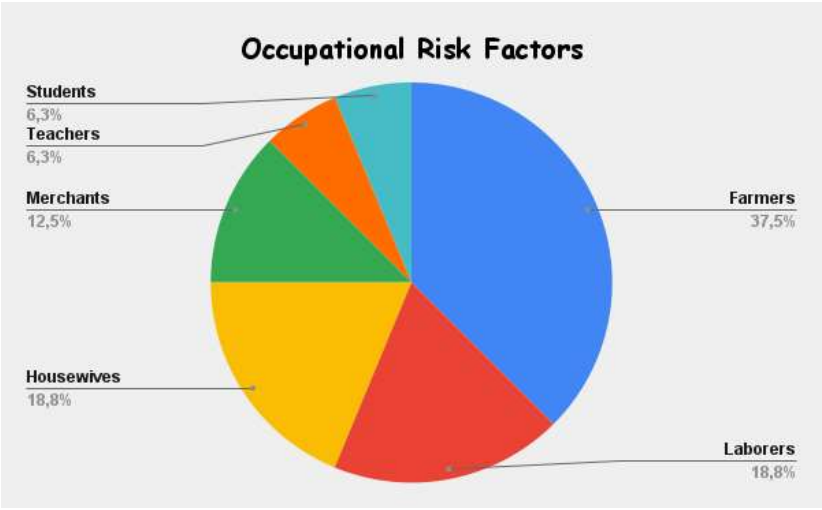

Figure 2. Occupational risk factors for deep mycosis.

Figure 3 provides a visual representation of the clinical presentations of deep mycosis cases observed in the study, specifically focusing on the anatomical location and type of infection. The majority of deep mycosis cases (10 out of 12) presented with lesions on the lower extremities. This observation aligns with the typical route of infection, which often involves traumatic inoculation of fungal pathogens through the feet or legs. Chromoblastomycosis was the most frequent diagnosis, accounting for 8 out of 12 cases. This finding is consistent with the prevalence of this condition in tropical and subtropical regions. Maduromycosis and sporotrichosis were less common, with 3 and 1 case(s) respectively. These infections, while less prevalent, still contribute to the overall burden of deep mycosis in the region. The predominance of lower extremity involvement likely reflects occupational and lifestyle factors that increase exposure of the lower limbs to soil-borne fungi, particularly among individuals engaged in agricultural activities. The different types of deep mycosis observed may be attributed to the diversity of fungal pathogens present in the environment and the specific circumstances of inoculation. The clinical presentation of deep mycosis can be variable and mimic other skin conditions, potentially leading to diagnostic challenges. This highlights the importance of careful clinical evaluation and appropriate diagnostic tests, such as histopathology and fungal culture.

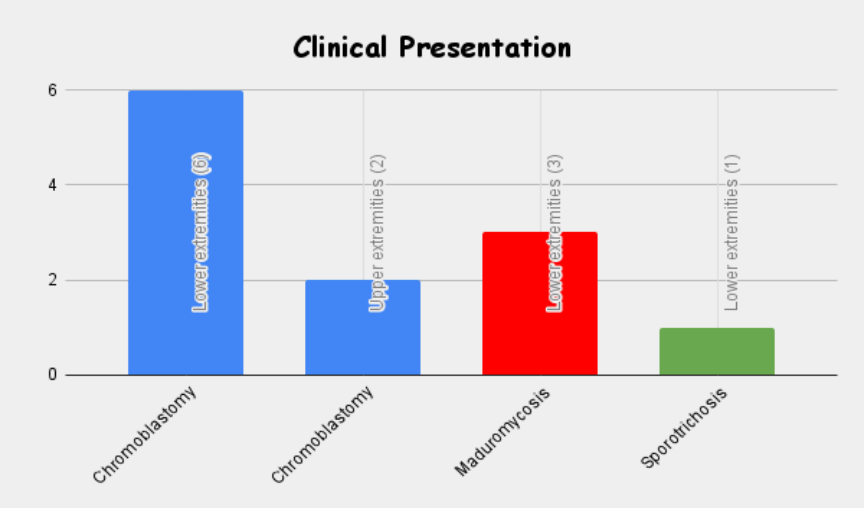

Figure 3. Clinical presentation of deep mycosis.

Table 1 provides a detailed overview of the anamnesis, clinical findings, diagnosis, and treatment for each of the 12 patients included in the study on deep mycosis. The majority of patients (9 out of 12) were male, suggesting a potential gender bias in the susceptibility to deep mycosis or in healthcare-seeking behavior. Most patients were older adults, with ages ranging from 35 to 78 years. This observation may reflect the slow-growing nature of deep mycosis and the accumulation of risk factors over time. Farmers and housewives constituted the largest proportion of patients, highlighting the potential for occupational and domestic exposure to fungal pathogens. The lower extremities were the most common site of infection, consistent with the typical route of inoculation through the feet or legs. Chromoblastomycosis was the most prevalent diagnosis, followed by maduromycosis and sporotrichosis. Itraconazole was the mainstay of antifungal therapy for most patients, reflecting its efficacy against a broad range of deep mycosis-causing fungi. Some patients with maduromycosis received adjunctive antibiotics, likely to address secondary bacterial infections. The predominance of farmers and housewives among the

patients underscores the importance of occupational and domestic activities in the acquisition of deep mycosis. The long duration of symptoms before presentation, ranging from 1 to 30 years, suggests potential delays in diagnosis and healthcare seeking. The chronic and relapsing nature of deep mycosis may necessitate prolonged antifungal therapy and, in some cases, surgical intervention.

Table 1. Overview of anamnesis, clinical findings, diagnosis, and treatment in every patient.

Patient	Anamnesis	Clinical finding	Diagnosis	Treatment
1	65-year-old male farmer, 5-year history of right foot lesions, initially small wound, slow-growing, painless	Multiple erythematous nodules, some ulcerated, with seropurulent discharge, right foot	Maduromycosis	Itraconazole, Clindamycin
2	70-year-old male farmer, 15-year history of left foot lesions, initially small nodule, slow-growing, painless	Multiple erythematous nodules, some with black dots, left foot	Chromoblastomycosis	Itraconazole
3	44-year-old male laborer, 2-year history of right-hand lesions, history of trauma, slow-growing, painless	Single erythematous nodule, ulcerated, right hand	Chromoblastomycosis	Itraconazole
4	70-year-old female housewife, 10-year history of left foot lesions, history of trauma, slow-growing, painless	Multiple erythematous nodules, some ulcerated, left foot	Chromoblastomycosis	Itraconazole
5	74-year-old male farmer, 30-year history of right foot lesions, initially small wound, slow-growing, painless	Multiple erythematous nodules, some with black dots, right foot	Chromoblastomycosis	Itraconazole
6	68-year-old male farmer, 10-year history of left-hand lesions, history of trauma, slow-growing, painless	Single erythematous nodule, ulcerated, left hand	Chromoblastomycosis	Itraconazole
7	35-year-old male merchant, 1-year history of right leg lesions, history of trauma, slow-growing, painful	Single erythematous nodule, ulcerated, right leg	Sporotrichosis	Itraconazole
8	71-year-old male farmer, 5-year history of right foot lesions, initially small wound, slow-growing, painless	Multiple erythematous nodules, some with black dots, right foot	Chromoblastomycosis	Itraconazole
9	70-year-old male farmer, 10-year history of left foot lesions, history of trauma, slow-growing, painless	Multiple erythematous nodules, some ulcerated, left foot	Chromoblastomycosis	Itraconazole
10	40-year-old female housewife, 3-year history of right-hand lesions, history of trauma, slow-growing, painless	Single erythematous nodule, ulcerated, right hand	Chromoblastomycosis	Itraconazole
11	78-year-old male laborer, 20-year history of right foot lesions, initially small wound, slow-growing, painless	Multiple erythematous nodules, some with black dots, right foot	Maduromycosis	Itraconazole, Azithromycin
12	70-year-old female housewife, 11-year history of left foot lesions, history of trauma, slow-growing, painless	Multiple erythematous nodules, some ulcerated, left foot	Maduromycosis	Itraconazole, Erythromycin

Table 2 outlines the significant diagnostic challenges encountered in managing deep mycosis cases, particularly in settings like Central Java, Indonesia. Deep mycoses often present with symptoms that mimic other skin conditions, such as skin tuberculosis, leprosy, or even cancers. This lack of distinctive clinical features makes it difficult for healthcare providers to differentiate deep mycoses from other diseases based solely on physical examination. Many healthcare professionals, especially those in primary care settings, may not be adequately familiar with the varied presentations of deep mycoses. This lack of awareness can lead to missed or delayed diagnoses, as the condition may not be considered as a possibility. Access to specialized diagnostic tools, such as fungal cultures and histopathology, is often limited, particularly in rural areas. This lack of access hinders timely and accurate diagnosis, as these tests are crucial for confirming the presence of deep mycoses and identifying the specific fungal pathogen involved. Due to the challenges mentioned above, patients with deep mycoses often experience delays in receiving the appropriate treatment. Initial misdiagnosis as in other conditions can lead to the prescription of ineffective treatments, allowing the disease to progress and potentially worsen the prognosis.

Table 2. Diagnostic challenges.

Challenge	Description
Non-specific clinical presentations	Deep mycoses often mimic other dermatological conditions, like skin tuberculosis, leprosy, or even cancers, making it difficult to distinguish based on clinical presentation alone.
Limited awareness among healthcare providers	Many healthcare professionals, especially in primary care settings, may not be familiar with the diverse presentations of deep mycoses, leading to missed or delayed diagnoses.
Inadequate access to diagnostic facilities	Especially in rural areas of Central Java, the availability of specialized diagnostic tools like fungal cultures and histopathology may be limited, hindering timely and accurate diagnosis.
Misdiagnosis and treatment delays	Patients often experience delays in receiving appropriate treatment due to initial misdiagnosis as other conditions, potentially leading to disease progression and a worse prognosis.

4. Discussion

The intimate link between agricultural work and deep mycosis cannot be ignored. Agriculture, at its core, involves constant interaction with soil, a dynamic environment teeming with microbial life, including a vast array of fungi. While many of these fungi play beneficial roles in nutrient cycling and soil health, some harbor the potential to cause deep-seated infections, particularly in individuals whose livelihoods necessitate frequent contact with the earth. Soil serves as a natural habitat for a diverse community of fungi, some of which are recognized as causative agents of deep mycosis. These pathogenic fungi, often found in decaying organic matter, can persist in the soil for extended periods, posing a risk to individuals who come into contact with contaminated soil through their work or daily activities. Dematiaceous fungi, characterized by their darkly pigmented hyphae, include several species known to cause chromoblastomycosis, a chronic and often disfiguring deep fungal infection. *Fonsecaea pedrosoi* and *Cladophialophora carrionii* are among the most common culprits, thriving in tropical and subtropical soils where agricultural activities are prevalent. These fungi gain entry into the body through traumatic inoculation, often via minor cuts or

abrasions sustained during work in the fields. Madurella species fungi are the primary agents of eumycetoma, commonly known as Madura foot, a debilitating infection characterized by the formation of grains and draining sinuses. *Madurella mycetomatis* and *Madurella grisea* are prevalent in arid and semi-arid regions, but can also be found in tropical environments. These fungi typically infect the feet or lower limbs, particularly in individuals who walk barefoot or wear inadequate footwear while working in contaminated soil. Sporothrix schenckii is a dimorphic fungus, found worldwide in soil and decaying vegetation, causes sporotrichosis, a subcutaneous infection that can spread along lymphatic channels. Agricultural workers, particularly those involved in handling thorny plants or sphagnum moss, are at risk of acquiring sporotrichosis through puncture wounds or cuts. The presence of these pathogenic fungi in the soil, coupled with the nature of agricultural practices, creates a conducive environment for the transmission of deep mycosis. Agricultural activities often involve tasks that increase the risk of minor injuries, providing an opportunity for fungal pathogens to breach the skin barrier and establish infection. The process of preparing the soil for planting can involve the use of sharp tools or machinery, potentially leading to cuts or puncture wounds. These injuries, when exposed to contaminated soil, create an entry point for fungal pathogens to invade deeper tissues. Handling seedlings or seeds can result in minor abrasions or pricks from thorns or sharp plant parts. These seemingly minor injuries can become portals for fungal invasion if they come into contact with contaminated soil. Harvesting crops, especially those with thorns or sharp edges, can cause cuts or scratches. These injuries, particularly when sustained on the hands or feet, can become infected if exposed to soil harboring pathogenic fungi. Contact with livestock can lead to scratches or bites, providing an entry point for fungal pathogens. These injuries, often neglected or inadequately treated, can become infected with fungi present in the animal's environment or on its skin. These seemingly minor injuries, when exposed to contaminated soil, become portals for fungal invasion. The fungal spores or hyphal fragments can penetrate the skin barrier and establish infection in the deeper tissues, initiating the cascade of events that characterize deep mycosis. A common practice in the region, barefoot farming increases the risk of direct inoculation of fungal pathogens through the feet. The soles of the feet are particularly vulnerable to puncture wounds from thorns, splinters, or sharp stones, providing a direct pathway for fungi to enter the subcutaneous tissues. The use of gloves, boots, and other protective clothing is often limited among farmers in Central Java, further increasing their risk of exposure to contaminated soil and vegetation. This lack of protection leaves the skin vulnerable to minor injuries that can serve as entry points for fungal pathogens. Due to the demanding nature of their work and limited access to healthcare, farmers may neglect minor injuries or delay seeking medical attention. This delay allows fungal infections to establish and progress, potentially leading to more severe complications and poorer treatment outcomes. The tropical climate of Central Java, characterized by high humidity and rainfall, provides ideal conditions for the growth and proliferation of fungal pathogens in the soil. The warm and moist environment favors the survival and dispersal of fungal spores, increasing the likelihood of exposure and infection. The high prevalence of deep mycosis among farmers in Central Java paints a stark picture of a public health challenge demanding urgent action. This disease, often neglected and misunderstood, carries a significant burden, not only for the individuals afflicted but also for their families, communities, and the agricultural sector as a whole. To effectively combat deep mycosis and safeguard the health and livelihoods of those who cultivate the land, a comprehensive and multi-faceted preventive strategy is essential. In the battle against deep mycosis, knowledge is a powerful weapon. Educational interventions play a crucial role in empowering farmers and agricultural workers to protect themselves from this debilitating disease. By

equipping them with the necessary information and understanding, we can foster a culture of prevention and promote proactive health-seeking behavior. Educational programs should be designed and implemented to raise awareness about deep mycosis among farmers and agricultural workers. These programs should be tailored to the specific needs and literacy levels of the target population, utilizing clear and accessible language, visual aids, and practical demonstrations to enhance understanding. The programs should delve into the risk factors associated with agricultural work, highlighting the importance of recognizing potential hazards and taking preventive measures. This includes understanding the role of soil as a reservoir of fungal pathogens, the significance of minor injuries as entry points for infection, and the impact of delayed wound care on disease progression. Farmers should be educated about the early signs and symptoms of deep mycosis, enabling them to identify potential infections promptly and seek medical attention without delay. This early recognition can significantly improve treatment outcomes and prevent the disease from progressing to more severe stages, potentially avoiding chronic pain, disability, and even amputation. The programs should also emphasize the potential consequences of delayed treatment, including chronic pain, disability, and even amputation in severe cases. By understanding the potential ramifications of neglecting their health, farmers can be motivated to prioritize their well-being and seek timely medical care. To reach the target population effectively, information should be disseminated through various channels, including community health centers, agricultural extension offices, and local media. Collaborating with community leaders and utilizing existing social networks can further enhance the reach and impact of educational interventions, ensuring that the message of prevention reaches even the most remote corners of the farming community. Prevention is always better than cure, and in the case of deep mycosis, simple protective measures can significantly reduce the risk of infection. By adopting these measures, farmers can create a barrier between themselves and the fungal pathogens lurking in the soil, minimizing the likelihood of contracting this debilitating disease. Farmers should be encouraged to wear appropriate protective footwear, such as closed-toe boots or shoes, to minimize direct contact with soil and potential contaminants. This simple measure can prevent puncture wounds and other injuries that serve as entry points for fungal pathogens. The use of gloves during agricultural activities that involve handling soil, plants, or tools should be promoted to reduce the risk of inoculation through hand injuries. Gloves provide a barrier between the skin and potential contaminants, minimizing the risk of fungal entry. Access to and proper use of basic first aid supplies and wound care materials should be ensured to enable prompt and effective treatment of minor injuries. This includes cleaning wounds thoroughly with soap and water, applying antiseptic solutions, and covering the wound with a clean dressing to prevent contamination and promote healing. Promoting regular handwashing and foot hygiene can further reduce the risk of infection. Farmers should be encouraged to wash their hands and feet thoroughly after work and before meals, using soap and clean water. This simple practice can remove soil and potential contaminants, minimizing the risk of fungal entry through minor cuts or abrasions. Timely and appropriate healthcare is crucial for managing deep mycosis and preventing severe complications. Improving access to healthcare facilities and strengthening diagnostic capabilities are essential components of a comprehensive preventive strategy, ensuring that farmers receive the care they need when they need it. Efforts should be made to improve access to healthcare facilities, particularly in rural areas where a significant proportion of farmers reside. This may involve establishing mobile clinics, increasing the number of healthcare providers in underserved areas, and providing transportation assistance to facilitate access to healthcare. Healthcare providers in primary care settings should be trained to recognize and diagnose deep mycosis, ensuring timely referral to specialized centers for

appropriate management. This training should include education on the clinical presentation, diagnostic tests, and treatment options for deep mycosis, equipping healthcare providers with the knowledge and skills to effectively manage this disease. Strengthening laboratory infrastructure and diagnostic capabilities in local healthcare facilities can facilitate early and accurate diagnosis, leading to prompt treatment initiation. This may involve equipping laboratories with the necessary tools and reagents for fungal cultures and histopathology, as well as training laboratory personnel in the proper techniques for processing and interpreting these tests.[11-14]

Deep mycosis, a master of disguise in the realm of dermatological diseases, often presents a diagnostic conundrum due to its remarkable ability to mimic other skin conditions. This chameleon-like nature, characterized by a diverse array of clinical manifestations, can lead to misdiagnosis, delayed treatment, and potentially severe consequences for patients. The clinical manifestations of deep mycosis are as varied as the fungal pathogens that cause them. The disease can manifest in a multitude of ways, often mimicking more common or well-known skin conditions. This lack of distinctive clinical features poses a significant challenge for healthcare providers, particularly those in primary care settings where awareness of deep mycosis may be limited. Nodules and papules are small, solid bumps, often painless and slow-growing, can easily be mistaken for benign skin growths or inflammatory conditions. They may appear as solitary lesions or in clusters, and their color can vary from skin-colored to reddish-brown. Chronic, non-healing ulcers, often with raised borders and a granular base, are a common manifestation of deep mycosis. These ulcers can be mistaken for those caused by bacterial infections, vascular insufficiency, or even skin cancers, leading to delays in appropriate treatment. Deep-seated abscesses, characterized by collections of pus within the deeper layers of the skin or subcutaneous tissues, can be a painful and debilitating complication of deep mycosis. These abscesses may mimic those caused by bacterial infections, requiring careful evaluation to determine the underlying cause. Sinus tracts, abnormal channels that connect deeper tissues to the skin surface, can develop in chronic cases of deep mycosis. These tracts often discharge pus or granular material, and their presence can mimic other conditions, such as hidradenitis suppurativa or actinomycosis. Changes in skin pigmentation, including hyperpigmentation (darkening of the skin) and hypopigmentation (lightening of the skin), can occur in deep mycosis. These changes can mimic other dermatological conditions, such as melasma or vitiligo, further complicating the diagnostic process. In some cases, deep mycosis can affect the peripheral nerves, leading to numbness, tingling, or pain. This nerve involvement can mimic the clinical features of leprosy or other neurological conditions, potentially leading to misdiagnosis. The non-specific nature of deep mycosis necessitates a high index of suspicion for timely diagnosis. Healthcare providers need to be vigilant, considering the possibility of deep mycosis in patients presenting with skin lesions, particularly those with occupational or lifestyle risk factors. Individuals engaged in agricultural activities, such as farmers and laborers, are at increased risk of deep mycosis due to their frequent contact with soil and potential contaminants. Individuals who walk barefoot or wear inadequate footwear, have a history of trauma or previous skin infections, or live in areas with poor sanitation are also at higher risk of deep mycosis. In the absence of distinctive clinical features, healthcare providers must rely on their clinical acumen and a combination of diagnostic tools to unravel the enigma of deep mycosis. A thorough medical history, including occupational and lifestyle factors, can provide valuable clues. Careful examination of the skin lesions, including their location, size, shape, and color, can help narrow down the differential diagnosis. Culturing a sample of the infected tissue or discharge can identify the specific fungal pathogen involved, confirming the diagnosis of deep mycosis. Microscopic examination of a biopsy specimen can reveal the

characteristic features of deep mycosis, such as granulomas, fungal elements, and tissue destruction. In some cases, imaging studies, such as X-rays or MRI scans, may be helpful in assessing the extent of the infection and identifying any underlying bone or joint involvement. The non-specific clinical presentations of deep mycosis, often mimicking other skin conditions, pose a significant diagnostic challenge for healthcare providers. To overcome this hurdle and ensure timely and accurate diagnosis, enhanced awareness and comprehensive training are essential. Deep mycosis, despite its prevalence in certain regions, remains a relatively unfamiliar disease for many healthcare providers, particularly those in primary care settings. This lack of awareness can lead to missed or delayed diagnoses, with potentially serious consequences for patients. Familiarize healthcare providers with the diverse clinical presentations of deep mycosis, emphasizing its ability to mimic other skin conditions. Educate healthcare providers on the risk factors associated with deep mycosis, including occupational and lifestyle factors, enabling them to identify high-risk individuals. Encourage healthcare providers to refer patients with suspected deep mycosis to specialized dermatological or infectious disease centers for prompt diagnosis and appropriate management. The ability to recognize the subtle signs and symptoms that may differentiate deep mycosis from other skin conditions is crucial for timely diagnosis. The specific characteristics of the skin lesions, such as their size, shape, color, and texture, can provide valuable clues. The location of the lesions, particularly on the lower extremities or areas exposed to trauma, can raise suspicion of deep mycosis. The slow, insidious progression of the disease, often over months or even years, can be a distinguishing feature. The failure of the lesions to respond to conventional treatments for other skin conditions can be a red flag for deep mycosis. Identifying patients with occupational or lifestyle risk factors is crucial for early diagnosis and intervention. Individuals engaged in agricultural activities, such as farmers and laborers, are at increased risk of deep mycosis due to their frequent contact with soil and potential contaminants. Walking barefoot or wearing inadequate footwear increases the risk of traumatic inoculation of fungal pathogens through the feet. A history of trauma, particularly puncture wounds or cuts, can provide an entry point for fungal pathogens. Individuals who live in areas with poor sanitation or have a history of exposure to contaminated soil are at higher risk of deep mycosis. Early referral to specialized dermatological or infectious disease centers is crucial for prompt diagnosis and appropriate management of deep mycosis. Healthcare providers should be encouraged to refer patients with suspected deep mycosis without delay, ensuring that they receive the specialized care they need. Continuing medical education programs, workshops, and seminars can provide healthcare providers with the latest information on deep mycosis, its clinical presentations, and diagnostic approaches. Presenting clinical case studies of deep mycosis can help healthcare providers recognize the diverse manifestations of the disease and develop their diagnostic skills. Online learning modules and interactive simulations can provide engaging and effective training on deep mycosis. Mentorship programs, pairing experienced dermatologists or infectious disease specialists with primary care providers, can provide valuable guidance and support in the diagnosis and management of deep mycosis. In resource-constrained settings like rural Central Java, Indonesia, where our study was conducted, the diagnostic challenges of deep mycosis are further compounded by a critical barrier limited access to specialized diagnostic facilities. This hurdle, often overlooked in discussions of global health, has profound implications for the timely diagnosis and effective management of this debilitating disease. The gold standard for confirming deep mycosis and identifying the specific fungal pathogen involved rests on two pillars, fungal cultures and histopathology. Culturing a sample of the infected tissue or discharge allows for the isolation and identification of the causative fungus. This process, while essential for

guiding treatment decisions, requires specialized laboratory equipment, trained personnel, and often a considerable waiting period for results. Microscopic examination of a biopsy specimen, stained with special dyes to highlight fungal elements, can reveal the characteristic features of deep mycosis, such as granulomas, fungal hyphae, and tissue destruction. This technique, however, necessitates trained pathologists and access to microscopy facilities, resources that may be scarce in resource-limited settings. In rural Central Java, and indeed in many other parts of the world where resources are stretched thin, these specialized diagnostic facilities are often concentrated in larger urban centers or tertiary care hospitals, leaving primary care settings and smaller healthcare centers ill-equipped to handle the diagnostic needs of deep mycosis. Patients may face significant delays in receiving a definitive diagnosis, as they may need to travel long distances or endure long waiting lists to access specialized diagnostic services. These delays can allow the disease to progress, potentially leading to more severe complications and poorer treatment outcomes. In the absence of confirmatory tests, healthcare providers may resort to empirical treatment, prescribing antifungal medications without knowing the specific fungal pathogen involved. This approach, while sometimes necessary, can lead to ineffective treatment, as different fungal species exhibit varying sensitivities to antifungal drugs. Moreover, prolonged use of broad-spectrum antifungals can contribute to the development of drug resistance, further complicating future treatment options. Diagnostic delays, coupled with potentially ineffective empirical treatment, can result in increased morbidity. The disease may progress to more severe stages, potentially leading to chronic pain, disability, and even amputation. The physical and psychological toll of these complications can be devastating, impacting not only the individual but also their families and communities. Governments and healthcare organizations must prioritize investment in strengthening laboratory infrastructure in resource-constrained settings. This includes equipping laboratories with the necessary tools and reagents for fungal cultures and histopathology, ensuring a reliable supply chain for essential materials, and providing regular maintenance and calibration of equipment. Training healthcare professionals in the proper techniques for collecting and handling specimens for fungal cultures and biopsies is crucial for ensuring accurate and timely diagnosis. This training should also encompass the interpretation of test results, enabling healthcare providers to make informed treatment decisions. Efforts should be made to expand diagnostic services to underserved areas, potentially through mobile clinics, outreach programs, or telemedicine initiatives. This can bring specialized diagnostic capabilities closer to the communities that need them most, reducing diagnostic delays and improving patient outcomes. Research and development of rapid and accurate diagnostic tests for deep mycosis would be invaluable in facilitating timely diagnosis and treatment, particularly in resource-limited settings. These tests, ideally point-of-care and easy to use, could revolutionize the diagnostic landscape, enabling healthcare providers to make prompt and informed decisions, even in remote areas with limited laboratory infrastructure.[15-18]

The treatment of deep mycosis is often a long and arduous journey, requiring a multifaceted approach and unwavering commitment from both the patient and healthcare provider. This complex disease, characterized by its chronic and relapsing nature, demands prolonged antifungal therapy, often in conjunction with surgical interventions, to achieve successful outcomes. Antifungal medications form the cornerstone of deep mycosis treatment. The choice of antifungal agent depends on several factors, including the specific fungal pathogen involved, the extent and severity of the infection, the patient's overall health, and potential drug interactions. Itraconazole, a broad-spectrum antifungal agent, has emerged as a mainstay in the treatment of deep mycosis. Its efficacy against a wide range of deep mycosis-causing fungi, coupled with its relatively favorable safety profile,

makes it a preferred choice for many clinicians. Other antifungal medications, such as terbinafine, posaconazole, and voriconazole, may also be employed, depending on the specific circumstances. The duration of antifungal therapy is typically prolonged, often lasting several months or even years. This extended duration is necessary to ensure complete eradication of the fungal infection and prevent relapse. However, the long treatment course can pose challenges in terms of patient adherence, drug side effects, and cost. In addition to antifungal therapy, surgical interventions may be necessary in certain cases of deep mycosis. Surgical debridement, involving the removal of infected tissue, can help reduce the fungal burden and promote healing. In severe cases, where the infection has caused extensive tissue damage or bone involvement, amputation may be considered as a last resort to prevent further spread of the disease and preserve the patient's overall health. Accurate diagnosis, including the identification of the specific fungal pathogen involved, is crucial for guiding treatment decisions. Misdiagnosis or delayed diagnosis can lead to the prescription of ineffective treatments, allowing the disease to progress and potentially worsen the prognosis. The choice of antifungal medication must be tailored to the specific fungal pathogen and the patient's individual circumstances. Factors such as drug sensitivity, potential side effects, and drug interactions must be carefully considered. Patient adherence to prolonged antifungal therapy is paramount for achieving complete eradication of the infection and preventing relapse. Non-adherence can lead to treatment failure, disease progression, and the development of drug resistance. The extent and severity of the infection can influence treatment outcomes. Early diagnosis and prompt treatment initiation are crucial for preventing the disease from progressing to more severe stages. The patient's overall health and immune status play a significant role in their ability to fight the infection. Patients with weakened immune systems, such as those with diabetes or HIV, may be more susceptible to severe complications and require more aggressive treatment. Patient education and support are essential components of deep mycosis management. Patients need to be informed about the nature of the disease, the importance of adherence to treatment, and the potential side effects of antifungal medications. Providing emotional support and addressing any concerns or anxieties can help patients cope with the challenges of long-term treatment and improve their quality of life. The prognosis of deep mycosis varies depending on several factors, including the specific fungal pathogen involved, the extent of the infection, the patient's overall health, and the timeliness of diagnosis and treatment. With appropriate treatment and adherence to therapy, many patients can achieve complete eradication of the infection and experience a good quality of life. However, deep mycosis can be a chronic and relapsing disease, requiring long-term monitoring and follow-up care.[19,20]

5. Conclusion

This study investigated the epidemiological trends, occupational risk factors, and diagnostic challenges associated with deep mycosis in Central Java, Indonesia. Our findings highlight the significant burden of deep mycosis in this region, particularly among individuals engaged in agricultural activities. The predominance of farmers among the affected individuals underscores the occupational risk associated with farming practices in the region. The non-specific clinical presentations of deep mycosis, coupled with limited access to diagnostic facilities, contribute to significant diagnostic delays. These delays can lead to disease progression, increased morbidity, and poorer treatment outcomes. The study emphasizes the urgent need for enhanced awareness, improved diagnostic capabilities, and strengthened healthcare infrastructure to address the challenges posed by deep mycosis in Central Java. Further research is needed to comprehensively evaluate the diagnostic challenges and treatment outcomes associated with deep mycosis in Central Java and other resource-constrained settings. Public health

interventions targeting high-risk occupational groups, such as farmers, are crucial for promoting prevention, early diagnosis, and effective management of deep mycosis.

6. References

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