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Prevalence and Characteristic of Superficial Fungal Infection in Denpasar City, Bali, Indonesia

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Abstract. Superficial mycoses are the most common dermatological diseases caused chiefly by dermatophytes. Due to poor hygiene, superficial mycosis is more common in rural areas, yet the disease can also spread in urban areas. This study aims to determine the prevalence of superficial mycoses and compare the characteristics of skin lesions with the results of a microscopic examination of the fungus. According to this study, *Pityriasis versicolor* (22.2%), *Tinea corporis* (35.8%), and *Tinea cruris* (25.3%) were the three most prevalent superficial *mycoses*. The age distribution revealed that 25.4% of the samples were obtained from children, 37.3% from young adults, 25.4% from middle-aged adults, and 11.9% from old adults. Results from microscopic examination suggest that *hyphae* were absent in 28.4% of samples suspected of having an infection with superficial *mycoses*. In this study, the short *hyphae* of *Malassezia* and the *septate* and *hyaline hyphae* of *dermatophytes* could be distinguished.

Keywords: Characteristic Infection, Dermatophytosis, Prevalence, Tineas

1. Introduction

Diseases caused by fungi are prevalent and ubiquitous, particularly in tropical regions. Superficial mycoses are the most prevalent dermatological diseases, caused primarily by dermatophytes and, in some cases, non-dermatophyte filamentous fungus, such as *Pityriasis versicolor* from the genus *Malassezia* (Buil et al., 2020; Oke et al., 2014). *Dermatophyte* fungi infect keratinized tissue, such as the skin and its appendages. It is sufficient for *dermatophyte* spores to initiate germination and infect skin cells, particularly keratin-rich stratum layers, when there is a certain amount of moisture. The spores on hair or under the nail plate can cause infection. Thus, *dermatophytosis* is considered a superficial infection (Hussein and AL-Janabi, 2014). Pathogenic species in this group are anthropophilic, zoophilic, and geophilic fungi belonging to the genera *Trichophyton*, *Microsporum*, and *Epidermophyton* (de Hoog et al., 2017).

Tineas are diseases that occur from a dermatophyte infection. *Tinea pedis* refers to dermatophyte infections of the foot, *Tinea cruris* to infections of the genitalia; *Tinea corporis* to trunk infections, and *Tinea capitis* to scalp infections. There are at least 40 human-infecting species of *dermatophytes*, and several of these fungi can cause disease in many body sites (White et al., 2014).

According to (Rahman et al., 2011), superficial *mycosis* is more prevalent in rural regions due to a lack of hygiene, although this does not preclude the disease from spreading in cities. This research is an analytic study that aims to measure the prevalence of superficial mycoses and compare the characteristics of skin lesions with the results of a microscopic investigation of the fungus.

2. Methodology

This study comprised patients from a clinic in Denpasar City, the capital of Bali Province, Indonesia. The data collection was conducted from November 2022 to January 2023, with 67 patients from Denpasar city. Patients suspected of having superficial mycosis underwent a skin scraping test for fungal infection. The specimens were placed aseptically on a glass slide with 10% KOH and examined under a microscope for fungal hyphae and spores. The microscope used is fluorescence microscope from the Lab of Genetic Resources, Udayana University, Denpasar, Bali, Indonesia. The microscope was connected to a computer, so that, its can be edited for making a better imaged. The microscope used was Nikon ECLIPSE 50 and Nikon SMZ 1500. Some samples were subjected to culture on Potato Dextrose Agar (PDA) media for 1-2 days and then the formed of hyphae and spores were observed and then confirmed under microscope. The PDA media was purchased from the Genetika Science Indonesia (GSI). The identified data were then tabulated and grouped into species of fungi and in age groups of the samples.

3. Results

This study comprised 67 individuals diagnosed with superficial fungal infection; 53.7% were male, and 46.3% were female. The most common superficial mycoses were *Tinea corporis* (35.8%), *Tinea cruris* (25.3%), and P*ityriasis versicolor* (PVC) (22.2%), as shown in Table 1. Tinea pedis represented 6% of cases, while tinea capitis and tinea facialis accounted for only 1.5%. Additionally, 7.5% had double infections.

Table 1. Prevalence of mycosis superficial infection in male, female, and total patients

Fungal Infection	Male n (%)	Female n (%)	N (%)
Tinea corporis	8 (11.9)	16 (23.9)	24 (35.8)
Tinea capitis	1 (1.5)	0 (0.0)	1 (1.5)
Tinea pedis	1 (1.5)	3 (4.5)	4 (6.0)
Tinea cruris	11 (16.4)	6 (8.9)	17 (25.3)
Tinea facialis	1(1.5)	0 (0.0)	1 (1.5)
Pityriasis versicolor (PVC)	11 (16.4)	4 (6.0)	15 (22.4)
Tinea capitis + Tinea cruris	1 (1.5)	0 (0.0)	1 (1.5)
Tinea corporis + Tinea cruris	1 (1.5)	2 (3.0)	3 (4.5)
PVC + *Tinea cruris*	1 (1.5)	0 (0.0)	1 (1.5)
Total	36 (53.7)	31 (46.3)	67 (100)

Distribution of age revealed that 25.4% of samples were collected from children ages 3 to 16 years, 37.3% from young adults aged 17 to 30 years, 25.4% from middle-aged adults aged 31 to 45 years, and 11.9% from old adults aged above 45 years as shown in Table 2. *Tinea corporis* (14,9%) was more prevalent in middle-aged adults; *Tinea capitis* and *Tinea facialis* were only observed in children; *Tinea pedis* (4.5%) and *Tinea cruris* (10,4%) were more prevalent in young adults; and PVC (8,9%) was equally prevalent in children and young adults. Only children had a double infection of *Tinea capitis* and *Tinea cruris*; one young adult, one middle-aged adult, and one old adult had a double infection of *Tinea corporis and Tinea cruris*; and only children had a double infection of PVC and *Tinea cruris*. Meanwhile Table 3 shows microscopic examination of mycosis superficial infection. The result indicates that 28.4% of samples with a suspected infection of superficial mycoses were negative upon microscopic examination.

Table 2. Prevalence of mycosis superficial infection based on age group

Fungal Infection	Age group n (%)				N (%)
	Children - teenager (3-16)	Young Adults (17-30)	Middle-aged Adults (31-45)	Adults (>45)	
Tinea corporis	*4 (6.0)*	*8 (11.9)*	*10 (14.9)*	*2 (3.0)*	*24 (35.8)*
Tinea capitis	1 (1.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.5)
Tinea pedis	1 (1.5)	3 (4.5)	0 (0.0)	0 (0.0)	4 (6.0)
Tinea cruris	2 (3.0)	7 (10.4)	5 (7.5)	3 (4.4)	17 (25.3)
Tinea facialis	1 (1.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.5)
PVC (Pityriasis versicolor)	6 (8.9)	6 (8.9)	1 (1.5)	2 (3.0)	15 (22.4)
Tinea capitis + Tinea cruris	1 (1.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.5)
Tinea corporis + Tinea cruris	0 (0.0)	1 (1.5)	1 (1.5)	1 (1.5)	3 (4.5)
PVC + Tinea cruris	1 (1.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.5)
Total	17 (25.4)	25 (37.3)	17 (25.4)	8 (11.9)	67 (100)

Table 3. Microscopic examination of mycosis superficial infection

Fungal Infection	N (%)	Positive
Tinea corporis	24 (35.8)	17 (25.3)
Tinea capitis	1 (1.5)	0 (0.0)
Tinea pedis	4 (6.0)	2 (3.0)
Tinea cruris	17 (25.3)	12 (17.9)
Tinea facialis	1 (1.5)	1 (1.5)
PVC (Pityriasis versicolor)	15 (22.4)	13 (19.4)
Tinea capitis + Tinea cruris	1 (1.5)	0 (0.0)
Tinea corporis + Tinea cruris	3 (4.5)	2 (3.0)
PVC + Tinea cruris	1 (1.5)	1 (1.5)
Total	67 (100)	48 (71.6)

The microscopic examination revealed that *dermatophytes* fungi were prevalent; these fungi have septate and hyaline hyphae as shown in Figure 1. However, as it is challenging to distinguish *microconidia, macroconidia,* and *arthroconidia* in the majority of samples, the genus of the fungi cannot be determined. On PVC samples, short hyphae of *Malassezia* were found.

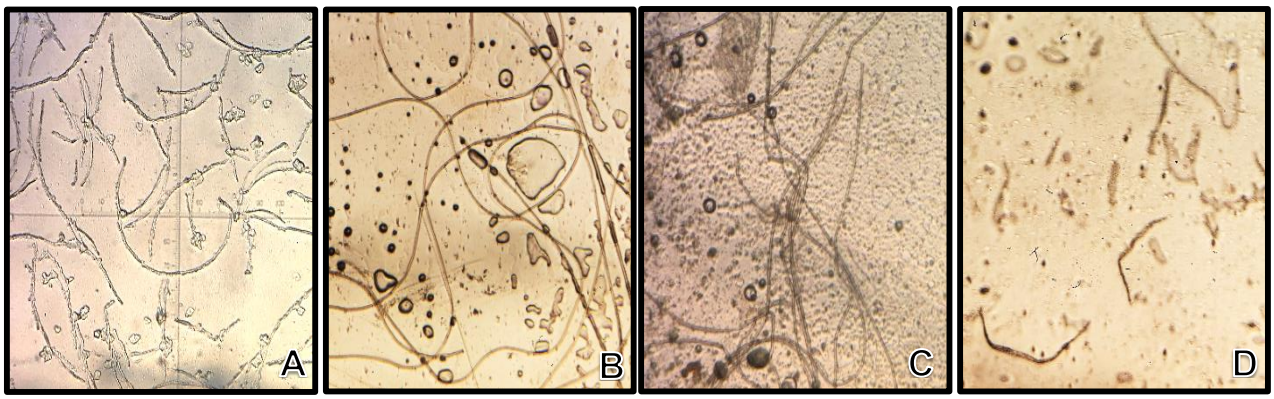

Figure 1. Fungal hyphae from microscopic examination. (A,B,C) *Dermatophytes*; (D) *Malassezia*

4. Discussions

In this study, *mycosis* superficial was more prevalent in males than in females. This result is likely attributable to the protective effects of androgenic hormones in women, specifically *progesterone* and *estradiol*, which are present in more significant quantities in women than in men. These hormones can suppress skin fungus growth (Heidrich *et al.*, 2015). Berenji et al. (2016) also observed that males had a greater prevalence of superficial *mycosis*. Personal hygiene, occupational activity, and exposure to contaminating agents are some factors that can influence gender predominance (Zareshahrabadi *et al*., 2021).

Tinea corporis was the most prevalent case of superficial mycosis in this investigation, as measured by the frequency of each occurrence. *Tinea cruris* and PVC represent the second and third most prevalent cases. *Tinea corporis* causes lesions on the trunk, the neck, the arms, and the legs. In the past seventy years, *Trichophyton rubrum* has been the most prevalent species causing *dermatophyte* diseases (Yee and Aboud, 2022). The fungus transmission is aided by a damp, warm environment, sharing towels and clothing, and wearing occlusive garments (Leung *et al*., 2020). Because Indonesia has a tropical climate with significant humidity, the prevalence of *dermatophyte* skin diseases is exceptionally high (Putri and Astari, 2017). According to Ebrahimi *et al*. (2019), *Tinea corporis* is most prevalent in tropical areas.

In this study, *Tinea cruris* is the second most frequent superficial mycosis. Based on age category, young adults are most susceptible to *Tinea cruris*. According to Yadav et al. (2013), adult males are more prone to *Tinea cruris* than females and children. According to research by Devy and Ervianti (2018), the incidence rate of *Tinea cruris* and/ or *Tinea corporis* is as high as 46.2% in the third and fourth decades of life. Based on profession, most instances of *Tinea corporis* and *Tinea cruris* often affect private employees (Sanggarwati *et al*., 2021). Without improved personal hygiene, individuals run the danger of developing *dermatophytosis* due to their strenuous daily activities that induce perspiration (Sodakh *et al*., 2016). In addition, heated climatic circumstances, heavy perspiration, and tight clothes are the triggers for *Tinea corporis* and *Tinea cruris* infections, which are present in all age groups and occupations. Additionally, genetics might render an individual more sensitive to dermatophytes (Gupta *et al*., 2017).

Pityriasis versicolor (PVC) or *Tinea versicolor* is a persistent superficial fungal disease on the trunk and upper arms characterized by round to oval lesions (White *et al*., 2014). *Malassezia furfur* and other *Malassezia* species mainly cause PVC infection on the *stratum corneum* of the skin (Kambil, 2017). This disease is connected with warm, humid conditions and is up to 60% more frequent in tropical regions than in temperate ones.

Krishan *et al*. (2015) reported that PVC is most prevalent in teens and young adults when *sebaceous gland* activity is at its peak. Malassezia requires the sebum produced by sebaceous glands for its metabolism. Typically, sebum is present on the face, scalp, chest, and back (Ahronowitz and Lesie, 2019). Sebum production in children is not yet optimal due to the small number of *sebaceous glands*, which will increase in number beginning with puberty (Nura *et al*., 2017; Remya and Arun, 2019).

In this study, *mycosis* superficial is most frequent in young individuals between the ages of 17 and 30. This conclusion is consistent with the findings of Khodadadi *et al*. (2021), who found that *mycosis* superficial was more frequent in individuals aged 21 to 40 years. Young adults have more outdoor working activities and are more likely to be exposed to fungal agents. Young adults are also more concerned about their health and attractiveness; therefore, they visit the hospital.

As demonstrated in Figure 1 (B), there were single-cell microconidia, which are characteristic of *Trichophyton*, but no macroconidia were observed. Figure 1 (D) shows the short hyphae that are characteristic of *Malassezia* that are responsible for PVC. *Epidermophyton, Trichophyton*, and *Microsporum* are the three closely related genera that make up the *Dermatophyta* and are separated into subgroups depending on the development and shape of their *conidia* (structures of asexual reproduction) (Hayette & Sacheli, 2015). *Trichophyton spp*. is one of the leading

causes of human hair, skin, and nail infections. Most *Trichophyton* species exhibit teleomorphic forms, which are classified within the *Arthroderma* genus (Ridzuan *et al*., 2020). The microscopic features of the fungus are *septate, hyaline, conidiophores, microconidia, macroconidia,* and *arthroconidia*. *Conidiophores* are challenging to differentiate from *hyphae. Miroconidia* is spherical or *pyriform* single-celled structures. *Microconidia* are frequently the predominant type of *conidia* in *Trichophyton. Macroconidia* is multicellular, soft, thin-walled, cylindrical, clavate, or cigar-shaped (Ridzuan *et al*., 2020).

Anthropophilic dermatophyte Epidermophyton spp. is widely dispersed worldwide and frequently causes *onychomycosis, Tinea pedis, Tinea corporis,* and *Tinea cruris*. *Microscopically*, *Epidermophyton* spp. exhibit *septate* and *hyaline hyphae filamentous fungus*. *Hyphae* are distinguished from other *dermatophytes* by the presence of soft, thin-walled, clavate, club-shaped *macroconidia* and the absence of *microconidia* (David, 2019).

Microsporum spp. are keratinophilic filamentous fungi belonging to the *dermatophyte* group. *Microsporum* spp. generate *septate hyphae, microaleurioconidia,* and *macroaleurioconidia* when viewed under the microscope. The *conidiophores* resemble *hyphae*. Soft, *hyaline*, thin-walled, unicellular, single, oval to clavate *microaleuriconidia*. *Hyaline,* roughened to *echinulate,* thin to thick-walled, generally fusiform, and multicellular (2-15 cells) are characteristics of macroaleuriconidia (Ridzuan *et al*., 2020).

Malassezia is the most common genus of fungi on healthy skin (Findley *et al*., 2013). *Malassezia* spp. are primarily found in lipid-rich anatomic regions, such as the face, scalp, and trunk (Gupta *et al*., 2003). *M. globosa, M. restricta, M. sympodialis,* and *M. furfur* are common *Malassezia* species that cause human dermatosis. *M. globosa* in pityriasis versicolor has been described as "spaghetti and meatballs" due to its short hyphal structures and plenty of yeasts (Clavaud *et al*., 2019). This short *Malassezia hyphae* were also discovered in our investigation.

Under a microscope, scrapings of skin treated with *potassium hydroxide* (KOH) will exhibit *septate* and branching long, thin hyphae. However, when utilizing simply KOH preparations for diagnosis, up to 15% of cases may generate false negatives (Panasiti *et al*., 2006). The findings of the KOH test conducted by Oktaviana *et al*. (2018) revealed that 85.25% of patient specimens contained *hyphae* structure. As a preliminary screening method, *potassium hydroxide* (KOH) microscopy is a quick, inexpensive, and easy procedure. This approach has a maximum sensitivity of 40%, a maximum specificity of 70%, and can give 15-30% false-negative findings (Yosella, 2015). For a more accurate diagnosis, conducting a fungal culture with SDA (Saboraud Dextrose Agar) medium is required. The gold standard for diagnosing *dermatophytosis* is a fungal culture, particularly if the diagnosis is uncertain and other tests produce unclear findings or if the disease is extensive, severe, or resistant to therapy (Andrews and Burns, 2008). Fungal culture can aid in the identification of fungal species (Leung *et al*., 2020).

5 Conclussion

The present study reveals that tinea corporis was the most frequent superficial mycosis in Denpasar, followed by tinea cruris and PVC (pityriaris versicolor). This study found that young individuals were the most susceptible to superficial mycoses. Some fungal specimens tested falsely negative after being examined under a microscope for this investigation. Nevertheless, this study was able to differentiate between dermatophytes and non-dermatophytes (Malassezia).

Author Contributions

Conceptualization, IGW.; methodology, IGW.; validation, IGW.; formal analysis, IMIW.; investigation, IMIW.; resources, IMIW.; data curation, IGW.; writing—original draft preparation, IGW.; writing—review and editing, IGW. and IMIW; visualization, IMIW.; supervision, X.X IGW. and IMIW.; project administration IMIW.; funding acquisition, IGW. All authors have read and agreed to the published version of the manuscript.

Informed Consent Statement

Not applicable.

Data Availability

Not applicable.

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Conflicts of Interest

The authors declare no conflict of interest

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