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AGE AND SEX CHARACTERISTICS OF DERMATOPHYTOSIS IN GIANYAR, INDONESIA

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ABSTRACT

Dermatophytosis is a superficial fungal infection caused by a filamentous fungus that attacks keratinized tissues on the skin, nails, and hair. The clinical manifestation of dermatophytosis is determined by the source. In addition, it can be influenced by host-related factors, such as age, sex, and race. These are significant epidemiological factors, although the association between these factors and susceptibility to infection has not been clarified. Therefore, this study aimed to determine the association between the incidence of dermatophytosis and host-related factors (i.e., age and sex) in Gianyar Regency, Indonesia. This observational study used a cross-sectional design and total sampling. A total of 100 samples were collected from the medical records of patients diagnosed with dermatophytosis. The Chi-square test was employed to determine the correlation between the independent and dependent variables with a p-value of <0.05. The data were analyzed using IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, N.Y., USA). The majority of patients with dermatophytes infection were adults over the age of 19 (74%) and females (57%). The most prevalent type of dermatophytosis was tinea corporis (36%). The Chi-square test revealed a significant association between the type of dermatophytosis and the variables being examined, namely age (p = 0.025; OR = 1.978; 95% CI = 1.087-3.599) and sex (p = 0.003; OR = 2.357; 95% CI = 1.334-4.162). In conclusion, the manifestation of certain types of dermatophytosis is associated with age and sex. The findings of this study recommend enhancing the detection of dermatophytosis infection, especially in adults (>19 years old) and women.

Keywords: Dermatophytosis; age; women; human and health

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Highlights:
1. Although dermatophytes may typically cause mild infections, it is crucial to conduct continuous research due to their potential to cause severe diseases in individuals who are highly susceptible to infection.
2. This study offers insight into the increased risk of developing dermatophytosis for female and adult individuals compared to male and younger individuals.

INTRODUCTION

Tropical countries, such as Indonesia, have high temperatures and humidity, which serve as risk factors for dermatophytosis. This superficial fungal infection known as dermatophytosis is caused by filamentous fungi that can invade keratinized tissues, such as the stratum corneum of the skin, hair, and nails. Dermatophytes are fungi that trigger dermatophytosis. They are classified into three genera: *Trichophyton*, *Epidermophyton*, and *Microsporum*. Dermatophytosis, commonly referred to as "tinea," is categorized according to its anatomical locations, i.e., tinea corporis (head), tinea cruris (groin), tinea pedis et manuum (feet and hands), tinea barbae (beard area), tinea capitis (scalp), and tinea unguium (nail) (Araya et al. 2021).

According to data released by the World Health Organization (2022), dermatophytosis affected about 25% of the world population. Approximately 30 to 70% of the dermatophytosis patients were asymptom-atic. Bitew & Wolde (2019) conducted a retro-spective study at the Arsho Advanced Medical Laboratory in Addis Ababa, Ethiopia, from January 2015 to December 2019. It was reported that out of

1,122 cases, 760 (67.7%) individuals were positively diagnosed with superficial dermatomycosis through a 10% potassium hydroxide (KOH) examination. Among the studied population, the highest proportion was observed in male patients and those aged 25–44 years. The most prevalent infection in the study was tinea unguium, followed by tinea capitis.

A retrospective study was conducted by Taufiq & Batubara (2020) at Deli Serdang Regional General Hospital, Deli Serdang, Indonesia, from 2015 to 2017. Their study reported that there were 86, 156, and 103 cases of dermatophytosis in the years 2015, 2016, and 2017, respectively. The most prevalent presentation of the infection was tinea corporis, which was mostly observed in patients aged 1–10 years. In a separate study carried out by Noegroho et al. (2017) at Wonosari Regional General Hospital, Gunung Kidul, Indonesia, 303 cases of skin infections were documented. Out of the 303 cases, fungal infections were reported in 127 (42%) individuals. Among the fungal infection patients, 96 (75.59%) individuals had dermatophytosis, which was most prevalent in those within the age range of 15–64 years. In addition, a retrospective study conducted by Devy & Ervianti (2018) at Dr. Soetomo General Academic Hospital, Surabaya, Indonesia, revealed a total of 466 dermatophytosis cases out of 648 cases from 2014 to 2016 in the Mycology Division. The prevalence of dermatophytosis was 184 (78.3%) cases in 2014, 102 (62.2%) cases in 2015, and 180 (72.3%) cases in 2016. Tinea corporis was the most prevalent type of dermatophytosis, followed by tinea cruris and tinea capitis.

Marsaoly et al. (2014) conducted a study at Prof. Dr. IGNG Ngoerah Central General Hospital, Denpasar, Indonesia, which revealed that 48 geriatric patients over 60 years developed dermatomycosis between 2010 and 2014. Tinea corporis and tinea cruris accounted for the largest proportion of cases, with a total of 16 cases (21.7%). At Sanjiwani Regional General Hospital, Gianyar, Indonesia, there had been no research related to dermatophytosis before this study. Hence, it is important to research to understand the characteristics of dermatophytosis patients. This will serve as a basis for further research aimed at identifying the risk factors of dermatophytosis, preventing its occurrence, and establishing guidelines for its management.

Although dermatophytosis is not life-threatening, it results in a significant financial burden, costing millions of rupiah annually for treatment, particularly if the first treatment is insufficient and the condition recurs. Additionally, the clinical presentation of dermatophytosis can resemble dermatitis, leading to inappropriate patient care. Prolonged and extensive use of antifungal medications may lead to the development of treatment resistance (Anggarini et al. 2015). Dermatophytosis, while limited to the skin, can persist and significantly disrupt daily life due to the emergence of aesthetic concerns, leading to a decline in quality of life. The rising incidence of dermatophytosis in Indonesia is an important health problem, necessitating careful consideration and evaluation (Devy & Ervianti 2018). This study aimed to characterize dermatophytosis patients at the Department of Dermatology and Venereology of Sanjiwani Regional General Hospital in Gianyar, Indonesia, between 2018 and 2021.

MATERIALS AND METHODS

The Health Research Ethics Committee of Sanjiwani Regional General Hospital, Gianyar, Indonesia, granted authorization for this research with reference No. 46/PEPK/I/2022 dated 10/1/2022. This study was carried out from September 2021 to July 2022 at Sanjiwani Regional General Hospital, located at Ciung Wanara Street No. 2, and at Darma Giri Skin Center, located at Dharma Giri Bypass Road No. 100, Gianyar, Indonesia. The collection of research sample data was conducted from February to March 2022, using the medical records of patients with clinical and/or laboratory diagnoses of dermatophytosis from 2018 to 2021 (Talari & Goyal 2020).

This study used a cross-sectional method to determine the clinical profiles of dermatophytosis patients who were admitted to the Department of Dermatology and Veneorology of Sanjiwani Regional General Hospital. The sample for this study was obtained using the total sampling method, which involved all population data that met the specified inclusion and exclusion criteria. Secondary data were collected from the medical records of the patients. The sample was calculated based on formula in cross-sectional design. A total of 100 medical records were included, following adjustments according to the inclusion and exclusion criteria (Vassar & Matthew 2013).

The collected data were grouped according to the predetermined research variables and arranged into frequency distribution tables. In addition, the data were analyzed using the Chi-square test to identify the factors associated with dermatophytosis across its different types, with a significance threshold set at $p<0.05$ (Singhal & Rana 2015). The statistical analysis was performed using IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, N.Y., USA).

RESULTS

The data gathered from this study revealed that the most common chief complaint reported by the subjects was itching, with a prevalence rate of 55%. Subsequently, there were also reports of itching and red patches (19%) as well as red spots (10%). As shown in Table 1, 89% of the subjects received a combination of oral and topical therapies (89%), which was the most prevalent form of treatment. The remaining subjects solely received topical therapy (6%) or oral therapy (5%). Tinea corporis was the most common type of dermatophytosis across all groups. The subsequent prevailing types of dermatophytosis observed in the subjects were tinea capitis, tinea cruris, tinea manuum, tinea pedis, and tinea unguium.

Table 1. Distribution of subjects according to the chief complaints, therapies, and dermatophytosis types.

Variables	n	%
Chief complaints		
Hyperpigmentation	2	2
Red patches	10	10
Red pathces, hypopigmentation, hair loss	1	1
Hypopigmentation	1	1
Hypopigmentation, hair loss	1	1
Itching	55	55
Itching, red patches	19	19
Itching, hypopigmentation	1	1
Crusty patces	1	1
Crusty and red patches	1	1
Nail discoloration	1	1
Nail avulsion	1	1
Skin avulsion	3	3
Hair loss	2	2
Alopecia, hair loss	1	1
Total	100	100
Therapies		
Oral	5	5
Topical	6	6
Combination	89	89
Total	100	100
Dermatophytosis types		
Tinea capitis	10	10
Tinea corporis	36	36
Tinea cruris	24	24
Tinea manuum	18	18
Tinea pedis	11	11
Tinea unguium	1	1
Total	100	100

According to the data shown in Table 1, it was noted that the type of dermatophytosis most diagnosed among the subjects was tinea corporis (36%), followed by tinea cruris (24%), tinea manuum (18%), tinea pedis (11%), tinea capitis (10%), and tinea unguium (1%). Additionally, the data showed that the most prevalent age group was the adult age group of 20–60 years (59%), with the most common type of dermatophytosis being tinea corporis (26%). This was followed by the group of children or adolescents aged 0–19 years with the type of dermatophytosis of tinea capitits (9%). The prevalence rate of dermatophytosis in the elderly group over 60 years was 15%, with the most common types of dermatophytosis being tinea corporis and tinea manuum at 5% prevalence rate each (Table 2).

Table 2. Distribution of dermatophytosis types according to age.

Dermatophytosis types	Age (y.o.)						Total
	0–19		20–60		>60		
	n	%	n	%	n	%	
Tinea capitis	9	9	1	1	0	0	10
Tinea corporis	5	5	26	26	5	5	36
Tinea cruris	5	5	16	16	3	3	24
Tinea manuum	1	1	12	12	5	5	18
Tinea pedis	5	5	4	4	2	2	11
Tinea unguium	1	1	0	0	0	0	1
Total	26	26	59	59	15	15	100

Table 3 presents an overview of the distribution of different types of dermatophytosis in both female and male subjects. According to the data, dermatophytosis occurred more frequently in female subjects (57%) than in male patients (43%). Tinea corporis was the most prevalent type of dermatophytosis in female patients, accounting for 21% of cases. Conversely, tinea cruris affected 18% of male patients.

Table 3. Distribution of dermatophytosis types according to sex.

Dermatophytosis types	Sex categories				Total
	Male		Female		
	n	%	n	%	
Tinea capitis	5	5	5	5	10
Tinea corporis	15	15	21	21	36
Tinea cruris	18	18	6	6	24
Tinea manuum	4	4	14	14	18
Tinea pedis	1	1	10	10	11
Tinea unguium	0	0	1	1	1
Total	43	43	57	57	100

The bivariate analysis, conducted using the Chi-square test, showed a significant association ($p<0.05$) between tinea capitis and the age of children or adolescents concerning the occurrence of dermatophytosis. Furthermore, there was a significant association between adult age and tinea corporis, tinea cruris, and tinea manuum ($p<0.05$). However, there was neither a significant correlation observed between age and tinea pedis nor tinea unguium across all groups. Table 4 displays the results of the investigation examining the correlation between age and different types of dermatophytosis.

Table 4. Association between age and dermatophytosis types.

Dermato-phytosis types	Age groups			Total	p
	Children	Adults	elderly		
Tinea capitis	9	1	0	10	0.017*
Tinea corporis	5	26	5	36	0.002*
Tinea cruris	5	16	3	24	0.03*
Tinea manuum	1	12	5	18	0.012*
Tinea pedis	5	4	2	11	0.930
Tinea unguium	1	0	0	1	0.504

*Significance level of p<0.05 by Pearson's Chi-square test.

The Chi-square test was also employed in the bivariate analysis to determine the correlation between sex and different types of dermatophytosis, as shown in Table 5. According to the analysis results, there was a significant correlation between the presence of dermatophytosis in female patients and the occurrence of tinea corporis, tinea manuum, and tinea pedis (p<0.05). Conversely, there was no correlation between sex and the occurrence of tinea capitis, tinea cruris, or tinea unguium in both female and male patients.

Table 5. Association between sex and dermatophytosis types.

Dermatophytosis types	Sex categories		Total		
	Male	Female			
	n	n	n	%	p
Tinea capitis	5	5	10	100	0.363
Tinea corporis	15	21	36	100	0.026*
Tinea cruris	18	6	24	100	0.375
Tinea manuum	4	14	18	100	0.001*
Tinea pedis	1	10	11	100	0.001*
Tinea unguium	0	1	1	100	0.179

*Significance level of p<0.05 by Pearson's Chi-square test.

DISCUSSION

Fungal diseases can be categorized into three major groups: superficial mycoses, subcutaneous mycoses, and systemic mycoses. Dermatophytosis is the most common contagious infection among superficial mycoses (Clebak & Malone 2018). It is a fungal infection that affects the outermost layer of the skin and its appendages, such as hair and nails. *Trichophyton rubrum*, *Epidermophyton sp.*, and *Microsporum canis* are the most common causes of dermatophytosis (Cornelissen & Hobbs 2020). Currently, dermatophytosis is a significant global disease and a public health problem in various parts of the world, particularly in developing countries. Most developing countries are located in tropical regions that are characterized by warm weather and high humidity. These environmental conditions are strongly associated with the colonization of skin fungi (Errichetti & Stinco 2018). While this disease is rarely fatal, it can still affect the well-being of its sufferers by subjecting them to social stigma and interfering with their daily activities. Unattractive cosmetic appearances also contribute to decreasing their work productivity (Ely et al. 2014).

The results of this study revealed that tinea corporis (36%) was the most common type of dermatophytosis, followed by tinea cruris (24%) and tinea manuum (18%). This epidemiological picture is important for clinicians, particularly in Gianyar, Indonesia, as the prevalence of each type of tinea varies among different regions. In a separate study conducted in Bali, Indonesia, it was discovered that the predominant types of dermatophytosis were tinea unguium (45.3%), tinea cruris (25.7%), and tinea corporis (15.5%) (Marsaoly et al. 2014). Another study carried out by Noegroho et al. (2017) in Gunung Kidul, Indonesia, yielded varied results. The study showed that the predominant types of dermatophytosis were tinea capitis (48.1%), tinea unguium (18.9%), and tinea corporis (17.1%). Kovitwanichkanont & Chong (2019) conducted a study in Australia, which revealed that the most common type of dermatophytosis was tinea corporis, accounting for 46.6% of cases. This was followed by tinea cruris at 27.7% and tinea pedis at 14.6%. In addition, a previous study by Petrucelli et al. (2020) showed that the most prevalent types of dermatophytosis were tinea corporis (32.8%), tinea cruris (27.8%), and tinea capitis (12.6%). Variations in research findings suggest that the prevalence of dermatophytosis varies by region. Therefore, it is crucial to conduct localized epidemiological studies to provide clinicians with information on the most common dermatophytosis cases.

This study found that dermatophytosis infection was most prevalent in adults aged 20–60 years. This is similar to the findings of a study in Medan, Indonesia, which reported that the majority of dermatophytosis patients fell within the age group of 40–59 years (36.2%), followed by the age group of 20–39 years (33.3%) (Astrid 2016). Similar results were also documented in a study conducted by Araya et al. (2021) in Ethiopia, which found that individuals most frequently infected were those aged 24-44 years (39.4%). This is possible because the immune system declines with age Devy & Ervianti (2018). A decrease in metabolism in adults may lead to obesity due to the accumulation of folds in several body parts (Kang et al. 2019). As this group is still in their productive age, the risk of contracting dermatophytosis increases due to their active lifestyle, which causes sweating when the body is hot and humid. Inadequate personal hygiene further fosters the growth of dermatophytes. Social activities are also common at adult age, thereby facilitating the spread of infection. Dermatophytosis infections can affect individuals of all age groups, although there are variations in how the different types are transmitted between adults and children. Referring to the findings of existing studies, it has been found that tinea capitis is common in children, while tinea corporis is more prevalent in adults (Vishnu et al. 2015).

In this study, dermatophytosis infections were more prevalent in female patients (57%) than male patients (43%). These results aligned with previous studies by Sondakh et al. (2016) in Manado and Taufiq & Batubara (2020) in Deli Serdang, Indonesia. The two studies showed that dermatophytosis was commonly found in female patients, with prevalence rates of 60.8% and 57%, respectively. A similar study conducted by Aref (2022) in Iran found that the highest proportion of individuals with dermatophytosis were female, accounting for 57.32% of the samples. Dermatophytosis can affect individuals of both sex categories. However, the prevalence rates of dermatophytosis may vary in different regions due to differences in habits and lifestyles. On the other hand, the results of this study were not in line with those of a previous study conducted by Sari (2021) in Denpasar, Indonesia. The study found that dermatophytosis mostly affected male patients (59%). According to Kang et al. (2019), dermatophyte infections are five times more common in male individuals than their female counterparts.

The most common chief complaint reported by patients in this study was itching (55%), followed by itching and red patches (19%). Previous research in Iran revealed comparable findings, with the most common complaints being itching (95.1%) and red patches (79.9%) (Rashidian et al. 2015). However, another previous study discovered that 65.38% of dermatophytosis patients exhibited red spots (Jartarkar et al. 2021). In theory, various types of tinea appear as well-circumscribed patches or plaques that are oval or circular in shape, reddish or scaly, and have prominent edges. Flat, scaly lesions spread centrifugally and disappear in the center, forming a distinctive annular lesion known as a ringworm. The central area becomes hypo-pigmented or brown and less scaly as the active border expands outward. Complaints of pruritus are typically present, although they are often mild. These manifestations arise because dermatophytes produce proteases and keratinases that penetrate and digest keratin. These two enzymes allow the fungus to invade the stratum corneum layer (Kang et al. 2019). The fungus cannot penetrate deeper tissues in healthy immunocompetent hosts, so chief complaint dominantly in superficial of skin (Jartarkar et al. 2021).

Most patients in this study (89%) received a combination of oral and topical therapies as their primary treatment. The results of this study contradicted previous research that indicated topical medication was the most often administered treatment for dermatophytosis patients, representing 68.6% of cases (Sondakh et al. 2016). Topical antifungals are the standard treatment for tinea. Local or superficial tinea usually improves with topical antifungal treatment applied once or twice daily for 2-4 weeks. Commonly used topical antifungal medications are from these groups: azoles (e.g., econazole, ketoconazole, miconazole), allylamines (e.g., naftifine, terbinafine), benzylamines (e.g., butenafine), ciclopirox, and tolnaftates. Deep, recurrent, chronic lesions that do not respond to topical antifungal treatment are indications for the administration of systemic antifungal medication. This is especially beneficial for immunodeficient patients or when many lesions make topical treatment challenging. A combination of oral and topical antifungal medications can improve cure rates (Al-Janabi & Al-Khikani 2020).

This study found that tinea capitis (9%), tinea corporis (5%), and Tinea cruris (5%) were the most prevalent types of dermatophytosis in children. On the other hand, tinea corporis (26%), tinea cruris (16%), and tinea manuum (12%) were types of dermatophytosis most commonly observed in adults. The analysis revealed a significant association between age and dermatophytosis types (p=0.000). Previous research conducted in other countries by Noronha et al. (2016) and Akbas et al. (2016) yielded comparable results. Out of 150 dermatophytosis patients, a significant correlation was observed between age and dermatophytosis types (p=0.05). The results of this study are not in line with those of prior research conducted by Astrid (2016), who used a retrospective design and included 182 patients at the Department of Dermatology and Veneorology of a central general hospital. The study reported no significant correlation between age and the dermatophytosis types (p=0.06). The study categorized participants into only two age groups: children aged ≤19 years and adults aged >19 years. It also focused on only four types of dermatophytosis: tinea capitis, tinea capitis and tinea capitis. cruris, tinea corporis, and tinea pedis. These differences might contribute to the variations in results between the study and this present study.

Bitew (2018) carried out a study on 303 dermato-phytosis patients at the African Tuberculosis and Leprosy Rehabilitation Training Center in Ethiopia, which revealed different results. The study revealed a lack of significant correlation between sex and dermatophytosis (p=0.883). This irrelevant result could be attributed to the exclusive focus on just one type of dermatophytosis, i.e., tinea unguium (onychomycosis). The study demonstrated an even distribution of tinea capitis prevalence between male and female patients. The most frequently found types of dermatophytosis in female patients were tinea corporis (58.3%), tinea manuum (77.8%), tinea pedis (90.9%), and tinea unguium. Conversely, tinea cruris was predominantly observed in male patients,

accounting for 75.0% of cases. This study found associations between sex and dermatophytosis types, with the strongest significance value of p=0.002. This is consistent with a previous study that identified a significant association between sex and different types of dermatophytosis (p=0.014) (Noronha et al. 2016).

The findings of this study differed from those of a cross-sectional study by Yuwita et al. (2016), which included 52 patients with dermatophytosis in Ciamis, Indonesia. It was found that there was no association between sex and dermatophytosis (p=0.780). The lack of significance in the results could be attributed to the limited sampling from a public health center where the majority of patients shared similar lifestyles and daily habits. Wang et al. (2020) conducted a retrospective cross-sectional study in northeastern China, which also produced different results from the participation of 36 patients. The study discovered no statistically significant association between sex and dermatophytosis (p=0.317). However, this could be because the sample population was categorized into only one type of dermatophytosis, specifically tinea pedis. The limitations and incompleteness of the data obtained might not cover all characteristics at the study site.

Superficial mycotic infections can affect individuals of all age groups. However, this research revealed that female adults were more prone to tinea corporis compared to male adults and individuals in other age groups (Akbas et al. 2016). Hormonal factors, physical activities, and interest in cosmetics may influence this phenomenon. The fungal infection commonly occurs in adults and is associated with various factors, such as increased physical activities, changes in hormonal patterns, and an elevated risk of exposure. In children, this infection occurs because of a lack of fatty acid production, which normally inhibits fungal invasion pre-puberty. In the elderly, there is a close correlation between this infection and changes in the immune system (Al-Janabi & Al-Khikani 2020). A decrease in the body's ability to fight infection can hinder the immune response, thus allowing the occurrence of dermatophytosis. Dermatophytosis is more common in male patients due to their active outdoor activities, such as sports and physically demanding jobs, leading to overactivity of sweat and sebaceous glands. Excessive sweat and sebum production create a conducive environment for the growth of dermatophytes (Kang et al. 2019).

Strength and limitations

This study provided an overview of the prevalence of dermatophytosis in Gianyar, Indonesia, by examining its correlation with different age and sex categories. However, this study was limited in its data collection from patient medical records. The improvement of medical record documentation is recommended by creating systematic, clear, and comprehensive records. Furthermore, the storage and classification of record data must be more organized to prevent information loss during data processing, thereby enhancing the optimization and accuracy of the research process. Further research is advised to analyze various factors that may affect the occurrence of dermatophytosis, such as personal hygiene, occupation, and the materials of clothing and footwear that are generally used. Future studies should also use a more appropriate research design, such as case control and cohort, to establish cause-and-effect correlations between variables.

CONCLUSION

Different types of dermatophytosis in Gianyar, Indonesia, are associated with age and sex. Additionally, female adults had a high risk of developing dermatophytosis. Promotive and preventive strategies are highly suggested to decrease the occurrence of dermatophytosis in this population.

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Conflict of interest

None.

Ethical consideration

This study obtained permission from the Health Research Ethics Committee of Sanjiwani Regional General Hospital, Gianyar, Indonesia, with reference No. 46/PEPK/I/2022 dated 10/1/2022.

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Author contribution

PIB contributed to the conception and design, analysis and interpretation of the data, drafting of the

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