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Original Research Article

EPIDEMIOLOGICAL AND CLINICOMYCOLOGICAL FEATURES OF SUPERFICIAL DERMATOPHYTIC INFECTIONS

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Abstract

Background: This study investigated the prevalence of superficial fungal infections (mycoses) caused by dermatophytes in a region with a humid climate and heavy monsoon rains, conditions known to favor their growth. The aim was to understand the types of dermatophytes present, potentially aiding in infection control.
Methods: All individuals presenting with skin OPD with a clinical diagnosis of superficial fungal infection were included in the study. Patient samples were obtained from the affected areas, including skin, hair, or nails, based on the clinical presentation and suspected site of infection. The affected region was meticulously cleansed using 70% ethyl alcohol and left to air dry. Skin scales, crusts, or nail and hair fragments were carefully collected in clean white paper packets. Skin lesions were sampled from the actively growing, erythematous peripheries.
Results: More common in males (11.25% each) compared to females (2.5% and 1.25%, respectively). *Tinea manuum*: Slightly more common in females (7.5%) compared to males (5%). *Tinea unguium*: More common in females (6.25%) compared to males (3.75%). Tinea pedis: Almost evenly distributed between males (8.75%) and females (2.5%). Tinea capitis: Not observed in males, but present in 2.5% of females. *Tinea faciei*: Mostly observed in males (7.5%) compared to females (1.25%). Pityriasis versicolor: Observed only in females (2.5%). Multiple infections: 13.75% of individuals had both *Tinea corporis* and *Tinea cruris*, with a higher prevalence in males (11.25%).
Conclusion: This study under its limitations concludes that the most commonly affected population by dermatophytosis was 31 – 40 years old and predominantly involved male cases. After investigations in the study, it was observed that the non-dermatophyte group was involved more than the dermatophyte group in causing superficial fungal infection. However considering the duration of the study, we suggest that extensive research can be carried out further in a more elaborative way.

Keywords: Dermatophytosis, tinea, *T. Corporis*, *T. Cruris*,

Introduction

The widespread occurrence of superficial dermatophytosis, alternatively referred to as tinea or ringworm infections, is notable on a global scale, establishing it as one of the most prevalent fungal skin conditions worldwide. Recent investigations conducted in various cities, including Kolkata, Ahmedabad, and Chennai, over the last 4-5 years, indicate a rising prevalence of dermatophytosis, as evidenced by comparative studies on superficial fungal infections [1-6]. Superficial fungal infections,

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encompassing a group of fungi affecting the upper layers of the skin, hair, and nails, are of significance due to the morbidity they induce, the potential for person-to-person transmission, and global prevalence. [7] Dermatophytes represent the primary etiological agents of cutaneous fungal infections, commonly known as "ringworm," "tinea," or dermatophytosis. These infections, affecting the skin, hair, and nails, are caused by a group of closely related keratinophilic fungi known as dermatophytes, all of which produce the enzyme keratinase. Factors promoting dermatophytic infections include close contact with animals, certain medications like antibiotics and steroids, and communal living arrangements.

They are a frequent occurrence, causing notable cutaneous distress. Symptoms often include severe itching, and lesions on areas such as the genitals can lead to social discomfort and a diminished quality of life. The escalating prevalence of dermatophytosis has been linked to various factors, including tropical climates, urbanization, crowded living conditions such as hostels, the use of occlusive footwear, tight clothing, communal showers, and participation in sports activities. [8] The term "recurrent dermatophytosis" lacks a standardized definition but generally denotes a persistent condition characterized by periods of exacerbation and remission. These individuals pose a risk of transmitting the infection to family members and close contacts. While several mechanisms contributing to chronicity and recurrence have been proposed, the precise underlying causes remain unclear. Despite the increasing incidence of recurrent dermatophytosis, information regarding its burden in our country remains limited. [9] Furthermore, a refractory superficial fungal infection may signal an underlying immunocompromised state. Coinciding with the surge in invasive fungal infections, superficial mycoses have become one of the most prevalent skin diseases worldwide. Typically, tinea infections present with lesions featuring a central clearing surrounded by an advancing red, scaly, elevated border. Inflammation aids in colonization and may lead to vesicles on the lesion's periphery, with increased inflammation observed in atopic individuals and those infected with zoophilic fungi [10]. The severity of a dermatophyte infection varies depending on the host's reactions, the virulence of the infecting strain or species, the infection's anatomical location, and local environmental factors. The prevalence of these infections tends to rise with age, changes in geographic location, and climate shifts. Particularly in tropical regions like India, environmental factors such as heat and humidity contribute to their common occurrence. Socioeconomic factors like overcrowding, poverty, and poor personal hygiene also heighten the risk. While dermatophytosis seldom leads to mortality, its impact on morbidity and cosmetic concerns underscores its significance.

Material and Methods

This cross-sectional study was done in the Department of Dermatology with the utilization of the services of the Department of Microbiology for the identification of the fungal strains in Prathima Institute of Medical Sciences, Naganoor, Karimnagar, Telangana state. Institutional ethical approval was obtained for the study. Written consent was obtained from all the participants of the study after explaining the nature of the study in vernacular language.

Inclusion criteria

1. All individuals presenting with skin OPD with a clinical diagnosis of superficial fungal infection were included in the study.
2. Males and Females
3. Aged 18 and above
4. Voluntarily willing to participate in the study

Exclusion criteria

1. Individuals already taking antifungal treatment were not included in the study.

Sample procurement and processing: Patient samples were obtained from the affected areas, including skin, hair, or nails, based on the clinical presentation and suspected site of infection. The affected region was meticulously cleansed using 70% ethyl alcohol and left to air dry. Skin scales, crusts, or nail and hair fragments were carefully collected in clean white paper packets. Skin lesions were sampled from the actively growing, erythematous peripheries. Hair specimens were selected from dull, lusterless

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strands and hair stubs, and extracted using sterile epilator forceps, while nail samples were obtained from the deeper, discolored, or dystrophic regions of the nails [11].

Direct microscopic examination: A portion of the sample was placed on a grease-free slide for microscopy. Various concentrations (10%, 20%, and 40%) of potassium hydroxide (KOH) were applied to the specimen, depending on the type of clinical sample, to identify fungal elements. Subsequently, the prepared slide was scrutinized under both low (10X) and high (40X) magnifications using a simple light microscope to detect yeast cells, hyphae, and arthroconidia. Fungal elements are typically manifested as highly refractive, hyaline, septate branching filaments [11].

Culture: Culturing was conducted on Sabouraud dextrose agar (SDA), with and without chloramphenicol (50 mg/L). Subsequent pure isolates were generated by subculturing on Sabouraud Dextrose and Potato Dextrose Agar (PDA) media for visual and microscopic examination of cultural characteristics (color and growth pattern) and morphological traits, respectively, for further differentiation. Following morphological assessment via microscopy, cultures were transferred to dermatophyte test media (DTM) for additional confirmation [11].

Statistical analysis: All the available data was analyzed and uploaded to an MS Excel spreadsheet and analyzed by SPSS version 19 in Windows format. The continuous variables were represented as mean, standard deviations, and percentages. The categorical variables were represented as p values obtained by application of the Mann-Whitney-Wilcoxon test and values of (<0.05) were considered as significant.

Results

A total of n=80 cases were studied during the duration of the study and selected based on the inclusion and exclusion criteria. Table 1 shows KOH Mount vs. Culture for Dermatophytosis Diagnosis. 54 patients (67.5%) had positive results for both KOH mount and culture, indicating good agreement between the methods. KOH mount sensitivity: Of the 64 patients with a positive fungal diagnosis, KOH mount identified 45 (56.25%). *KOH mount specificity*: Of the 16 patients with a negative fungal diagnosis, KOH mount correctly identified 7 (8.75%), with 9 false-positive results. *Culture sensitivity*: Of the 64 patients with a positive fungal diagnosis, culture identified 54 (67.5%), meaning there were 10 false-negative results. *Culture specificity*: Of the 16 patients with a negative fungal diagnosis, culture correctly identified all 16, meaning no false positives specificity of culture was (100%).

Table 1: Showing the comparison of results of KOH mount and Culture

KOH mount	*Culture results*		*Total (%)*
	Positive	*Negative*	
Positive	45 (56.25%)	9 (11.25%)	54 (67.5%)
Negative	19 (23.75%)	7 (8.75%)	26 (32.5%)
Total	64 (80.0%)	16 (20.0%)	80 (100.0%)

Figure 1 shows the age distribution of 80 suspected cases of superficial dermatophytosis included in the study. The majority of cases (61.25%) fall within the age groups 21-40. This suggests that young adults are more susceptible to superficial dermatophytosis compared to other age groups. The frequency of cases gradually decreases with increasing age. This could be due to various factors, such as the development of immunity: Individuals might develop some immunity to common dermatophytes over time through previous exposures. *Physiological changes*: Skin changes with age, potentially making it less hospitable for fungal growth. Decreased activity levels: Younger individuals might engage in activities that increase the risk of fungal infections, like sports or close contact with animals.

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 5, 2021

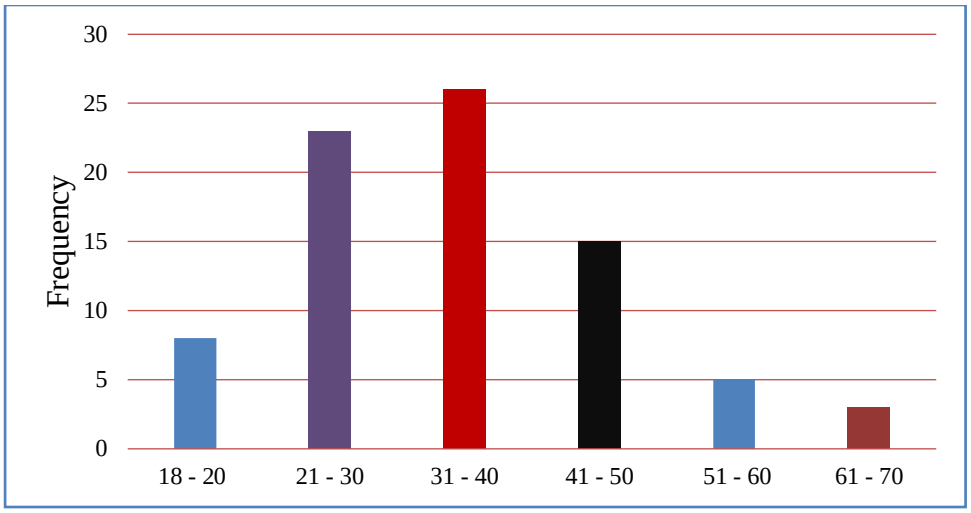

Figure 1 shows the age-wise distribution of suspected cases of superficial dermatophytosis included in the study.

Table 2: Sex-wise distribution of superficial dermatophytosis in the cases of study

Type	*Male (%)*	*Female (%)*	*Total (%)*
T. corporis	13	9	22 (27.5%)
T. cruris	10	8	18 (22.5%)
T .unguium	3	5	9 (11.25%)
T. capitis	0	2	2 (2.5%)
T. pedis	7	2	9 (11.25%)
T. faciei	6	1	7 (8.75%)
T. manuum	4	6	10 (12.5%)
T. corporis and T. cruris	9	2	11 (13.75%)
P. versicolar	0	2	2 (2.5%)

Table 2 analyzes the sex distribution of different types of superficial dermatophytosis infections in 80 study participants. There seems to be a slight female preponderance with 40% (females) vs 37.5% (males) having at least one dermatophyte infection. *Tinea corporis and Tinea cruris*: More common in males (11.25% each) compared to females (2.5% and 1.25%, respectively). *Tinea manuum*: Slightly more common in females (7.5%) compared to males (5%). *Tinea unguium*: More common in females (6.25%) compared to males (3.75%). Tinea pedis: Almost evenly distributed between males (8.75%) and females (2.5%). Tinea capitis: Not observed in males, but present in 2.5% of females. *Tinea faciei*: Mostly observed in males (7.5%) compared to females (1.25%). Pityriasis versicolor: Observed only in females (2.5%). Multiple infections: 13.75% of individuals had both *Tinea corporis* and *Tinea cruris*, with a higher prevalence in males (11.25%). Certain activities like wearing tight clothing or using communal showering facilities might be more common in males, increasing their risk for Tinea cruris and corporis. Hormonal factors: Estrogen dominance in females might influence susceptibility to *Tinea unguium* and possibly *Tinea manuum*. Hair length: Longer hair in females might create a more favorable environment for Tinea capitis. Cosmetics and hygiene practices: Facial hair grooming in males could explain the higher prevalence of *Tinea faciei*.

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 5, 2021

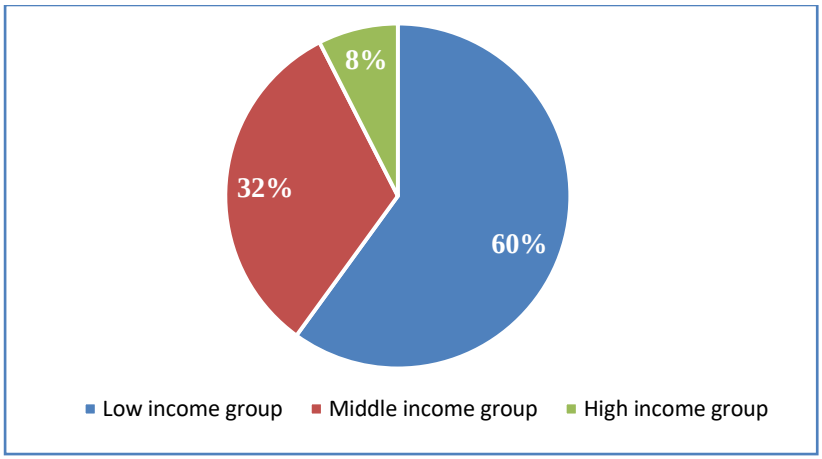

Figure 2 Distribution of socioeconomic status among the cases of the study

Figure 2 shows the distribution of socioeconomic status (SES) among 80 patients included in a study on superficial dermatophytosis. The majority (60%) belong to the low-income group. This suggests a potential association between low SES and increased susceptibility to superficial dermatophytosis. The middle-income group represents 32.5% of the patients. The high-income group has the lowest representation (7.5%). *Living conditions*: Individuals with lower SES might have crowded living conditions, limited access to proper hygiene facilities, or difficulty affording antifungal medications, all of which can contribute to fungal infections. *Nutritional deficiencies*: Poor nutrition, common in low-income groups, can weaken the immune system, making individuals more susceptible to infections. *Occupational exposure*: Certain occupations associated with lower SES might have a higher risk of exposure to dermatophytes, such as agricultural work or jobs involving close contact with animals.

Table 3: Distribution of isolated dermatophyte species among the clinical pattern of fungal infections.

		Clinical pattern								
		T. capitis	*T. ungium*	*T. Faciei*	*T. manuum*	*T. pedis*	*T. corporis*	*T. cruris*	*T. corporis with T. cruris*	*P. vesicolor*
Species	*T. mentegrophyt*	0 (0.00 %)	1(33.33 %)	2(100.0 %)	3(100. 0%)	2(50. 0%)	3 (60.0 %)	4 (50.00%)	2 (40.0 %)	2(100 %)
	T. rubrum	1 (100. 0%)	1(33.33 %)	0(0.00 %)	0(0.00 %)	0(0.0 0%)	1 (20.0	2 25.00(0. 00%)	1 (20.0	0(0.0 0%)
	M. cannis	0 (0.00 %)	0(0.00 %)	0(0.00 %)	0(0.00 %)	0(0.0 0%)	1 (20.0 %)	1 12.50(0. 00%)	1 20.0%)	0(0.0 0%)
	M. gypsium	0 (0.00 %)	0(0.00 %)	0(0.00 %)	0(0.00 %)	1(25. 0%)	0(0.00 %)	1 (12.50%)	1 (20.0 %)	0(0.0 0%)
	Epidermophyton	0 (0.00 %)	1(33.33 %)	0(0.00 %)	0(0.00 %)	1(25. 0%)	0(0.00 %)	0 (0.00%)	00(0.0 0%)	0(0.0 0%)
	Total	1 (50%)	3 (33.335 0%)	2 (28.575 0%)	3 (30.05 0%)	4 (44.4 4%)	5(22.2 7%)	8 (44.44%)	5 (45.45 %)	2(100 %)

Mixed infections: Several clinical patterns display infections with multiple dermatophyte species. Notably, *T. corporis* with *T. cruris* show combined infections in 40% of cases. *Species prevalence: T. mentagrophytes***:** Most prevalent overall, present in all patterns except *T. faciei* Highest association with *T. pedis* (50%) and *T. corporis* (60%). *T. rubrum***:** Primarily associated with *T. unguium* (33.33%) and *T. faciei* (100%). *M. canis***:** Primarily associated with *T. cruris* (20%) and *T. corporis* with *T. cruris* (20%). *M. gypseum***:** Less common, appearing in *T. pedis* (25%), *T. corporis* with *T. cruris* (12.5%), and *T. corporis* (20%). *Epidermophyton***:** Less common, isolated only in *T. unguium* (33.33%) and *T. pedis* (25%). *T. capitis***:** Only infected by *T. mentagrophytes* (50%). *T. unguium***:** Primarily infected by *T. rubrum* (33.33%) and *Epidermophyton* (33.33%). *T. faciei***:** Exclusively infected by *T. rubrum* (100%). *T. manuum* and *T. corporis***:** No dominant species, with infections spread across *T. mentagrophytes*, *T. rubrum*, and *M. canis*.

Discussion

Out of a total of 80 clinically diagnosed cases of superficial fungal infection, 54 (67.5%) samples were positive by direct microscopy and culture. 64 (80%) were culture positive out of which 45 (56.25%) grew dermatophytes. The 80 clinically diagnosed cases of superficial fungal infections were distributed between the ranges of 18-70 years. The most common age group to be affected was 31-40 years (32.5%) followed by 21-30 years (28.75%). The least common age group affected was 61-70 years (3.75%). This age predilection has been suggested due to the involvement of this age group in outdoor activity. In addition, males do more exhaustive physical work and prolonged exposure to the sun causes excessive sweating. Also, the tight fittings and synthetic clothing particularly in males provide damp, sweaty, and warm skin conditions. Comparable observations have been done by other authors also [12, 13]. Males were more commonly affected 48 (60%) than females 32 (40%), majority of the sample included skin scraping (91.25%) followed by nail scrapping or clipping (6.25%) and least commonly, plucked hair (1.25%). The lower incidence in females could be due to not paying attention to the lesion they have, as in most of the communities' females do not bother about their health and they do not get enough time for reporting in hospitals due to the prevailing social stigma in rural population and poor health seeking behavior of females [12, 13]. The incidence of infection is closely related to the site of infection and consequently to the clinical materials collected. In the present study, skin scales represent 91% of cases, while nails account for 7% and hair 2%. Similar findings have been shown in studies from abroad also [14]. In the present study most commonly, the affected group was students (26.25%) followed by housewives (22.5%) and agriculture workers (22.5%). The majority were from the low socio-economic group followed by the middle socio-economic group and the least from the high socio-economic group. Out of a total of 80 clinically diagnosed cases of superficial fungal infections, 54 patients (67.5%) had positive results for both KOH. *Trichophyton mentegrophytes* were the most common isolate followed by *Trichophyton rubrum*, *Microsporum gypseum, and Microsporum canis* (3.4%). The least common isolate was *Epidermophyton floccosum* (2.3%). In the case of student's higher freedom of movement, carelessness, common sharing of articles by fellow students, and perhaps lack of guidance regarding personal hygiene could be the factors in exposing students to increased dermatophytic infections [15]. In agricultural workers, this may be due to increased physical activity and increased opportunity for exposure to plants, animals, and soil [16]. A study carried out in West Bengal found that Dermatophytoses are related to activity, living conditions, and age groups [17]. A higher prevalence of dermatophytic infection was seen in the low-income group, (60%) followed by the middle-income group (32%) and least common in the high-income group (8%), which is similar to the observation of Kamothi et al. [18] from Rajkot, who reported that higher prevalence of dermatophytic infection was seen in low-income group than middle-income group. The reason behind this may be the poor living conditions, large family size, and close contact, either directly or by sharing facilities, including combs and towels between family members in low socio-economic people. In this study out of the 64 patients with a positive fungal diagnosis, KOH mount identified 45 (56.25%). *KOH mount specificity*: Of the 16 patients with a negative fungal diagnosis, KOH mount correctly identified 7 (8.75%), with 9 false-positive results. *Culture sensitivity*: Of the 64 patients with a positive fungal diagnosis, culture identified 54 (67.5%), meaning there were 10 false-negative results. These variations

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between microscopy and culture have also been noted by Grover S, et al. [19] Various studies have reported that the KOH positivity rate was higher than culture positivity [13, 17] Among dermatophytes, *Trichophyton mentagrophyte* was the predominant dermatophyte followed by *Trichophyton rubrum*, *Microsporum cannis* and *Microsporum gypseum*, least common isolate was of *Epidermophyton* floccosum. The difference in isolation rates of dermatophytes versus non-dermatophytes was found statistically non-significant p value=0.92 Similar results were also reported by other workers previously from Himachal Pradesh [20]. However, the findings differ in other studies from India as well as outside India, according to which *Trichophyton rubrum* was the predominant fungal pathogen than *Trichophyton mentagrophyte* [14, 18, 21]. This variation is possibly due to the different geographical regions and warm climatic conditions in the southern and western parts of the country. Some studies have also reported the prevalence of *Trichophyton rubrum* in chronic dermatophytosis [22], as it is a slow-growing organism, so there is a possibility that other dermatophyte species might overgrow or mask the growth of *Trichophyton rubrum* while attempting isolation. [20] *T. mentegrophytes*, the predominant species was found associated mainly with *Tinea corporis* (26.6%) and *Tinea cruris* (22.7%) however it was seen in all other Tinea conditions except *Tinea capitis*. Similar observations have been made by authors from Himachal Pradesh in 2014 [22]. The majority of *T. rubrum* were isolated in *Tinea cruris* (13.6%) followed by *Tinea ungium* (25%) and *Tinea corporis* with *Tinea cruris* (11.7%). similar findings have been shown in other studies also [23]. *M. cannis* and *M. gypseum* were isolated the same in *Tinea corporis* (6.6%) followed by *Tinea cruris* (4.5%) and *Tinea corporis* with cruris (5.8%), which is similar to findings from abroad studies [14]. *Epidermophyton* spp. were isolated in *Tinea ungium* (12.5%) and Tinea pedis (8.3%). Similar results were also reported by other workers previously from Bijapur (2004) (23). The current study shows *Tinea. corporis* to be the commonest clinical type of superficial mycosis followed by *Tinea cruris*, & *Tinea corporis* with *Tinea cruris*, *Tinea mannum*, *Tinea unguim*, and *Tinea pedis*. *Tinea corporis* was the most common clinical condition observed in which various exposed parts of the body are affected followed by *Tinea cruris* in the groin and surrounding areas are affected. Similar observations have been made by other studies across India in this field. [14, 24, 25] This tinea condition is more common in males due to tight clothing, maceration, and high rate of sweating in the groin and waist region making this site more vulnerable to dermatophytosis. Most of the incidence of *Tinea. mannum* and *Tinea. unguium* in females has been found in our study, which may be attributed to repeated prolonged exposures to water and different types of detergents (especially in the kitchen) while performing daily domestic chores. Similar findings have been shown by Bhatia et al. and Sharma et al. [24, 25] In our study most of the cases of *Tinea pedis* were seen in male than female cases. Our study group mainly comprised of students (26%) because of wearing closed footwear socks and shoes for a long period in all weather. These promote sweating and sweat retention in a-milieu conducive to fungal growth. These also provide damp conditions, especially in inter-digital spaces.

Conclusion

This study under its limitations concludes that the most commonly affected population by dermatophytosis was 31 – 40 years and predominantly involved male cases. After investigations in the study, it was observed that the non-dermatophyte group was involved more than the dermatophyte group in causing superficial fungal infection. However considering the duration of the study, we suggest that extensive research can be carried out further in a more elaborative way.

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