

Original Research Article

Assessment of factors related to treatment failure and recurrence of superficial dermatophytosis

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ABSTRACT

Background: Superficial dermatophytosis, commonly known as ringworm, is a fungal infection of the skin, hair, or nails caused by dermatophytes, primarily belonging to the genera *Trichophyton*, *Microsporum*, and *Epidermophyton*. Despite being a superficial infection, the rising incidence of treatment failure and recurrence has become a matter of concern in recent years.

Methods: This prospective observational study, conducted at the department of dermatology and venereology of Chittagong Medical College Hospital, aimed to investigate the epidemiological factors associated with treatment failure and recurrent cases of superficial dermatophytosis. The study spanned from March 2022 to February 2023, involving 249 participants diagnosed with *Tinea corporis*, *Tinea cruris*, *Tinea facies*, or *Tinea pedis*. Factors such as excessive sweating, use of warm water, clothing habits, sharing practices, and topical corticosteroid application were analyzed.

Results: The most common age group affected was 21-30 years, with a male preponderance (1.6:1). Excessive sweating, wearing water-soaked garments, and sharing towels were prevalent among participants. After 4 weeks of treatment, 81.5% achieved complete cure, but 52.7% of these cases experienced a recurrence within the subsequent 4 weeks. Multivariate analysis identified sharing towels, family history of dermatophytosis, and past topical steroid use as significant risk factors for treatment failure/recurrence.

Conclusions: The study emphasizes the importance of linen (sharing towels) in the transmission of dermatophytosis and highlights the increased risk associated with a family history of the condition. Additionally, the injudicious use of topical steroids emerged as a significant factor contributing to treatment failure and recurrence.

Keywords: Superficial dermatophytosis, Topical steroids, Treatment failure and recurrence, Fungal infections

INTRODUCTION

It is believed that around a billion individuals worldwide suffer from dermatomycoses, or fungal infections of the skin, hair, and nails.¹ Fungal skin disorders are incredibly widespread. The disease is characterized by an unprecedentedly high rate of transmission among family members and intimate contacts, and it now occurs regardless of climate variations, age, sex, educational

attainment, or socioeconomic status.² Although superficial dermatophytosis was once thought to be purely cosmetic, it has recently emerged as a serious public health issue. These infections are now to be viewed like other chronic and recurrent disorders because of its altered nature. The degree of discomfort caused by superficial dermatophytosis can have a negative impact on an individual's quality of life, even though it seldom results in mortality.^{2,3} Dermatologists have observed that a large number of patients with persistently resistant

dermatophytosis experience emotions of helplessness, guilt, and rage; a small percentage even show suicidal thoughts.⁴ When the disease (lesions) returns a few weeks (less than four weeks) after treatment is finished, dermatophytosis is deemed recurrent.^{5,6} However, even though they have received appropriate treatment, patients are deemed to have had the condition for more than six months to a year, with or without a recurrence.⁷ Various antifungal agents have been used for the treatment of these infections. Most common systemic agents used are terbinafine, fluconazole, and itraconazole. Although there is a rising trend of patients who tend to relapse following cessation of antifungal therapy, the relapses have not been conclusively proven to be consequent to resistance. Recently, Sardana et al concluded from their study that *in-vitro* resistance to antifungals is not common and should not be frequently labelled as a cause of treatment failure.⁸ The problem lies in the intricate host fungal interaction, and this should be the focus for research.

Various factors implicated in recalcitrant dermatophytosis are - host-fungal immune response, virulence potential of the infecting strain or species, clinical type of dermatophytosis, barrier defect, local factors (heat, humidity, sweating, type of clothing), pharmacological factors (quality of the drug, compliance, pharmacokinetics and absorption of the drug), and reinfection from other sources.

To this end the purpose of this study was to assess the factors related to treatment failure and recurrence of superficial dermatophytosis of the patients presenting to dermatology OPD of a tertiary care hospital of Bangladesh.

METHODS

This study is a prospective observational investigation conducted at the department of dermatology and venereology of Chittagong Medical College Hospital, Chattogram, Bangladesh. The study spanned from March 2022 to February 2023, during which the research focused on patients exhibiting superficial dermatophytosis. The study population comprised individuals attending the specified medical facility within the designated timeframe and carrying a diagnosis of *Tinea corporis*, *Tinea cruris*, *Tinea facies*, or *Tinea pedis*, with or without a history of recurrence or treatment failure. A total of 260 participants were included in the study through a convenience sampling method. The inclusion criteria encompassed patients aged 18 years and above, of both sexes, diagnosed with superficial dermatophytosis. Exclusion criteria comprised individuals who refused to participate and those exclusively presenting with *Tinea capitis* or *Tinea unguium*, as their treatment regimens differed from the primary focus of the study. A detailed history was taken from each participants regarding the duration, treatment taken, topical corticosteroid application, treatment compliance, affected family members, type of clothing, sharing of cloths, towels, soaps and footwear, bath habits,

frequency of changing cloths, contact with pets/cattle, intake of any immuno-suppressants, history of any other cutaneous or systemic disease. Appropriate physical examination and reviewing of medical records was done in every cases. Treatment was given according to hospital protocol by registered physician or specialist dermatologist in OPD of dermatology. Data were recorded in the form of excel worksheet. After completion of data collection, they were fed into statistical package for the social sciences (SPSS) for processing analysis. Multivariate analysis was performed using logistic regression to understand the influence of each variable while controlling the effects of others. P value <0.05 was considered statistically significant. This study was conducted after receiving ethical clearance from the ethical review committee of Chittagong Medical College. To ensure ethical considerations, individuals eligible for participation voluntarily provided informed written consent.

RESULTS

In this study, 300 patients with superficial dermatophytosis were screened for the eligibility. Among them 270 were found eligible. Informed consent was given by 260 eligible participants and finally 249 participants were included in the study after completion of 2 consecutive follow up at 4 and 8 weeks.

Age ranged between 18-70 years and the mean age was 34.4±13.9 years. The most frequent age group was 21-30 years, having 32.9% of the patients, followed by 31-40 years (21.3%), 18-20 years (17.7%), 41-50 years (14.1%), 51-60 years (10%), and 61-70 years (4%). There was male preponderance with a male to female ratio of 1.6:1. Most of the patients (80.7%) reside in urban locality (Figure 1).

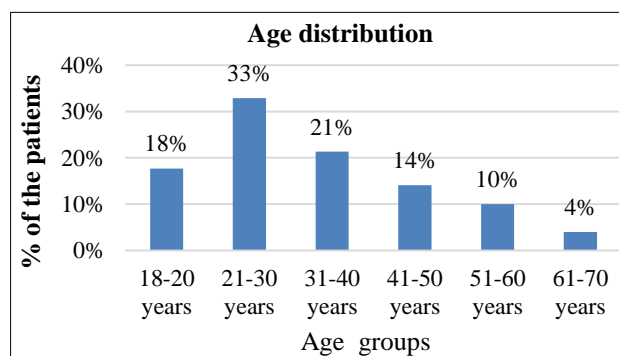


Figure 1: Age distribution.

Excessive sweating was reported by 182 (73.1%) of the patients, 216 (86.7%) patients gave history of taking bath every day, about half of the patients reported to use hot water to get relief from itching. Frequently wearing tight garments was seen in 130 patients (52.2%). Sharing of clothes, towels, and footwear among close contacts or family members was habitual among 52 (20.8%), 119 (47.8%), and 10(4%) of the patients. History of contact with animals such as dog/cats was seen to be present in

very few patients 17 (6.8%). History of similar complaint among family members or close contacts was seen in 142 (57%) of the patients (Table 1).

Table 1: Epidemiological factors related to treatment failure/recurrent superficial dermatophytosis.

Factors	Frequency	Percentage
Excessive sweating	182	73.1
History of topical steroid application	172	69.1
Use of warm water	122	49.0
Weekly frequency of washing clothes	7 (7-7)	
Wear synthetic cloths mostly	125	50.2
Wearing water-soaked garments	188	75.5
Tight clothing	130	52.2
Sharing cloths	52	20.8
Sharing towels	119	47.8
Sharing footwear	10	4.0
History of cooking food oneself	115	46.2
Average time (minutes) spent in kitchen	90 (60-180)	
Pets in home	17	6.8
Family history of tinea	142	57.0
Number of rooms in home	3 (2-4)	
Number of family members living in home	5 (3-6)	

Data were expressed as frequency and percentage or median and interquartile range

After 4 weeks of treatment, out of 249 patients complete cure was observed in 203 (81.5%) of the patients, and other 46 (18.5%) were labelled as treatment failure cases due to persistent of the lesions. Among the cured cases 107 (52.7%) have recurrent infection in next 4 weeks follow-up period (Table 2).

In this study, out of 249 patients, complete cure was achieved by 96 (38.6%) of the patients. Other 153 (61.4%) cases were either treatment failure cases or recurrent cases (Figure 2).

Table 3: Association of epidemiological factors related to treatment failure/recurrent superficial dermatophytosis with therapeutic response.

Factors	Therapeutic responses		P value
	Cure (n=96)	TF/Re (n=153)	
Excessive sweating	58 (60.4)	124 (81.0)	<0.001*
History of topical steroid application	43 (44.8)	129 (84.3)	<0.001*
Use of warm water	42 (43.8)	80 (52.3)	0.190*
Weekly frequency of washing clothes	7.0 (7.0-7.0)	7.0 (4.0-7.0)	0.112††
Wear synthetic cloths mostly	42 (43.8)	83 (54.2)	0.107*

Continued.

In univariate analysis, treatment failure/recurrence cases are associated with excessive sweating, wearing water-soaked garments, sharing towels, family history of tinea, and history of topical steroid use in the past (Table 3).

Table 2: Therapeutic response after completion of therapy.

Time of assessment	Frequency	Percentage
1st follow-up (4 weeks) (n=249)		
Cure	203	81.5
Treatment failure	46	18.5
2nd follow-up (8 weeks) (n=203)		
Cure	96	47.3
Recurrence	107	52.7

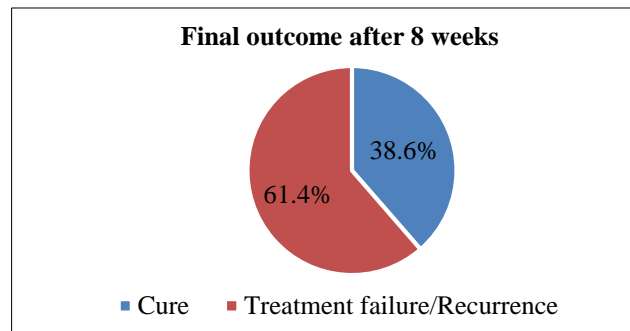


Figure 2: Final outcome of the studied patients after eight weeks of enrollment.

Data were expressed as frequency and percentage or median and interquartile range.

There are no association of diagnostic modalities chosen for the therapeutic outcome (Table 4). There is no association between treatment regimen and therapeutic responses of the patients (Table 5).

Sharing towel was an independent risk factor for treatment failure/recurrent dermatophyte infection (OR: 1.97, 95% CI: 1.07-3.64). Family history of dermatophytosis was revealed as a significant factor associated with treatment failure and recurrent infection. Patients with FH of dermatophytosis were 2.46 (OR: 95% CI: 1.34-4.51), times more likely to have treatment failure and recurrent infection than their counterpart. Patients with a history of topical steroid uses were 5.98 (OR: 5.978, 95% CI: 3.12-11.46) (Table 6).

Factors	Therapeutic responses		P value
	Cure (n=96)	TF/Re (n=153)	
Wearing water-soaked garments	60 (62.5)	128 (83.7)	<0.001*
Tight clothing	48 (50.0)	82 (53.6)	0.510*
Sharing cloths	16 (16.7)	36 (23.5)	0.195*
Sharing towels	37 (38.5)	81 (52.9)	0.027*
Sharing footwear	3 (3.1)	7 (4.6)	0.517*^
History of cooking food oneself	42 (43.8)	73 (47.7)	0.542*
Daily time spent in kitchen, min	70 (60-160.)	90 (60-180)	0.544††
Pets in home	4 (4.2)	12 (7.8)	0.250*^
Family history of tinea	41 (42.7)	102 (66.7)	<0.001*
No. of rooms in home	3.0 (2.0-4.0)	3.0 (2.0-4.0)	0.814*^
No. of family members living in home	5.0 (3.0-7.0)	5.0 (3.0-7.0)	0.778*

TF/Re: Treatment failure/recurrence, *Chi square test, ^Fisher’s exact test, ††Mann Whitney test

Table 4: Association between diagnostic modalities used and therapeutic responses.

Diagnostic modalities	Therapeutic responses		P value
	Cure (n=96)	TF/Re (n=153)	
Clinical	88 (91.6)	124 (81)	0.063
Microscopy	4 (4.2)	18 (11.8)	
Culture	4 (4.2)	11 (7.2)	

TF/Re: Treatment failure/recurrence; data were expressed as frequency and percentage, *Chi-square test

Table 5: Association between treatment received and therapeutic responses.

Treatment received	Therapeutic responses		P value
	Cure (n=96)	TF/Re (n=153)	
Terbinafine	28 (29.2)	59 (38.6)	0.130
Itraconazole	68 (70.8)	94 (61.4)	

TF/Re: Treatment failure/recurrence; data were expressed as frequency and percentage, *Chi-square test

Table 6: Binary logistic regression analysis to determine the association of independent risk factors for treatment failure/Recurrent superficial dermatophytosis.

Variables	β	OR	95% OR for CI		P value
			Lower	Upper	
Education - above SSC versus below	0.407	1.503	0.793	2.847	0.212
Marital - unmarried versus married	0.276	1.318	0.637	2.729	0.457
DM - absent versus present	0.704	2.021	0.731	5.589	0.175
Excessive sweating - absent versus present	0.573	1.773	0.795	3.958	0.162
Wear-soaked garments - no versus yes	0.664	1.943	0.851	4.435	0.115
Sharing towel - no versus yes	0.680	1.974	1.070	3.642	0.029
FH of dermatophytosis - absent versus present	0.898	2.455	1.337	4.507	0.004
Topical steroid - used versus unused	1.788	5.978	3.119	11.460	<0.001

DISCUSSION

Across various studies, the present study noticed a similar trend of the young people being the most common affected. In the present study, patients aged between 18-70

years were included, and the mean age was 34.4±13.9 years. The most frequent age group was 21-30 years, having (82) 32.9% of the patients. The age distribution of the present study agreed to the previous studies conducted in Bangladesh and India which reported age group of 20-30 years followed by 30-40 years as most commonly

affected.^{3,9,10-13} The predisposition of infection among adults may be attributed to their greater physical activity, mobility, and perspiration that aids in the proliferation of the fungus. Previous studies reported the association of recurrent dermatophytosis with various risk factors such as occupation, family history of dermatophytosis, pre-existing comorbidity, excessive sweating, type of undergarments (tight fit), poor frequency of washing clothes, sharing of a towel/clothes, frequency of taking baths, and prior use of topical steroids.^{12,14} In the present study, in multivariate analysis, sharing towels, having family history of dermatophytosis, and history of using topical steroid in the past were significant risk factors. In a study of recurrent dermatophytosis, observed that a high incidence of intra-familial tinea infections, misuse of corticosteroids containing topical antifungal preparations, poor compliance to treatment and poor personal hygiene were associated with recurrences and poor responses to treatment.¹² A positive association has been found between chronic and chronic relapsing tinea and pre-existing diabetes mellitus, family history of tinea and personal history of cooking food. However, the study did not show that following variables increase the risk: wearing jeans, frequency of washing clothes (including undergarments, jeans, and towel), frequency of taking bath, history of excessive sweating, presence of children below 15 years in home, pets in home, crowding in home and BMI.¹³ Comorbid conditions such as diabetes can predispose an individual to immunosuppression, thereby promoting recurrence or persistence of infection.¹⁵ In the present study, there were 34 (13.7%) known cases of diabetes mellitus. However, when it comes to treatment failure and recurrent dermatophytosis infection, present study finds only statistically significant association between the presence of diabetes mellitus and recurrent tinea infection ($p=0.021$). In a study by Singh et al 5.3% of cases had pre-existing diabetes.¹³ The authors found a positive association between diabetes mellitus and the risk of chronic or relapsing dermatophytosis. On the contrary, Kalekhan et al did not find a significant difference in the presence of diabetes or any other concomitant illnesses among the case of chronic and/or recurrent infection and control.¹⁶ Excessive sweating was found in 124 (81%) participant and was found to be associated with treatment failure or recurrent cases in univariate analysis in the present study, but the association did not persist in regression analysis, after adjusting for other significant variables. The association of hyperhidrosis with the duration of disease was found to be statistically insignificant in the study of Jain et al.¹⁷ Sweating has been well established as a risk factor for increasing the prevalence of dermatophytosis. Sweating in conjunction with other factors, such as poor hygiene, might further increase the incidence of dermatophytosis. In a study by Ranganathan et al the authors found that people who were engaged in occupations associated with increased sweating (58.9%), such as laborers, exhibited increased incidence rates of dermatophytosis relative to those who were not engaged in such occupations.¹⁸ Tinea lesions were commonly seen to be present in areas prone for occlusion

due to tight fitted clothes like the waistline, groin, or inframammary area.¹⁹ Frequently wearing tight garments was seen in 130 (52.2%) patients in the present study. However, the association of wearing tight-fitting clothes with the recurrence or treatment failure was not statistically significant in the current study. Similar to the tight-fitting clothes, wearing synthetic clothes were not associated with treatment failure or recurrent cases in the present study. A recent consensus statement formulated by the IADVL Taskforce against Recalcitrant Tinea (ITART) advises against the use of synthetic and tight clothing. The statement also discourages wearing bands, threads, drawstrings, and rings as they could carry fungus and add to persistence and recurrence of infection.¹⁸ Family history of dermatophytosis was revealed as a significant factor associated with treatment failure and recurrent infection. Patients with FH of dermatophytosis were 2.46 (95% CI: 1.34-4.51), times more likely to have treatment failure and recurrent infection than their counterpart. Similarly, sharing towel was an independent risk factor for treatment failure/recurrent dermatophyte infection (OR: 1.97, 95% CI: 1.07-3.64). Tinea rubram survived <12 weeks on towel. Tinea mentagrophyte survived >25 weeks on towel. This fact highlights the increased risk of re-infection in family members sharing same towel and the importance of disinfection which could be best done by washing clothes and towel in hot water and drying in sunlight.² Re-infection from the contacts or through fomites is a significant contributing factor for the increasing prevalence of chronic and recurrent forms of superficial dermatophytosis reported that family members of 72% of patients had dermatophytosis, the spouse being frequently affected.²⁰ In the present study, patients' past prescriptions by non-dermatologists were examined, and came across many instances of improper management. Use of topical steroids either alone or in combination with antibiotics and antifungals was frequent 172 (69.1%) in the present study. The association of use of topical steroids with treatment failure and recurrence was found statistically significant ($p<0.001$) in multivariate analysis. Topical corticosteroid prescription, whether alone or in combination with other components, was strongly discouraged by all the experts of the Indian Association of Dermatologists, Venereologists and Leprologists (IADVL) taskforce against recalcitrant tinea (ITART).²⁰ The main limitation of the study was the absence of calculation of MIC in cases with failed cure and recurrent cases. However, Sardana et al found that, MIC seen in the patients with treatment failure dermatophytosis were higher than western data, in vitro resistance to antifungals was not seen and probably may not be a cause of treatment failure.⁸ Possibly, treatment failure lies in the intricate host fungal interaction and virulence of species which help it to evade host immune response. It was not possible to consistently culture the agent responsible for the tinea in the present study and, hence, it was decided to focus more on clinico-epidemiology than microbiology. 87 (34.9%) participants were treated by terbinafine and among them 28 (29.2%) participants were cured and 59 (38.9%) participants were treatment failure/recurrence. 162 (65%) participants were

treated by itraconazole and among them 68 (70.8%) participants were cured and 94 (61.4%) participants were treatment failure/recurrence. There is no association between treatment regimen and therapeutic responses of the patients.

CONCLUSION

There may be some important epidemiological determinants for higher chances of treatment failure or recurrent dermatophytosis. Linen (sharing towel) may play an important role in the transmission of the infection. There may be higher chances of the treatment failure or recurrent infections in people with history of topical steroid abuse. Family history of dermatophytosis was a significant risk factor for treatment failure or recurrent dermatophytosis. Excessive sweating may favor fungal growth and colonization which ultimately contribute in treatment failure and recurrent dermatophytosis.

Recommendations

Management of the patients in the current scenario requires a longer duration of treatment with comprehensive care including general measures such as counselling on lifestyle and full adherence to the treatment.

Clothing should be loose-fitting, of cotton or synthetic material that removes moisture away from the skin surface. Sharing garments and towels must be discouraged.

Undergarments, socks, and cloths should be regularly washed and dried in the sun and ironed. Frequent changing of clothes should be advised

Simultaneous treatment of other affected family members should be done.

One of the most important factors that immediate attention in a war footing is the abuse of OTC topical steroid-antifungal cream. We need to create health awareness about dermatophytosis and the topical steroid abuse among the practitioners, pharmacist and the public by means of meetings, social media mass campaign, posters and pamphlets.

Further studies are required concerning the role of genetic factors, innate immunity, local immune response in recurrences of the disease, and evaluation of current available antifungal agents for the treatment of recurrent dermatophytosis.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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