Clinicomycological Profile of Pediatric Dermatophytoses: An Observational Study

Abstract
Background/Objectives: There has been a recent explosion in the incidence of dermatophytic infections globally, especially in tropical countries including India. This increase is associated with a change in the clinical pattern and mycological profile with poor response to treatment in adults and children. Limited studies in India have focused on pediatric dermatophytosis. Our study’s primary objective was to assess the clinicomycological profile of pediatric dermatophytosis in our region and secondarily to understand the association of lifestyle factors with poor response to treatment. Methods: This was an observational study including children ≤16 years of age, clinically diagnosed with tinea. Clinical and lifestyle data regarding site, affected surface area, duration of infection, previous treatment, possible sources of infection, overcrowding, and bathing practices were collected. Samples were collected for potassium hydroxide mount and fungal culture. Results: A total of 183 children participated in our study. The most common diagnosis was tinea corporis. Tinea cruris was more frequent in preadolescents, where males were more affected. Positive associations were seen between increased duration of infection, increased household infection, infection among playmates, irregular bathing, and use of steroid creams. The most common organism isolated was Trichophyton mentagrophytes/interdigitale (55.19%) followed by Trichophyton rubrum (14.75%). Conclusions: There is a change in the mycological profile of pediatric dermatophytosis with an increase in Trichophyton mentagrophytes/interdigitale infection. Important sources of infection in children must be identified in chronic and recurrent cases. Misinformed and ignorant use of steroid creams is an important reason for recurrent infection.

Keywords: Dermatophytosis, pediatric, superficial fungal infection, tinea

Introduction
Dermatophytes cause superficial infections of keratinized tissue, commonly called tinea. They grow within the stratum corneum, within and around the hair shaft, in the nail plate and keratinized nail bed.[1] Increasing incidence with a paradigm shift in the clinical and mycological patterns has made it a dermatologist’s epidemic.[2] Presently, there are limited studies on pediatric dermatophytosis from the Indian subcontinent. The primary objective of our study was to assess the clinicomycological profile of pediatric dermatophytoses in our region. Secondarily, we determined the association of lifestyle factors with chronic and recurrent infection.

Materials and Methods
This was an observational cross-sectional study at a tertiary care hospital in Eastern India including children ≤16 years with dermatophytosis of skin/hair/nails. Prior approval of the institutional ethical committee was obtained. The sample size at 95% confidence interval was 180 using Raosoft software.[3] A total of 183 children were included in the study. We excluded children treated with antifungals within the previous month.

Patient details including age, gender, infection duration, previous treatment, infection in contacts, overcrowding, and bathing habits were noted. Clinical data included the sites affected and body surface area (BSA) involvement.[4] Samples for KOH mount and fungal culture were collected from affected areas after obtaining the guardian’s consent. The lesion was cleaned with 70% alcohol and scrapings were collected from the edge or clinically most active site. Direct microscopic examination for fungal elements, was done using potassium hydroxide (KOH). The material was inoculated onto 2 sets of Sabouraud Dextrose Agar slope.

Access this article online
Website: www.idoj.in
DOI: 10.4103/idoj.idoj_235_21

How to cite this article: Ray A, Singh BS, Kar BR. Clinicomycological profile of pediatric dermatophytoses: An observational study. Indian Dermatol Online J 2022;13:361-5.

Address for correspondence:
Dr. Bhabani STP Singh,
Department of Dermatology,
IMS and SUM Hospital,
SOA University, Bhubaneswar - 751 021,
Odisha, India.
E-mail: drbstp@gmail.com

© 2022 Indian Dermatology Online Journal | Published by Wolters Kluwer - Medknow
one with chloramphenicol and cycloheximide and the other with only chloramphenicol. The tubes were incubated in Biochemical Oxygen Demand incubator and observed for 4-6 weeks. Speciation was done by observing colony morphology, pigment production if any, LPCB (lactophenol cotton blue) mount and subculture. Biochemical tests like urease test were also used.

Statistical calculation was done using Software SPSS version 23 (IBM Statistical Package for the Social Sciences for Windows, version 23.0, IBM Corp, Armonk, New York).

Results

Our study included 183 children with 100 males and 83 females. The age ranged from 10 days to 16 years with a mean age of 9.5 years. In children aged below 10 years, males and females were equally affected, and in children above 10 years, male-to-female ratio was 1.5:1 [Table 1].

Duration of infection

The mean duration was 2.8 months with significantly longer duration in pre-adolescents. The disease duration was longer in children from overcrowded households and with infected family members. Children taking infrequent baths had longer duration [Table 2]. Children, who had used mixed creams, had significantly longer duration. (P = 0.001).

Body surface area (BSA)

Eighty two patients had single site involvement, and 101 patients had multisite involvement. Only 2 children had over 10% BSA involvement and 66.65% had <3% BSA involvement. Pre-adolescent children had significantly higher BSA involvement (P = 0.05).

Diagnosis

Tinea corporis was the most common diagnosis [Figure 1a]. The commonest clinical presentation among the neonates and toddlers was tinea corporis followed by tinea faciei [Figure 1b]. Tinea cruris was primarily seen in pre-adolescents [Table 3] [Figure 1c and Figure 1d]. Only 3 patients had tinea capitis.

Sources of infection

62.2% children had infected family members and 13.11% children had infection in only friends/playmates. Both groups were infected in 14.7% of the study population.

Mother was the most commonly infected member (29.5%), mostly in pre-schoolers (67.7%), and in 47.6% of infants and toddlers. In older age-groups, infection in playmates was significantly more.

Treatment with mixed creams

Recurrence and relapse

There was no significant relationship between species and recurrence/relapse. The most common organism in both was Trichophyton mentagrophytes/interdigitale.

Table 1: Frequency of infection in different age groups

| Age group (years)          | Frequency |
|----------------------------|-----------|
| 0-3 (infants and toddlers) | 21 (11.48%) |
| 4-5 (preschoolers)        | 18 (9.83%) |
| 6-10 (primary school)     | 57 (31.15%) |
| 11-16 (middle school)     | 87 (47.54%) |

Table 2: Duration of infection

| Factors                        | Duration of infection (months) | P   |
|--------------------------------|-------------------------------|-----|
| Overcrowding in households     | 2.8                           | P=0.524 |
| No overcrowding in households  | 2.6                           |     |
| >4 infected family members     | 3.7                           | P=0.357 |
| <4 infected family members     | <3                            |     |
| Infected playmates             | 3.17                          | P=0.524 |
| No infected playmates          | 2.65                          |     |
| <10 years of age               | 2.01                          | P=0.001 |
| >10 years of age               | 3.5                           |     |
| Irregular baths                | 3.2                           | P=0.149 |
| Regular baths                  | 2.7                           |     |
| Mixed cream use                | 3.05                          | P=0.001 |
| No mixed cream use             | 2.6                           |     |

Table 3: Diagnosis according to age groups

| Age (years) | Most common diagnosis | 1st M/C site | 2nd M/C site | 3rd M/C site |
|-------------|-----------------------|--------------|--------------|--------------|
| 0-3         | Tinea corporis        | Abdomen     | Face        | Buttocks     |
| 4-5         | Tinea corporis        | Abdomen     | Buttocks    | Face         |
| 6-10        | Tinea corporis        | Groins      | Abdomen     | Lower limbs  |
| >10         | Tinea corporis with cruris | Groins  | Abdomen    | Face/Neck |

M/C: Most common

Figure 1: (a) Tinea corporis with cruris. (b) Tinea faciei. (c) Tinea axillaris. (d) Tinea cruris
Recurrence or relapse of infection was not significantly associated with mixed cream use. \((P = 0.504)\).

**Hygiene**

The mean duration of infection was higher in children taking irregular baths. \((3.2 \text{ months}) \quad (P = 0.149)\).

**Atopy**

In our study, 19.67% children were atopic. Atopy did not show any association with the species or recurrence/relapse.

**Organism**

Of all the samples, 75.41% showed growth in culture media with mostly *Trichophyton mentagrophytes/interdigitale* (73.18%) followed by *Trichophyton rubrum* (19.56%) [Table 4] [Figures 2 and 3].

a. Organism and duration: Mean duration of infection was 2.8 months. There was no association between the species and the duration.

b. Organism and BSA: Infection with *Trichophyton rubrum* had involved higher BSA (3.08%).

**Discussion**

Dermatophytosis is the most common infective dermatoses globally, affecting almost 25% of the global population, with a recent epidemic wave in India. The estimated lifetime risk of infection is almost 20%, incurring large healthcare expenses.[5] Infection is by deposition of viable arthrospore or hyphae on the surface of susceptible individuals. Radial germination of arthroconidia and hyphae occurs under suitable local conditions. Secretion of pathogenic enzymes like proteases, fungalysins, hydrolases, and ceramidases and hydrolysis of disulfide bonds facilitates the biodegradation of keratin.[6]

**Environment and lifestyle**

In tropical regions, infections are frequent and chronic/ recurrent infection is associated with poor living environment, company of infected children, and inadequate health-seeking behavior.[7] Household density is considered the primary socioeconomic determinant of skin lesions.[8]

Our study shows a higher mean disease duration in children taking irregular baths, living in overcrowded households, and belonging to families with over 4 infected members. The sex ratio in our study matches those in different regions.[9]

| Organism                          | Frequency |
|----------------------------------|-----------|
| *Trichophyton mentagrophytes/interdigitale* | 101 (55.19%) |
| *Trichophyton rubrum*            | 27 (14.75%) |
| *Trichophyton tonsurans*         | 3 (1.63%)  |
| *Microsporum audouinii*          | 4 (2.18%)  |
| *Microsporum gypseum*            | 2 (1.09%)  |
| *Epidermophyton floccosum*       | 1 (0.54%)  |

**Table 4: Overall frequency of organisms grown on culture**
Age distribution
A significantly higher incidence was seen in preadolescent age group, similar to other studies from Eastern India.[10,11]

Possible causes could be:
1. More participation in outdoor activities with increased sweating.
2. Negligence of personal hygiene is more common since parents are less vigilant with pre-adolescent children.
3. Pre-adolescent children are shyer about their bodies and are less likely to allow examination of private regions during hospital visits, which become an often missed source of recurrent infection.

Duration of infection
In our study, the mean infection duration was 2.8 months. Similar finding was noted by Mishra et al.[12] Long duration negatively impacts the child’s quality of life with considerable psychological distress, especially in recurrent cases.[11,14] Dermatophytic infections poorly impact child’s academic well-being and school performance.[15]

Use of mixed creams shows significantly longer duration of infection in our study, which has also been noted by others.[12,13] Longstanding infections are also explained by pathogenic factors such as adaptability of slow-growing fungi, inhibited local host defenses, inherited genetic susceptibility, and increasing clinical antifungal resistance.

Clinical presentation
The most common diagnosis in our patients was tinea corporis. Other studies demonstrate a higher prevalence of tinea corporis and cruris in children.[10,12]

The clinical profile of dermatophytosis in older children now mirrors adults. Tinea cruris in our study was commonly seen in pre-adolescent children with involvement of bilateral groin. Singh et al.[11] showed that the most common diagnosis was tinea cruris with corporis in all ages. The increased duration of school hours, use of synthetic uniforms, occlusive clothing, increased outdoor activity, which causes increased sweating possibly explains the involvement of crural regions.

Larger lesion size and multisite involvement could be explained by high spore load in the family and increasing fungal virulence.[2]

The changes like involvement of large areas of the body, chronic, recurrent infections and lack of response to established pediatric treatment schedules, necessitate revision of existing antifungal treatment strategies.

Atopy
Atopic dermatitis has the commonest systemic association with dermatophytosis.[16] In our study, 19.67% were atopic without any association with recurrence/relapse, or specific organism. Trichophyton rubrum is more frequently identified in atopic patients.[16-19]

Sources of infection
Dermatophytosis is highly contagious and in our study, till 5 years of age, 70% children had infected mothers, compared to less than 35% in older age groups. In younger children, there is a prolonged close contact with the mother, hence she becomes the source of chronic/recurrent infection. Infection in the family is seen in 83 to 91% cases of pediatric tinea.[12]

In pre-adolescent ages, there is a significantly longer duration of infection, and a significantly higher incidence among friends/playmates, which become a likely source of chronic/recurrent infection.

Fungal culture and organism
In our study, the most common organism was Trichophyton mentagrophytes/interdigitale [Figure 2a and b], followed by Trichophyton rubrum [Figure 2c] and Microsporum audouinii. Other detected organisms included Epidermophyton floccosum [Figure 3a], Trichophyton tonsurans [Figure 3b] and Microsporum gypseum. [Figure 3c and d]. These findings align with the findings of recent studies.[11,12]

Hygiene and lifestyle
The prevalence, chronicity, and recurrence of dermatophytosis are due to poor hygiene, fomite sharing, overcrowding, and close contact with infected family members.[2] Children with recurrent infection had more number of infected family members. Mean BSA involved was significantly higher in children taking irregular baths.

Limitations
1) A more detailed questionnaire about personal hygiene is pertinent.
2) Incidence of causative organism was skewed since majority of the fungus isolated was Trichophyton mentagrophytes/interdigitale which limited the derivation of associations between clinical factors and other species.

Conclusion
The present epidemic of superficial dermatophytic infections affects children and clinical patterns in pre-adolescent children mimics those in adults. An important source of pediatric infection is the family, especially mothers in younger children, and classmates/playmates in pre-adolescents. Improved hygiene, and restriction of mixed cream use will ensure early recovery. Overall, the most common organism in our study was Trichophyton mentagrophytes/interdigitale followed by Trichophyton rubrum.
Declaration of patient consent

Prior to inclusion in the study an informed consent was taken from the parent/guardian of all the children after they were given an explanation about the diagnosis, the required investigations and the sample collection procedure in their preferred colloquial language. Consent was taken for the purpose of capturing, recording and publishing the patient’s photographs and all attempts have been made to preserve the patient’s anonymity.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Segal E, Frenkel M. Dermatophyte infections in environmental contexts. Res Microbiol 2015;166:564-9.
2. Verma S, Madhu R. The great Indian epidemic of superficial dermatophytosis: An appraisal. Indian J Dermatol 2017;62:227-36.
3. Sample Size Calculator by Raosoft, Inc. Available from: http://www.raosoft.com/samplesize.html. [Last accessed on 2018 Nov 06].
4. Rajagopalan M, Inamadar A, Mittal A, Miskeen AK, Srinivas CR, Sardana K, et al. Expert consensus on the management of dermatophytosis in India (ECTODERM India). BMC Dermatol 2018;18:6.
5. Islam TA, Majid F, Ahmed M, Afrin S, Jhumky T, Ferdouse F. Prevalence of dermatophytic infection and detection of dermatophytes by microscopic and culture methods. J Enam Med Coll 2018;8:11-5.
6. White TC, Findley K, Dawson TL Jr, Scheynius A, Boekhout T, Cuomo CA, et al. Fungi on the skin: Dermatophytes and malassezia. Cold Spring Harb Perspect Med 2014;4:a019802.
7. Gräser Y, Monod M, Bouchard JP, Dukik K, Nenoff P, Kargl A, et al. New insights in dermatophyte research. Med Mycol 2018;56(suppl_1):2-9.
8. Gibbs S. Skin disease and socioeconomic conditions in rural Africa: Tanzania. Int J Dermatol 1996;35:633-9.
9. Chepichirchir A, Bi C, Ndinya-Achola JO. Dermatophyte infections in primary school children in Kibera slums of Nairobi. East Afr Med J 2009;86:59-68.
10. Dash M, Panda M, Patro N, Mohapatra M. Sociodemographic profile and pattern of superficial dermatophytic infections among pediatric population in a tertiary care teaching hospital in Odisha. Indian J Paediatr Dermatol 2017;18:191-5.
11. Singh BSTP, Tripathy T, Kar BR, Ray A. Clinicomycological study of dermatophytosis in a tertiary care hospital in Eastern India: A cross-sectional study. Indian Dermatol Online J 2019;11:46-50.
12. Mishra N, Rastogi MK, Gahalaut P, Yadav S, Srivastava N, Aggarwal A. Clinicomycological study of dermatophytoses in children: Presenting at a tertiary care center. Indian J Paediatr Dermatol 2018;19:326-30.
13. Sathyarayana Rao TS, Basavaraj KH, Das K. Psychosomatic paradigms in psoriasis: Psoriasis, stress and mental health. Indian J Psychiatry 2013;55:331-3.
14. Narang T, Bhattacharjee R, Singh S, Jha K, Kavita, Mahajan R, et al. Quality of life and psychological morbidity in patients with superficial cutaneous dermatophytosis. Mycoses 2019;62:680-5.
15. Nweze EI, Eke I. Dermatophytosis in Northern Africa. Mycoses 2016;59:137-44.
16. Hay RJ. Failure of treatment in chronic dermatophyte infections. Postgrad Med J 1979;55:608-10.
17. Sentamilselvi G, Kamalam A, Ajithadas K, Janaki C, Thambiah AS. Scenario of chronic dermatophytosis: An Indian study. Mycopathologia 1998;140:129-35.
18. Hay RJ, Brostoff J. Immune responses in patients with chronic Trichophyton rubrum infections. Clin Exp Dermatol 1977;2:373-80.
19. Hay RJ. Chronic dermatophyte infections. I. Clinical and mycological features. Br J Dermatol 1982;106:1-7.