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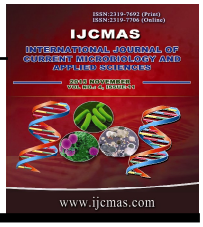

Original Research Article

Recent Trends of Dermatophytosis in Northeast India (Assam) and Interpretation with Published Studies

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A B S T R A C T

Dermatophytosis is among the most commonly diagnosed skin diseases in India. The climatic condition of northeast India is predominantly hot and humid with severe monsoons, promoting fungal infections. To determine the prevalence of dermatophytosis and their etiologic agents in Assam (India), 632 suspected to have dermatophytic infections were studied. A total of 437 males and 195 females ranged from 1 year to 80 years were included in the study. Clinical materials, including skin scraping, hair and nail clipping were collected. All the specimens were assessed by direct microscopic examination and *in vitro* culture. Of 632 patients, 377 (59.66%) had tinea. The types of tinea, according to anatomical locations were as follows: Tinea corporis (34.82%), tinea unguium (27.85%), tinea cruris (21.48%), tinea pedis (11.14%), tinea faciei (3.71%) and tinea capitis (1.32%). *Trichophyton rubrum* (50.15%) was the prominent causative agent followed by *T. mentagrophytes* followed by *Epidermophyton floccosum*. In addition, non dermatophytic molds (NDM) (10.79%) were also isolated. Based on a review of published data from different parts of India, there are regional differences in the incidence of dermatophytosis. *T. rubrum* has been the most frequently isolated dermatophyte species followed by *T. mentagrophytes*, *E. floccosum* and *T. tonsurans*.

Keywords

Dermatophytosis, Trichophyton rubrum, Tinea corporis, Tinea unguium, Non dermatophytic molds (NDMs)

Introduction

Dermatophytoses are superficial infections of keratinized tissues like hair, skin and nail, caused by a specialized group of fungi closely related antigenically, physiologically and morphologically, known as dermatophytes or ringworm fungi (Rabell and Taplin, 1974). The etiologic agents of the dermatophytoses are classified in three anamorphic (asexual or imperfect) genera, *Epidermophyton*, *Microsporum*, and

Trichophyton (Ajello, 1968). In addition, dermatophytes can alsobe divided into anthropophilic, zoophilic, and geophilic species on the basis of their primary habitat associations. Species of all three groups can cause human infection (Ajello, 1962). Dermatophytic infections include several distinct clinical manifestations named according to the anatomic locations involved. The severity of the disease relies on the specific strain of the infecting dermatophyte, the sensitivity of the host and the site of infection (Rippon, 1988; Richardson and Warnock, 2012). Dermatophytosis is very common throughout the world. About 20-25% of the world's populations are infected with dermatophytic fungi and the incidence is increasing on a steady basis (Menan *et al.*, 2002). At any topographical location no human race is free from dermatophytoses (Rippon, 1988). However, the prevalence of dermatophytosis varies according to geographical regions. The variance in the distribution pattern of dermatophytosis is attributed to the social practices, migration of labour, movements of troops, immigration and frequent worldwide travelling (Rippon, 1988; Sepahvand, 2009).

Several studies have investigated the prevalence of dermatophytosis in different parts of the world as well as many regions of India. A North Eastern region of India, Assam has predominantly humid sub-tropical climate with hot, humid summers, severe monsoons and mild winters, the fungal infections particularly dermatophytosis is quite common.

Moreover, due to the socioeconomic conditions of the residents, immigration of labours and tourists as well as being the trade centre of northeast India, the present study was aimed to establish the importance of this region for prevalence of dermatophytosis, their etiological agents and changes in distribution patterns of the disease.

Materials and Methods

Sample collection

A total of 632 clinical samples was collected from patients visiting at the outpatient department of dermatology, 155 Army Base Hospital, Tezpur, Assam and from different cosmetic clinics located in and around the region for a period of three years, from January 2012 to December 2014. Before the samples were collected, the information regarding gender, age, site of lesion and the profession of the patient was noted. During sample collection, the lesion site was sterilized with 70% alcohol and ensured total dryness. Then the samples were collected by scrapping skin, clipping nails and plucking the hairs with sterile scalpel and forceps. Collected samples were kept in a sterile container and carried to the laboratory for further analysis.

Direct microscopic examination was carried out using 10% KOH-DMSO preparations to observe fungal hyphae (Singh and Beena, 2003). Specimens were inoculated on Sabouraud cycloheximide chloramphenicol agar (Himedia Laboratories Pvt. Ltd., India), incubated at 28°C for 4 weeks and observed after an interval of 2–3 days (Irene and Summerbell, 1995).

Identification of the cultures was based on macro and microscopic morphology, hair perforation test, urease and cornmeal agar (Himedia Laboratories Pvt. Ltd., India) tests. Urease test was used to differentiate between *Trichophyton rubrum* and *T. mentagrophytes*. Further, for definitive identification of these isolates, corn meal agar with 1% dextrose was used. *T. rubrum* produces red pigment in this medium (Naseri *et al.*, 2013). In addition, further

species level identification of the isolates was confirmed by ITS rDNA sequencing (Ninet *et al.*, 2003).

Results and Discussion

Out of 632 clinical specimens, 437 samples were of male and 195 samples were of female (Fig. 1). Direct microscopic and culture examinations showed 377 (59.66%) cases were positive for different types of dermatophytic infections (Table 1). Tinea corporis (34.82%) was the prominent clinical manifestation of dermatophytosis followed by tinea unguium (27.85%), tinea cruris (21.48%), tinea pedis (11.14%), tineafaciei (3.71%), tinea capitis (1.32%), tinea mannum (0.79%) and tinea barbae (0.53%) (Table 2).

According to clinical manifestations with respect to age, patients belonging to age group 21-30 years and 31-40 years were most commonly infected with dermatophytes. Tinea cruris, tinea unguium and tinea pedis were observed commonly in male.

T. rubrum (50.15%) was the prominent causative agent, isolated mostly from tinea corporis, tinea unguium and tinea cruris. The other dermatophytic species isolated were *T. mentagrophytes* (29.2%) and *Epidermophyton floccosum* (9.84%). In addition, non dermatophytic molds (NDM) (10.79%) were also isolated (Table 3).

The prevalence of dermatophytosis has been studied in various parts of India. The prominent reports from different regions are summarized in figure 1 and table 4. According to published studies, the incidence of dermatophytosis ranges from 36.6% to 78.4% in India. Moreover, *T. rubrum* has been the most frequently isolated dermatophyte species followed by *T. mentagrophytes*, *E. floccosum* and *T. tonsurans*. Though, species like *T. violaceum*, *Microsporum gypseum* and *M. audouinii* have also been isolated, but in less number (Table 4).

Hot and humid climate in tropical and subtropical countries like India makes dermatophytoses or ringworms a very common superficial fungal skin infection. Factors like socioeconomic conditions, lifestyle and migration also play further significant role in the prevalence of dermatophytosis in population. The present study investigated the epidemiology of dermatophytic infections in the northeastern region of India, Assam.

In our study, tinea was more common in males (81.43%) than in females (18.57%) with a ratio of 4.38:1 and the majority of the patients were between 21 and 50 years contributing 78.77% of the total dermatophytosis. This finding is well correlated with the outcomes of other researchers in India (Bindu and Pavithran, 2002; Grover and Roy, 2003; Bhavsar *et al.*, 2012; Maulingkar, 2014). The cases of dermatophytosis are usually in lag phase from 1 to 10 years, then in exponential phase from 11 to 40 years and finally in decline phase from 41-80 years (Table 2). This suggests that infections are common in young adults irrespective of the gender and the reason behind is the working culture which disposes them to the climatic conditions. In addition, personal hygiene and the nature of the job also act as add on factors in the occurrence of dermatophytosis in young adults. The predominance of male cases is mainly due to the fact that they are physically more active, which predisposes to increase sweating thus facilitating fungal growth (Mishra *et al.*, 1998; Patel *et al.*, 2010; Lyngdoh, 2014). The lower incidence in females might be due to the no reportingto the dermatology clinics and prevailing social stigma in the semi urban

and rural population (Garg *et al.,* 2004; Summana and Singaracharya, 2004; Naseri *et al.,* 2013).

The commonest clinical type observed in the present study was tinea corporis followed by tinea unguium and tinea cruris (Table 2). The finding with respect to tinea corporisis well corroborated with the majority of studies conducted in India (Aggarwal *et al.,* 2002; Bindu and Pavithran, 2002; Summana and Singaracharya, 2004; Sen and Rasul, 2006; Bhavsar *et al.,* 2012 and Maity, 2014). However, Grover *et al.* (2003) reported tinea pedis as the prominent dermatophytosis in serving army personnel which could be well correlated with their profession as they wear closed shoes regularly for longer hours for the day. Similarly, Lyngdoh *et al.* (2014) also showed tinea pedis as the most common manifestation in the majority of the Meghalaya population because people tend to wear socks and shoes for prolonged periods irrespective of climatic conditions. In contrast, in the study of Gupta *et al.* (2014) tinea unguium was the major group because most of the patients were farmers and labourers with poor hygiene. Whereas Kainthola *et al.* (2014) reported tinea capitis as the most common type of tinea in rural population of the Garhwal Himalayan region, Uttarakhand, India. This may be due to the tradition of populace to wear caps for prolonged time irrespective of weather and poor hygiene. In our study tinea unguium is the second most common tinea infection. This finding is well supported by the study of Bhatia and Sharma (2014) in Himachal Pradesh. The incidence of tinea unguium may be attributed to the fact that infection is typically asymptomatic, usually ignored by young adults and hence no proper medical treatment is taken. Infected nails serve as a chronic reservoir of infection leading to frequent mycotic infections of the skin. The occurrence of clinical types of dermatophytosis in a particular population mainly depends on geographical location, profession, hygiene, age group and gender.

In our study *T. rubrum* was the most prevalent causative agent followed by *T. mentagrophytes* (Table 3) which is in conformity with other studies in India (Table 4). The prevalence of this species is due to better adaptation in many habitats and virulence (Dahl and Grando, 1994). Moreover, the frequency of recurrent infection with this dermatophyte is quite common because of its ability to produce less severe lesions, often left untreated or neglected by the patient (Venkatesan, 2007). In contrary, Bhatia and Sharma (2014) had reported *T. mentagrophytes* as the predominant species followed by *T. rubrum*. This reverse trend was due to the fact that *T. rubrum* is usually linked to chronic dermatophytosis (Aya *et al.,* 2004) and such severe cases were excluded from the study. Besides, extended use of antifungal therapy to treat patients might have also reduced the occurrence of this species in the concerned region (Bhatia and Sharma 2014). Whereas, Grover and Roy (2003) reported *T. tonsurans* as the commonest species followed by *T. rubrum*, explaining that the variation was due to different geographical locations harboring different dermatophytic species.

In our study, from tinea unguium cases *T. rubrum* was commonly isolated which is in concurrence with the results of other studies in India (Das *et al.,* 2008; Kaur *et al.,* 2008; Bhavasar *et al.,* 2012). It is due to the ability of *T. rubrum* to survive and adapt well on skin surfaces, and easy to colonize on hard keratin (Dahl and Grando, 1994; Bhavasar *et al.,* 2012).

In the present study, 10.79% of the isolates belong to non dermatophytic molds (NDM) (Table 3). Though commonly referred as contaminants and reported to colonize

damaged tissues leading to infection. Interestingly, the majority of the NDM was isolated from tinea unguium, suggesting their possible direct involvement in the infection. However, their primary role in pathogenicity of superficial fungal infections cannot be established with certainty yet (Grover and Roy 2003). Lakshmanan *et al.* (2015) reported 24.4% non-dermatophytic fungus in the study, mostly comprising *Candida*, *Aspergillus*, *Alternaria*, *Curvularia* and *Fusarium*, suggesting that non dermatophytic molds are emerging agents of superficial infections, particularly in nail. The findings are in concurrence with our results.

The previously published studies in India revealed that the incidence of dermatophytosis is quite common, i.e. > 36% throughout India irrespective of climatic conditions (Table 4). This suggested that superficial infections caused by dermatophytes are common and thus pose one of the major public health problems all over the world (Ammem, 2010). However, the prevalence of dermatophytosis in hot and humid regions of India is high which elucidate that such environment is conducive for the growth of dermatophytic fungi (Bindu and Pavithran, 2002; Grover and Roy, 2003; Sen and Rasul, 2006; Balakumar *et al.,* 2012). Whereas studies conducted in Rajasthan (Sharma and Sharma, 2012), Gujarat (Bhavsar, 2012), Madhya Pradesh (Gupta *et al.,* 2014)) and Karnataka (Peerapur *et al.,* 2004) also reported high percentage of dermatophytic infections in the respective population. This can be attributed to the high temperature for most of the time, which facilitate body sweating thus resulting in fungal growth (Mishra *et al.,* 1998; Patel *et al.,* 2010). Moreover, in the case of Himachal Pradesh and Meghalaya, the incidence of dermatophytosis is less as compared to other published studies in India due to climatic conditions, particularly low temperature mostly throughout the year, but still infection persists in this region because of relatively high population density consisting primarily of farmers and construction workers/labours and high frequency of tourism (Bhatia and Sharma, 2014; Lyngdoh *et al.,* 2014). *T. rubrum* is the dominant species isolated from most of the clinical manifestations of dermatophytosis whereas *T. mentagrophytes* is the co-dominant species as reported by several studies in India (Patwardhan and Dave, 1999; Bindu and Pavithran, 2002; Bhavsar *et al.,* 2012; Lyngdoh *et al.,* 2014; Kainthola *et al.,* 2014). In addition, *T. violaceum* and *M. audouinii* species of dermatophytes were also reported but less in number and mainly isolated from tinea capitis (Gupta *et al.,* 2014; Peerapur, 2004; Bhavsar *et al.,* 2012).

The distribution pattern of dermatophytes in northeast India has changed during the course of time. The study conducted by Mattada *et al.* (1982) in the northeastern region showed *T. mentagrophytes* as the dominant isolate followed by *E. floccosum*, *M. gypseum* and *T. rubrum*. However, our study revealed *T. rubrum* as the major species isolated followed by *T. mentagrophytes* and *E. floccosum* which is well supported by the findings of other researchers (Sen and Rasul, 2006; Sarma and Borthakur, 2007; Lyngdoh *et al.,* 2014). This change in dermatophyte flora in the region is, due to the variation in climatic conditions and also immigration from the rest of India and surrounding countries as this region is being considered as the economic hub of the northeast India. Moreover, a remarkable finding in our study was that the frequency of tinea unguium cases (27.85%) in the population studied which is significant because non dermatophytic molds were co-dominant (Table 3).

Table.1 Details of clinical types with respect to direct and culture examination

Clinical Manifestation	KOH +ve& Culture +ve	KOH –ve& Culture +ve	KOH +ve& Culture –ve	KOH –ve& Culture –ve	Total number of +ve cases & %	Total number of cases
T. barbie	0	1	1	2	2(0.53)	4
T. corporis	87	25	18	78	130(34.82)	203
T. cruris	46	24	11	15	81(21.48)	96
T. faciei	7	4	3	17	14(3.71)	31
T. mannum	3	0	0	16	3(0.79)	19
T. pedis	17	14	11	41	42(11.14)	83
T. unguium	49	38	18	86	105(27.85)	191
Total	209(33.06%)	106(16.77%)	62(9.81%)	255(40.34%)	377	632

Table.2 Details of clinical manifestation with respect to age group and gender

Clinical Manifestation	Age Groups								Gender		Total & %
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Male	Female	
T.barbie	0	0	1	1	0	0	0	0	2	0	2(0.53)
T. corporis	2	18	57	26	16	10	0	1	97	33	130(34.82)
T. Cruris	0	6	32	23	12	4	4	0	76	5	81(21.48)
T. faciei	0	0	8	4	1	1	0	0	9	5	14(3.71)
T.mannum	0	0	1	2	0	0	0	0	0	3	3(0.79)
T. pedis	1	3	10	12	10	3	3	0	38	4	42(11.14)
T. unguium	5	8	28	37	16	8	3	0	85	20	105(27.85)
Total	8 (2.12%)	35 (9.28%)	137 (36.33%)	105 27.85%)	55 (14.59%)	26 (6.90%)	10 (2.65%)	1 (0.26%)	307 (81.43%)	70 (18.57%)	377

Table.3 Clinico-mycological correlation of dermatophytosis

Clinical Manifestation	*E. floccosum*	*T. mentagrophytes*	*T. rubrum*	Unknown	Total and %
T. barbie	0	1	0	0	1(0.31)
T. corporis	8	43	56	5	112(35.55)
T. cruris	2	23	45	0	70(22.22)
T. faciei	0	6	4	1	11(3.49)
T. mannum	0	2	1	0	3(0.95)
T. pedis	9	9	10	3	31(9.84)
T. unguium	12	8	42	25	87(27.62)
Total	31(9.84%)	92(29.20%)	158(50.15%)	34(10.79%)	315

Table.4 Published studies of dermatophytosis in different regions of India

Author	Years	Area	Dermatophytosis (%)	Major causative agents	Common clinical manifestation
Gupta et al.	1993	Punjab	49.05	*T.rubrum, E. floccosum, T. violaceum, T.mentagrophytes*	T. corporis
Patwardhan *et al.*	1999	Maharashtra	37.71	*T.rubrum, T.mentagrophytes, T. soudanense*	T. corporis, T. cruris
Bindu etal.	2002	Kerala	41.33	*T.rubr,T.mentagrophytes*	T. corporis, T. cruris
Grover and Roy	2003	West Bengal	70.5	*T.tonsurans, T.rubrum*	T. pedis, T. cruris
Peerapur etal.	2004	Karnataka	74.5	*T.mentagrophytes, T.rubrum, E. floccosum, M.audouinii*	T. cruris, T. corporis
Summana etal.	2004	Andhra Pradesh	45	*T.rubrum, T.violaceum*	T. corporis
Senand Rasul	2006	Assam	51	*T.mentagrophytes, E.floccosum, T.violaceum, T.tonsurans*	T. corporis, T. cruris, T. unguium
Sharma and Sharma	2012	Rajasthan	62.7	*T.rubrum*	T. corporis, T. cruris
Balakumar etal.	2012	Tamilnadu	78.4	*T.rubrum, T.mentagrophytes*	T. corporis, T. cruris, T. capitis
Bhavsar etal.	2012	Gujarat	68.16	*T.rubrum, T.mentagrophytes, E.floccosum, T.violaceum*	T. corporis, T. cruris
Lyngdoh etal.	2013	Meghalaya	38.22	*T.rubrum, T.mentagrophytes*	T. pedis, T. corporis, T. cruris
Bhatia and Sharma	2014	Himachal Pradesh	36.6	*T.mentagrophytes, T.rubrum, M.gypseum*	T. corporis, T. cruris, T. unguium
Gupta etal.	2014	Madhya Pradesh	55	*T.rubrum*	T. capitis, T. corporis, T. unguium
Kainthola *et al.*	2014	Uttarakhand	69.8	*T.rubr T.mentagrophytes, E.floccosum, T.verrucosum*	T. capitis, T. corporis, T. pedis
Maity *et al.*	2014	Bihar	37.9	*T.rubrum*	T. corporis, T. cruris, T. unguium

Fig.1 Geographic distribution of published studies of dermatophytosis in India

The main reason behind this is the emergence of NDM as primary agents of superficial infections in nail which are steadily but consistently disposing the primary dermatophytic species due to their fast growing characteristics and better adapted to the nail plates.

It can be concluded that the present study gives an insight about the prevalence of dermatophytosis and distribution pattern of dermatophyte flora in Assam, northeastern region of India. The data also provideinformation regarding various factors such as weather conditions, profession, social lifestyle and tourism, which are responsible for dermatophytosis in a region. Moreover, the published studies of dermatophytosis in India showed that the incidence of infection in a particular region is directly correlated to the category of population studied. In addition, the present study highlights the current scenario of dermatophytosis in northeast India, particularly the co-dominance of non dermatophytic fungi in cutaneous infection suggesting, evolution and addition of new taxa in dermatophytosis.

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