A CLINICO-MYCOLOGICAL EVALUATION OF DERMATOPHYTIC INFECTIONS – A SINGLE CENTRE PROSPECTIVE OBSERVATIONAL STUDY

SABA MOHSIN SIDDIQUI[1], YOGANAND J PHULARI[2]*, RAVISHEKAR N HIREMATH[3], CHETAN PATIL[4], PRIYANKA PATEL[5]

[1]Consultant Dermatologist and Cosmetologist, Cloud 9 Hospital, Vashi, Maharashtra, India. [2]Department of Dermatology and STD, Dr. D.Y. Patil Medical College, Kadamwadi, Kolhapur, Maharashtra, India. [3]Department of Community Medicine, AFMS, New Delhi, India. [4]Department of Dermatology, AFMS, New Delhi, India. [5]Assistant Hospital Administrator, GMERS Medical College and General Hospital, Himmatnagar, Gujarat, India. Email: dr.yogeshphulari@gmail.com

ABSTRACT

Objectives: The objectives of the study were to assess the epidemiological profile, clinical types, and association between the etiological agent isolated and the clinical type of dermatophytic infections. The epidemiology of dermatophytic infection is influenced by the changing patterns of migration, growth in tourism, immunocompetence of the host, pathogenicity of the infectious agents, availability of medical treatment, and changes in socioeconomic conditions.

Methods: An observational prospective study was carried out at large tertiary care hospital in Southern Maharashtra, India. 110 Participants were selected based on Inclusion and exclusion criteria. Data collection was done with help of personal interview and detailed examination by investigator using predesigned, pre-tested, and structured questionnaire. All patients were followed up in dermatology department till complete investigation, treatment, and discharge.

Results: Patients belonging to 21–40 year constituted 45% of the study population. Male to female ratio was 3:1. About 51.82% belonged to low socio-economic status and 56.36% were from rural areas. The most common isolate obtained was *Trichophyton rubrum* (25.45%) followed by *Trichophyton mentagrophytes* (7.27%). Out of the 110 samples collected, 66.36% (73 samples) were KOH positive and 35.45% (39 samples) were culture positive. The most common type of mixed dermatophytic infection was Tinea Corporis with Tinea Cruris (38.46%) followed by Tinea Manuum with Tinea Unguium (30.77%). Mixed type was seen more commonly in 21–40 years age group (30.77%). Association of isolate and the clinical type involved among study participants was assessed by applying Chi-square test which showed no statistical significance (p=0.94). Similarly, association of results of KOH mount and culture report to clinical types also showed no statistical significance (p=0.94). However, when association of age and sex with clinical types was assessed, age showed statistically significant association (p=0.004) while sex showed no statistical significance (p=0.32).

Conclusions: Incidence of dermatophytosis was maximum in rural areas, low socioeconomic group and in summer. Thus, changing environmental and socio-economic conditions often led to changing epidemiology of dermatophytic infections. Tinea corporis was found to be the commonest clinical type followed by Tinea cruris. T. rubrum was the commonest isolate obtained (25.45%). Fungi were demonstrated by direct microscopy and/or by culture in 73 cases (66.36%) out of 110 cases. Hence, direct microscopy with or without culture is an important diagnostic tool in dermatophytosis. Authors recommend more in-depth study with larger sample size and multicentric based to have clearer picture of dermatophytosis.

Keywords: Mycology, Dermatophytic, Infections.

INTRODUCTION

Dermatophytosis is common in the tropical and subtropical countries including India where the hot and humid climatic condition helps in acquisition and maintenance of mycotic diseases [1,2]. Other factors such as increased urbanization including the use of occlusive footwear and tight fashioned clothes, have been linked to higher prevalence [3]. Fungal infections of the skin and nails are thus a common global problem. The high prevalence of superficial mycotic infections shows that 20–25% of the world's population has skin mycoses making these one of the most frequent forms of infection [3]. The etiologic agents of the dermatophytoses are classified in three anamorphic (asexual or imperfect) genera, namely, Epidermophyton (*Epidermophyton floccosum*), Microsporum (*Microsporum audouinii*), and Trichophyton (*Trichophyton tonsurans*). Epidermophyton genus has only two known species to date, and only *E. floccosum* is pathogenic. Some dermatophytes, mostly the zoophilic and geophilic species of Microsporum and Trichophyton, are also capable of reproducing sexually and producing ascomata with asci and ascospores. These are called as Teleomorphs.

Various factors influence dermatophytosis infections including age, sex, temperature, occupation socio-economic status, and site. Large family size, crowded living conditions, and low socio-economic situations may contribute to the increased incidence of dermatophytosis in some urban populations [4]. Some areas of the body are more susceptible to the development of dermatophyte infections such as intertriginous areas (web spaces and groins) where excess sweating, maceration, and alkaline pH favor the growth of fungus [5]. Dermatophytosis present in different ways depending upon the site. Tinea corporis is a superficial dermatophyte infection characterized by either inflammatory or noninflammatory lesions on the glabrous skin (i.e., skin regions other than the scalp, groin, palms, and soles) [6].

During the last several years, reports on epidemiology of dermatophytic infection coming from various parts of India have demonstrated an increasing trend in the prevalence of cutaneous dermatophytic infections along with shift in spectrum of dermatophytic infection and isolation of a few unusual species [7,8]. *Trichophyton rubrum* continues to be the most common isolate along with Tinea corporis and cruris being the most frequent clinical type in comparatively big studies coming from Chennai and Rajasthan. Nevertheless, in studies from Lucknow and New Delhi, *T.*

mentagrophytes [9] and *M. audouinii* [9] have been the most consistent isolates. Few studies additionally revealed isolation of uncommon species such as *Microsporum gypseum* in non-endemic areas of the world [8]. The epidemiology of dermatophytic infection is also influenced by the changing patterns of migration, growth in tourism, immunocompetence of the host, pathogenicity of the infectious agents, availability of medical treatment, and changes in socioeconomic conditions [10]. As we see these changing trends, this study was carried out to assess the epidemiological profile, clinical types, and association between the etiological agent isolated and the clinical type of dermatophytic infections.

METHODS

An observational prospective study was carried out at dermatology department of large tertiary care hospital in Southern Maharashtra, India. Sample size was calculated using Slovin's formula and prevalence of dermatophytosis as 20% [3], 8% as allowable error on either side and 95%CI. The minimum sample of 97 was thus estimated. Finally, 110 participants were selected based on Inclusion criteria which included all clinically diagnosed cases of dermatophytic infection (skin hair and nails) irrespective of their age, sex, occupation, economic status, and willing to participate and giving consent. Patients already on treatment/ recently treated for fungal infection and co-morbidities such as diabetes mellitus, thyroid or parathyroid disorders or other chronic diseases, Immunocompromised and patients having secondary pyoderma, deep or subcutaneous fungal infection were excluded. Data collection was done with help of personal interview and detailed examination by investigator using predesigned, pre-tested, structured questionnaire (pro forma). Each and every patient was followed up in dermatology, venereology, and leprology department till complete investigation, treatment and discharge. The data thus collected were analyzed using SPSS (Statistical Program for the Social Sciences) software 15 version, Open Epi Software Version 2.3. This study was approved by the Institutional Research Committee and written informed consent was taken from the study subjects before enrolling them in the study.

RESULTS

Socio-demographic, clinical, and laboratory profile of study participants are shown in Tables 1 and 2. The most common type of mixed dermatophytic infection was Tinea corporis with Tinea cruris (38.46%) followed by Tinea Manuum with Tinea Unguium (30.77%). In this study,

Table 1: Socio-demographic profile of study participants

	Frequency	Percentage
Age (years)		
<20	20	18.18
21–40	45	40.91
41–60	35	31.82
>60	10	9.09
Gender		
Male	83	75.45
Female	27	24.55
Area		
Urban	48	43.64
Rural	62	56.36
Occupation		
Manual Laborer	36	32.73
Household worker	17	15.45
Sedentary Worker	16	14.55
Student	30	27.27
Other	11	10
SES (Socio-economic status)		
High	23	20.91
Middle	30	27.27
Low	57	51.82
Family History		
Present	52	47.27
Absent	45	40.91
Unknown	13	11.82
Total	110	100

the commonest isolate obtained was *T. rubrum* (25.45%) followed by *T. mentagrophytes* (7.27%). Out of the 110 samples collected, 66.36% (73 samples) were KOH positive. Out of 110 specimens inoculated into Sabouraud dextrose agar with chloramphenicol and cycloheximide, 35.45% (39 samples) were culture positive.

Patients belonging to 21–40 year constituted 45% of the study population. Tinea Capitis was seen 100% in <20 years age group. Tinea cruris was more seen in 21–40 year group (42.86%). Tinea corporis was most common (40.82%) in 21–40 years followed by 41–60 years (40.82%), and >60 years group (6.12%). Tinea pedis was seen more commonly in <20 years age group (50%). Tinea manuum was seen most commonly in age group of 21–40 years (66.67%). Tinea faciei was most commonly seen in 21–40 years age group (72.73%) followed by 41–60 years age group (27.27%). Tinea unguium was most common in >60 years age group (66.67%).Mixed type was seen more commonly in 21–40 years age group (30.77%) and 41–60 years age group (30.77%) followed by >60 years (15.38%).

Association of isolate and the clinical type involved among study participants was assessed by applying chi square test which showed no statistical significance (p=0.94) (Fig. 1). Similarly, association of results of KOH mount and culture report to clinical types also showed no statistical significance (p=0.94) (Fig. 2). However, when association of age and sex with clinical types was assessed age showed statistically significant association p=0.004 while sex showed no statistical significance (p=0.32) (Table 3). Distribution of results of KOH mount and culture report to clinical types is shown in Table 4.

DISCUSSION

The present study showed that average age in years was 38.13±19.25. Majority of the patients (40.91%) were in age group of 21–40 years.

Table 2: Clinical and laboratory findings of study participants

Season	Frequency	Percentage
Summer	48	43.64
Winter	29	26.36
Rainy	33	30
Duration in weeks		
<10	66	60
>10	44	40
Clinical types		
Tinea Capitis	2	1.82
Tinea Cruris	21	19.09
Tinea Corporis	49	44.55
Tinea Pedis	8	7.27
Tinea Manuum	3	2.73
Tinea Faciei	11	10
Tinea Unguium	3	2.73
Mixed	13	11.81
Isolate		
Trichophyton mentagrophytes	8	7.27
Trichophyton rubrum	28	25.45
Microsporum Audounii	1	0.91
Trichophyton Schoenleinii	1	0.91
Epidermophyton floccosum	1	0.91
Fusarium	1	0.91
Not known	70	63.64
KOH Mount		
Positive	73	66.36
Negative	37	33.64
Culture findings		
Positive	39	35.45
Negative	71	64.55
KOH and Culture status		
KOH positive Culture positive	29	26.36
KOH positive Culture negative	44	40
KOH negative Culture positive	10	9.09
KOH negative Culture negative	27	24.55
Total	110	100

Table 3: Association of age and sex parameters in relation to clinical types

Clinical type	Sex*		Age** (in years)				Total
	Male	Female	<20	21−40	41−60	>60	
	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)	
Tinea Capitis	2 (100)	0	2 (100)	00	00	00	2
Tinea Cruris	17 (80.95)	4 (19.05)	5 (23.81)	9 (42.86)	5 (23.81)	2 (9.52)	21
Tinea Corporis	35 (71.43)	14 (28.57)	6 (12.24)	20 (40.82)	20 (40.82)	3 (6.12)	49
Tinea Pedis	6 (75)	2 (25)	4 (50)	2 (25)	2 (25)	00	8
Tinea Manuum	3 (100)	0	00	2 (66.67)	00	1 (33.33)	3
Tinea Faciei	10 (90.91)	1 (9.09)	00	8 (72.73)	3 (27.27)	00	11
Tinea Unguium	3 (100)	0	00	00	1 (33.33)	2 (66.67)	3
Mixed	7 (53.85)	6 (46.15)	3 (23.08)	4 (30.77)	4 (30.77)	2 (15.38)	13
Total	83 (75.45)	27 (24.55)	20 (18.18)	45 (40.91)	35 (31.82)	10 (9.09)	110

*Applying chi square test, p=0.32, shows no statistical significance, ** Applying chi square test, p=0.004. Shows statistical significance.

Table 4: Distribution of results of KOH mount and culture report to clinical types

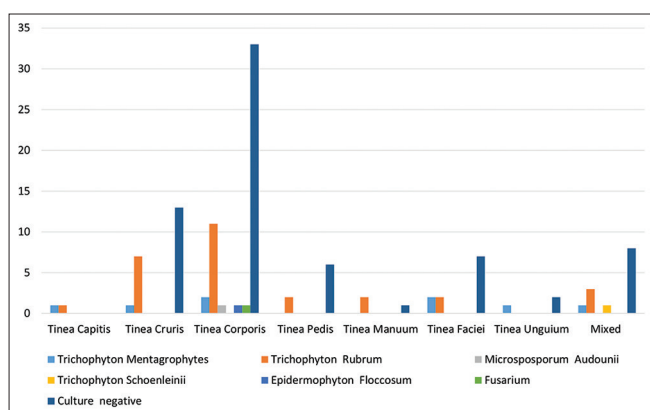| Clinical type	No of cases	KOH positive Culture positive	KOH positive Culture negative	Total KOH positive		KOH negative culture positive	KOH negative Culture negative	Total Culture positive	
				No.	(%)			No	(%)
Tinea Capitis	2	2	0	2	100	0	0	2	100
Tinea Cruris	21	5	8	13	61.91	3	5	8	38.1
Tinea Corporis	49	11	18	29	59.18	4	16	15	30.61
Tinea Pedis	8	2	4	6	75	0	2	2	25
Tinea Manuum	3	0	0	0	0	2	1	2	66.67
Tinea Faciei	11	3	7	10	90.91	1	0	4	36.36
Tinea Unguium	3	1	2	3	100	0	0	1	33.33
Mixed	13	5	5	10	76.92	0	3	5	38.48
Total	110	29	44	73	66.36	10	27	39	35.45

Fig. 1: Distribution of isolate and the clinical type involved among study participants (Applying Chi-square test, p = 0.94 shows no statistical significance).
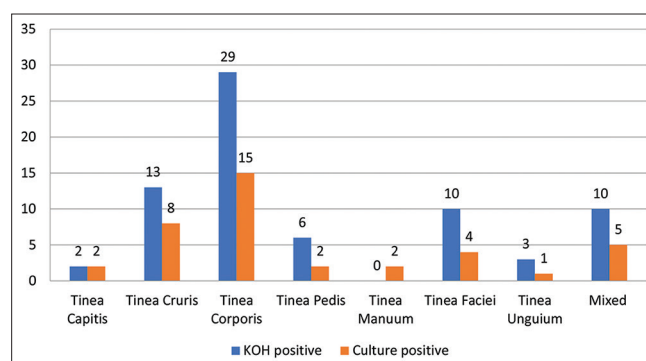

Fig. 2: Distribution of results of KOH mount and culture report to clinical types (Applying chi square test, p= 0.94 shows no statistical significance)

The elevated occurrence of dermatophytosis within this age bracket is because of the fact that this populace group is highly active and mobile and participates in more outdoor activities like farming and manual labor, which unfortunately predisposes them to acquire infection from environmental exposure. Lakshmanan *et al*. [7] in their study showed that predominant age group that was affected was 22–45 years. Kaur *et al*. [11] in their study showed that most common age group was 21–30 years (23.3%). Study by Shah *et al*. [12] in their study reported that majority of patients (34.47%) were in the age group of 30–45 years. The mean age was 36±14.06 years. Study by Karmakar *et al*. [13] showed that majority of patients (28%) were in the age group of 0 to 10 years. In a study by Teklebirhan *et al*. [14] showed that the age range of dermatophytic infections was 1 to 80 years, mean age being 26 years. Study by Bhatia *et al*. [15] showed that majority of the patients were in the age group of 21–50 years. Study by Hanumanthappa *et al*. [16] showed that majority of patients (24%) were in the age group of 21–30 years.

Gender distribution

In the present study, majority 75.45% were males and ratio of male to female being 3:1. The higher incidence in males may be as a result of more physical activity and increased sweating. Lakshmanan *et al*. [7] in their study reported that males (56%) were more commonly affected as compared to females (44%). Kaur *et al*. [11] in their study showed that majority of patients were males (67.2%) and 32.7% were females, male to female ration being 2:1. The study by Shah *et al*. [12] reported that majority of patients were (57.3%) females and 42.7% were males male to female ratio being 0.74:1. Rashmi *et al*. [1] in their study showed that males were more affected as compared to females in ratio of 1.6:1. Balakumar *et al*. [17] showed that males (67.1%) were more affected than females. A study by Karmakar *et al*. [13] showed that majority of patients affected (65.6%) were males. In a study by Teklebirhan *et al*. [14], it was reported that majority of patients (68.2%) were females and 31.8% were males. Study by Bhatia *et al*. [15] showed that majority of patients (45%) were males and 17% were females. Study by Hanumanthappa *et al*. [16] showed that majority were males, male to female ratio being 1.94:1.

Residential area

In the present study, majority of patients resided in rural area (56.36%). The higher incidence of dermatophytosis in rural areas could possibly be a consequence of bad personal hygiene in rural people in comparison to urban people. Kaur *et al.* [11] in their study showed that the frequency of patients from urban areas (81.5%) was more than that in rural areas (18.5%). Study by Hanumanthappa *et al.* [16] showed that majority of patients (54.6%) were from rural areas.

Clinical type

The present study showed that majority, that is, 44.55% of patients had Tinea Corporis, 19.09% had Tinea Cruris, 11.81% had mixed infection, 10% had T. Faciei, 7.27% had T. Pedis, 2.73% had T. Unguium, 2.73% had T. mannum, and 1.82% had T. capitis infection. The most common type of mixed infection was Tinea Corporis with Tinea cruris (38.46%). Lakshmanan *et al.* [7] in their study showed that 78% patients had T. corporis, 10% had T. cruris, etc. Similar results were found in present study. Study by Shah *et al.* [12] showed that majority of patients (31.3%) had Pityriasis versicolor, 13.5% were diagnosed as T. cruris. Balakumar *et al.* [17] showed that 35.4% patients had T. Corporis, 16.8% had Tinea Cruris, and 16.7% had Tinea capitis. Study by Karmakar *et al.* [13] showed that Tinea cruris (34.8%) was the major clinical type found; followed by Tinea corporis (24.0%), Tinea capitis (16.8%); Tinea Faciei(6.0%), Tinea manuum (3.2%), Tinea unguium (2.8%), and Tinea pedis (2.0%). In a study by Teklebirhan *et al.* [14], it was reported that majority of patients (51.1%) had Tinea unguium, 20% had T. corporis, and 10.8% had T. capitis. Study by Hanumanthappa *et al.* [16] showed that majority of cases (33.3%) belonged to T. corporis.

Occupation

The present study showed that majority of patients (32.73%) were manual laborers, 27.27% were students, 15.45% were doing household work, and 14.55% were sedentary workers. Greater incidence of Dermatophytosis in active workers could possibly be the result of a lot more physical exertion along with environmental exposure resulting in far more perspiration and therefore dermatophytic infection. Study by Hanumanthappa *et al.* [16] showed that majority of patients(30.6%) were manual laborers.

Exposure to season

In the present study, majority of the infection occurred in summer (43.64%), 30%occured in rainy season and 26.36% occurred in winter season. This might be a consequence of elevated temperatures and sweating in the summer months. In a study done by Siddappa *et al.* [18] greatest incidence of dermatophytoses was reported in summer.

Socioeconomic status

The present study showed that majority (51.82%) belonged to low socioeconomic class, followed by middle socioeconomic class (27.27%) and high socioeconomic class (20.91%). Study by Hanumanthappa *et al.* [16] showed that majority of patients (65.4%) belonged to low socioeconomic status. The higher incidence of dermatophytosis in low socioeconomic status may be due to poor personal hygiene (practice of sharing clothes, towels, etc.), poor nutritional status, overcrowding, and lack of proper education about sanitation.

Isolate obtained

In the present study, 36.36% isolates were obtained. Among them 25.45% were of *T. rubrum*, 7.27% were of *T. mentagrophytes*, 0.91% were of *M. audounii*, *Trichophyton Schoenleinii*, *E. floccosum,* and Fusarium (a non dermatophyte) each, respectively. Lakshmanan *et al.* [7] in their study showed that commonest dermatophyte isolated was *T. rubrum* (79%) followed by *T. mentagrophytes* (14.5%). Kaur *et al.* [11] in their study showed that that *T. rubrum* was isolated from 4.6% cases, *T. verrucosum* from 3.2% cases, *T. mentagrophytes* from 2.1% cases, and *T. schoenleinii* from 2.1% cases, etc. Study by Shah *et al.* [12] showed that majority of isolates (25.7%) were of *Candida albicans*, 22.8% were of Malassezia furfur, 20% were of *T. rubrum,* etc. Balakumar *et al.* [17] showed that *T. rubrum* was identified in majority of cases (32.8%) followed by *T. mentagrophytes* (29.2%).

Study by Karmakar *et al.* [13] showed that majority of isolates were of Trichophyton violaceum followed by *T. rubrum*. In a study by Teklebirhan *et al.* [14], it was shown that majority of isolates were of T. violaceum (37.7%), 17.7% isolates were of *T. mentagrophytes*, 16.9% isolates were of *T. tonsurans*. A study by Bhatia *et al.* [15] showed that majority of isolates were of *T. mentagrophytes* followed by *T. rubrum* [19]. Microsporum species was detected in only 1.35% cases. Study by Khadka *et al.* [20] showed that majority of isolates (39.6%) were of *T. mentagrophytes*, 11.7% were of *T. rubrum*, 5.4% were of *T. tonsurans,* etc. The difference in isolates being identified may be due to regional variation in the prevalence of various dermatophyte species and affinity of certain species for particular anatomical sites. The study by Malik *et al.* [19] concluded that in addition to dermatophytes, non-dermatophytic fungi are also emerging as a significant cause of superficial mycoses. In the present study Fusarium, a non-dermatophyte was isolated from a case of Tinea corporis (Table 5).

Association between dermatophyte isolate and the clinical type involved

In the present study, the most common species isolated from Tinea corporis, Tinea cruris, mixed clinical type, Tinea manuum, and Tinea Pedis was *T. rubrum*. No statistical significance was seen (p=0.94) between dermatophyte isolate and the clinical type. In the Study by Karmakar *et al.* [13], it was shown that there was no statistical significance in the correlation between the dermatophyte isolate and the clinical type involved, these findings were similar to the findings in the present study.

Association of KOH and culture findings to clinical types

Highest culture positivity was seen in Tinea capitis, followed by Tinea manuum, Tinea corporis, mixed clinical type, Tinea cruris, Tinea faciei, Tinea Unguium, Tinea corporis, and Tinea pedis. Highest KOH positivity was seen in Tinea capitis and Tinea unguium followed by Tinea faciei, mixed clinical type, Tinea pedis, Tinea cruris, Tinea corporis, and Tinea manuum. No statistical significance was seen (p=0.94) between KOH and culture findings to clinical types.

Association of age and sex parameters in relation to clinical types

In the present study, in all the clinical types of dermatophytic infection, males were more commonly affected. However, no statistical significance was seen (p=0.32). Balakumar *et al.* [17] also showed that there was no statistical significance seen. The present study showed that Tinea Corporis and Tinea Cruris were the predominant clinical types observed. Clinical manifestation was commonly seen in the age group of 21–40 years which shows statistical significance (p=0.004). Rashmi *et al.* [1] in their study showed that T. capitis was commonly seen in the age group of 1–10 years. Balakumar *et al.* [17] showed similar results to the present study i.e. Tinea Corporis and Tinea Cruris were the predominant clinical type observed. A study by Teklebirhan *et al.* [14] showed that clinical manifestation was commonly seen in the age group of 25–44 years. Tinea unguium was seen more commonly in this age group.

In present study, it was seen that majority of males (37.34%) and females (51.85%) were in the age group of 21–40. No statistical

Table 5: Findings on KOH mount and culture positivity

Various studies under ROL	KOH positivity (%)	Culture positivity (%)
Present study	66.36	35.45
Lakshmanan *et al.* [12]	50.5	-
Kaur *et al.* [11]	53.5	61.2
Shah *et al.* [12]	47.9	72.9
Rashmi *et al.* [16]	64.9	61.01
Balakumar *et al.* [17]	78.4	
Karmakar *et al.* [13]	86	41.6.
Teklebirhan *et al.* [14]	54.4	79.4
Khadka *et al.* [16]	44.5	55.5
Bhatia *et al.* [15]	-	36.6

significance was seen (p=0.36). Study by Karmakar *et al.* [13] showed that p value was 0.24 (no statistical significance). Kaur *et al.* [11] in their study showed that majority of the males (23.7%) were in the age group of 21–30 years. Similar findings were seen in the present study. Study by Bhatia *et al.* [15] showed that 64.9% patients were in the age group of 21–50 years (statistical significance was seen).

Culture and KOH results cross tables

In the present study, it was seen that patients positive on both culture and KOH mount were 26.36%, 40% were positive on KOH mount but negative on culture, 9.09% were negative on KOH but positive on culture, and 24.55% were negative on both culture and KOH mount. Kaur *et al.* [11] in their study showed that both KOH and culture positivity was seen in 45.8% cases, both KOH and culture negativity was seen in 31.3% cases, 4.2% cases were KOH positive and culture negative and 11.5% cases were culture positive and KOH negative.

The study by Karmakar *et al.* [13] showed that 2.4% samples were both KOH positive and positive on culture, 41.6% were negative on KOH but positive on culture. The study by Khadka *et al.* [16] showed KOH positivity and culture positivity in 31.5% samples, 13% samples were KOH positive and culture negative, 24% were KOH negative and culture positive, and 31.5% were both KOH and culture negative. Study by Hanumanthappa *et al.* [16] showed that both KOH and culture positivity was seen in 36% patients, 30.6% patients were KOH positive and culture negative, 12.6% patients were KOH negative and culture positive, and 20.6% patients were and both KOH and culture negative. Thus, the results of KOH and culture vary from study to study and can be due to multiple factors such as non-viability of fungal elements, presence of contaminants, and certain technical errors.

CONCLUSION

In the present study, majority of cases of dermatophytosis belonged to the age group of 21–40 years. Males were more commonly affected than females. Male to female ratio was 3:1. Incidence of dermatophytosis was maximum in rural areas, low socioeconomic group and in summer. Tinea corporis was found to be the commonest clinical type followed by Tinea cruris. *T. rubrum* was the commonest isolate obtained (25.45%) followed by *T. mentagrophytes* (7.27%). Fusarium (a non-dermatophyte) was isolated from a case of Tinea Corporis. Fungi were demonstrated by direct microscopy and/or by culture in 73 cases (66.36%) out of 110 cases. Hence, direct microscopy with or without culture is an important diagnostic tool in dermatophytosis. Authors recommend more in-depth study with larger sample size and multi-centric based to have clearer picture of dermatophytosis.

AUTHORS CONTRIBUTION

All authors have contributed to preparation of manuscript.

CONFLICT OF INTEREST

Nil.

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