Clinico-Mycological Characteristics Of Dermatophytosis- A Comparative Study Of The Past And The Present

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Abstract: Background: Incidence and prevalence of dermatophytosis have increased recently. The clinico-mycological characteristics of dermatophytosis in the past and present were compared to determine the difference, if any, that can explain the present scenario. Material and Methods: Hospital-based cross-sectional study design with retrospective data comparison was done. The clinico-mycological data of 425 patients in 2019 was compared to 124 patients in 2011 with a Chi-square statistic. Result: Significant differences were observed in the following socio-demographic and disease characteristics in the present compared to the past: female gender (57.9% vs.33.9%, P-0.000002), chronicity (29.4% vs. 16.1%, P-0.003), sharing of clothes (35.3% vs. 20.5%, P-0.0014), co-morbidity of atopy (22.6% vs. 6.5%, P-0.00005), prior use of topical antifungals (64.5% vs. 30.7%, P <0.0001), prior use of systemic antifungals (43.1% vs. 13.7%, P <0.0001), prior use of topical steroids (24.7% vs. 12.1%, P-0.0028), and infection in multiple sites (25.2% vs. 11.3%, P-0.001). T.mentagrophytes was the most common isolate in the present compared to the past (73.6% vs. 32.8%, P-0.0035). Other isolates were T.rubrum (13.2%) and M.gypseum(13.2%) in 2019 and T.rubrum (53.1%), M. gypseum(9.4%), T. schoenleinii (1.6%) and E. floccosum (3.1%) in 2011. Conclusion: T. mentagrophytes has emerged as the dominant species. Irrational use of topical and systemic antifungals and steroids has increased considerably. Frequent training of general practitioners regarding appropriate management and educating patients about avoidance of tight-fitting clothing, personal hygiene, and avoidance of over the counter medications, and adherence to treatment schedule can decrease the disease burden to some extent. [Anish K.A Natl J Integr Res Med, 2021; 12(5): 14-20]

Key Words: Dermatophytosis, Trichophyton, Microsporum, Epidermophyton, Steroids

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Introduction: Dermatophytosis is one of the most common fungal infections encountered by dermatologists and general practitioners alike. Though not life-threatening, the disease causes considerable morbidity and adversely affects the quality of life. The incidence and prevalence of dermatophytosis vary significantly with geographical regions, host factors, and the causative species[1]. India with its tropical and subtropical climate is a hot spot for dermatophytosis. There are recent reports of increased incidence and prevalence of dermatophytosis in alarming proportions throughout India[2,3]. Atypical presentation, recurrences, chronicity, and unresponsiveness to the commonly used antifungals have become the norm. An easy-to-treat infection in the past has become a nightmare to dermatologists. There is no clear-cut evidence as to the cause for the present increase in the prevalence of dermatophytic infection to epidemic proportions other than few studies reporting microbiological resistance, genetic alteration in the dermatophyte, and topical steroid abuse. Our centre has also been witnessing the onslaught of difficult-to-treat dermatophytosis. With this background of a changing profile of dermatophytosis in India we decided to compare the past and present clinico-mycological data of dermatophytosis in our institution to determine the difference, if any, in the host characteristics and the species isolated, that can explain the present scenario.

Material & Methods: Department of Dermatology of a tertiary care teaching hospital in Kerala, the southernmost state of India was the study setting. A cross-sectional type of study design with retrospective comparison was done. The study sample constituted all clinically

diagnosed patients with dermatophytosis, from mycological data of dermatophytosis patients who attended the department from January 2011 to June 2011. The detailed clinical history was elicited and patients were subjected to relevant investigations after getting informed written consent.

The study variables were 1) socio-demographic characteristics: age, sex, occupation, family history of dermatophytosis, sharing of clothes among family members 2) disease characteristics: duration of disease, history of dermatophytosis in the past, co-morbid conditions like atopy, diabetes mellitus, and HIV infection 3) prior drug therapy: topical antifungals, systemic antifungals, topical steroids, systemic steroids, immunosuppressants 4) site of infection and 5) mycological characteristics: species isolated. Scraping from the skin and/ or nail and /or hair was divided into two halves. One-half was subjected to direct microscopy with 10% KOH. The other half was sent to the Department of Microbiology for culture and species identification. The culture media used were Sabouraud's dextrose agar with chloramphenicol and cycloheximide, and dermatophyte test medium. The species of dermatophytes were identified by macroscopic characteristics like colony morphology and pigment production; and micromorphological characteristics such as microconidia, macroconidia, sporulation, hyphae, and chlamydospores, by slide culture technique in Lactophenol Cotton Blue. T. mentagrophytes and T. rubrum were distinguished by the urease test and invitro hair perforation test. Data were entered in Microsoft Excel and analyzed using Excel and Epi Info 7. A Chi-square test was used for testing differences in proportion. Institutional ethics committee clearance was obtained.

Results: Dermatophytosis was clinically diagnosed in 124 patients in 2011 and 425 patients in 2019. Table 1 shows the socio-demographic characteristics during both time frames.

Table 1: Socio-Demographic Characteristics

Variables		2011 Total Cases 124	2019 Total Cases 425
Gender	Male	82(66.1%)	179 (42.1%)
	Female	42(33.9%)	246 (57.9%)
Age	< 10	1(0.8%)	14(3.3%)
	10-19	35(28.2%_	101(23.8%)
	20-29	26(21%)	61(14.4%)
	30-39	16(12.9%)	66(15.5%)
	40-49	25(20.2%)	93(21.9%)
	50-59	13(10.5%)	49(11.5%)
	60-69	6(4.8%)	33(7.8%)
	70-79	1(0.8%)	4(0.9%)
	>80	1(0.8%)	4(0.9%)
Mean Age		32.9	34.7
Occupation	Unemployed	8(6.5%)	44(10.4%)
	Students	42(33.9%)	160 (37.6%)
	Home Makers	27 (21.7%)	143(33.6%)
	Unskilled	16(12.9%)	37 (8.7%)
	Skilled	23(18.5%)	24(5.6%)
	Professionals	8 (6.5%)	17 (4%)
Duration	≤6 Months	104 (83.9%)	300(70.6%)
	> 6 Months	20(16.1%)	125 (29.4%)
History Of Dermatophytosis In The Past	Yes	47(37.9%)	198 (46.6%)
	No	77(62.1%)	227 (53.4%)
Prior Treatment Present	Topical Antifungals	38 (30.7%)	274 (64.5%)
	Systemic Antifungals	17 (13.7%)	183 (43.1%)
	Topical Steroids	15 (12.1%)	105(24.7%)
Comorbidities	Atopy	8 (6.5%)	96(22.6%)

	Diabetes	10(8.1%)	53(12.5%)
	HIV	0	5 (1.2%)
Family History Of Dermatophytosis	Yes	28 (22.6%)	133(31.3%)
	No	96(77.4%)	292 (68.7%)
Sharing Of Clothes	Yes	25(20.2%)	150 (35.3%)
	No	99(79.8%)	275(64.7%)

Prior Treatment: 2011- Topical antifungals were applied by 38 (30.7%) patients. Whitfield's ointment, clotrimazole, ketoconazole, and miconazole were the topical antifungals applied. Systemic antifungals such as griseofulvin and fluconazole were used by 17(13.7%) patients and topical steroids either alone or in combination were applied by 15(12.1%) patients. 2019- Two hundred and seventy four (64.5%) patients applied topical antifungals. The topical antifungals applied were clotrimazole (224, 52.7%), ketoconazole (98, 28.3%), terbinafine (72, 16.9%), miconazole (38, 8.9%), sertaconazole (22, 5.2%) and newer antifungals like luliconazole, eberconazole, fenticonazole and amorolfine (67,15.8%). The systemic antifungals used were fluconazole (152, 35.8%), terbinafine (48, 11.3%), itraconazole (44,10.4%) and griseofulvin (8,1.9%).

Clinical Presentation: Single site infection was seen in 110 (88.7%) patients in 2011 and 318 (74.8%) patients in 2019. Table 2 shows the different types of clinical presentations in both time frames.

Table 2: Clinical Presentations

Clinical Presentation	2011 Total Cases 124	2019 Total Cases 425
Tinea Corporis	74 (59.7%)	195 (45.9%)
Tinea Cruris	30 (24.2%)	45 (10.6 %)
Tinea Unguium	4 (3.2%)	30 (7.1%)
Tinea Incognito	-	27 (6.4%)
Tinea Manuum	2 (1.6%)	8 (1.9%)
Tinea Faciei	-	7 (1.6%)
Tinea Pseudoimbricata	-	4 (0.9 %)
Tinea Capitis	-	2 (0.5%)
Tinea Pedis	-	1 (0.2%)
Tinea Corporis, Tinea Cruris	14 (11.3%)	62 (14.6 %)
Tinea Corporis, Tinea Manuum	-	5 (1.2 %)
Tinea Corporis, Tinea Faciei	-	6 (1.4%)
Tinea Corporis, Tinea Unguium	-	1 (0.2%)
Tinea Manuum, Tinea Pedis	-	1 (0.2%)
Tinea Corporis, Tinea Cruris, Tinea Manuum	-	8 (1.9%)
Tinea Corporis, Tinea Cruris, Tinea Faciei	-	16 (3.8%)
Tinea Corporis, Tinea Cruris, Tinea Unguium	-	2 (0.5%)
Tinea Corporis, Tinea Cruris, Tinea Faciei, Tinea Manuum	-	3 (0.7%)
Tinea Corporis, Tinea Cruris, Tinea Faciei, Tinea Pedis	-	2 (0.5%)

Investigations: Direct microscopy with KOH mount was positive for fungal elements in 95 (76.6%) and culture was positive for dermatophytes in 63 (50.8%) in 2011.

In 2019 direct microscopy was positive for fungus in 336 (79.1%) and culture positivity for dermatophytes was observed in 53 (12.5%) cases.

Table 3 shows the species isolated in the time frames. A Chi-square test was used to compare the data between 2011 and 2019. The P-value was less than 0.05 for the following variables: gender (P-0.000002), duration more than six weeks (P-0.003), sharing of clothes (P-0.0014), co-morbidity of atopy (P-0.00005), prior use of topical antifungals (P <0.0001), prior use of systemic antifungals (P <0.0001), prior use of topical steroids (P- 0.0028), infection in multiple sites (P-0.001) and species isolated (P-0.0035).

Table 3: Species Isolated

Species	2011 Culture Positive Cases- 64	2019 Culture Positive Cases- 53
T. Rubrum	34 (53.1)%	7 (13.2%)
T. Mentagrophytes	21 (32.8%)	39 (73.6%)
M. Gypseum	6 (9.4%)	7 (13.2%)
E. Floccosum	2 (3.1%)	
T. Schoenleinii	1 (1.6%)	

Discussion: In 2019 there were 425 patients over a period of one year and in 2011 there were 124 patients over a period of six months. There was an increase in the number of cases in 2019 as compared to 2011, though the duration was not comparable. With the assumption that the patient attendance was constant throughout the year, the number of patients over six months in 2011 was doubled to compare the number of patients in 2011 and 2019. The increase in the number of patients observed in 2019 was two-fold and was similar to the unprecedented increase in the incidence and prevalence of dermatophytosis reported from other parts of India[2,3].

There was no change in the most commonly affected age group over the years. Similarly, occupation-wise, students and homemakers predominated, in the past and present, and were in concordance with other reports[4-6]. The occlusive synthetic materials of uniforms and the exposure to heat while cooking predisposes the students and homemakers to excessive sweating, retention of moisture, and maceration necessary for the survival of dermatophytes. Contrary to this Goa[7], and Karnataka[8] reported the majority of their patients, as manual labourers.

Recent years have witnessed a change in the dressing pattern, with most young females preferring tight-fitting clothes unsuitable to the Indian climate. This may explain the significant increase (P <0.0001) in females in 2019 compared to 2011, 57.9% vs. 33.9% respectively. The predominance of females may also be due to a change in health-seeking behaviour with more females seeking health care services. Most of the places in India report male preponderance[4-6] except Chennai and Vadodara[3,9]. Previous episodes of infection and infection among the members of the family were reported by patients, both in the past and present, slightly more in 2019 when compared to 2011. Arthrospores, the dissemination forms of dermatophytes are shed along with keratinocytes during desquamation. Household dust, by preserving these dermatophyte spores for years, may act as a reservoir of anthropophilic dermatophytes. Thus previous episodes of disease and infection among other members of the family may lead to a vicious cycle resulting in the chronicity of infection. The proportion of patients who shared clothes among family members significantly increased in 2019 compared to 2011, 35.3% vs. 20.2% respectively (P 0.0014). Clothes harbour spores and can result in the spread of infection from one person to another.

The relationship between dermatophytosis and atopic diseases is complex. There is no evidence as to whether atopy predisposes to dermatophytosis, but dermatophytosis can contribute to the pathogenesis of atopic diseases[10].

Similar to atopic diseases, the immune response in chronic dermatophytosis is mediated mainly by T helper 2 (Th2) cells with high levels of Th2 cytokines, IgE, and IgG4 antibodies. The proportion of patients with atopy was 22.6% in 2019 compared to 6.5% in 2011 (P < 0.0001). The considerable increase in atopic diseases may either be due to an increase in the prevalence of dermatophytosis predisposing to atopy or a reflection of the trend in the increasing prevalence of atopic diseases in the population.

There was no significant difference in the comorbidities like diabetes and HIV infection in the past and present. Prior use of topical antifungals increased significantly from 30.7% in 2011 to 64.5% in 2019 (P <0.0001). In 2011 the choice of topical antifungals was limited to Whitfield's ointment, clotrimazole, ketoconazole, miconazole, and terbinafine. The present-day practitioners has a wide array of topical antifungals to choose from and almost all topical antifungals marketed in India, like clotrimazole,

ketoconazole miconazole, luliconazole, sertaconazole eberconazole, fenticonazole, terbinafine, amorolfine, and amphotericin, were prescribed. The irrational use of antifungals, especially the topical preparations of systemic antifungals, reserved for life-threatening fungal infections may lead to grave consequences in the future. There was a statistically significant increase in the prior systemic antifungal usage in 2019 compared to 2011(43.1% vs. 13.7%, P<0.0001) indicating a change, either in the prescription practises of the practitioners or the health care seeking behaviour of patients.

If griseofulvin and fluconazole were the preferred systemic antifungals in 2011, fluconazole, terbinafine, itraconazole and griseofulvin were the preferences in 2019. The majority of the patients reported non-adherence to the prescribed treatment. The practice of stopping treatment at the early sign of improvement sets in motion a vicious cycle of incomplete treatment, development of resistance, and treatment unresponsiveness.

Many scientific forums and authors from India have raised their concern about the abuse and misuse of topical steroids either alone or in fixed drug combinations with topical antifungals and/or antibacterials. This is the most common topical preparation purchased over the counter and considered by many as a wonder drug for a multitude of dermatologic problems. The body mounts an antifungal response by cell-mediated immunity and topical as well as systemic steroids suppress the T cell immune response and cause the fungus to spread.

The proportion of patients who had applied topical steroids increased significantly from 12.1% in 2011 to 24.7% in 2019 (P-0.0028). Though steroid use was prevalent in the past, the significant increase in steroid use in the present may be responsible for the current menace to some extent.

Chronic dermatophytosis is defined as patients who continue to have the disease for 6 months to 1 year with or without recurrence despite treatment[2]. The proportion of chronic dermatophytosis increased significantly from 16.1% in 2011 to 29.4% in 2019 (P-0.003), validating our hypothesis that there has been an increase in the clinically unresponsive type of dermatophytosis in our institution.

Dermatophytosis involving a single site was the most common pattern, observed in 88.7% in 2011 and 74.8% in 2019. The most common pattern of single-site infection remained the same in the past and present i.e. tinea corporis followed by tinea cruris. The same pattern was observed in other studies from India[4-9]. In 2019 the proportion of patients with tinea unguium doubled, tinea manuum remained the same, tinea capitis and pedis announced their arrival.

Tinea pedis is common in geographical locations where occlusive foot wear is the norm[11]. The changing trend in fashion is gradually replacing open footwear with covered occlusive ones, unsuitable for a tropical climate like ours. This can lead to maceration and friction paving the ideal condition for tinea pedis. Tinea capitis though common in other places was practically absent among our patients in the past. Daily coconut oil application of scalp and hair followed by hair wash was the bath routine in Kerala.

Coconut oil with its antifungal properties may explain the absence of tinea capitis in the past[12]. Adoption of new hair styling practises, disregarding the tradition, may explain the gradual increase in the proportion of tinea capitis.

The consequence of steroid abuse manifested in the form of tinea incognito and tinea pseudo imbricata in 2019. A hallmark of difficult to treat dermatophytosis is the affection of multiple sites.

The proportion of patients with infection in multiple sites increased from 11.3% in 2011 and 25.2% in 2019 (P- 0.001). If tinea corporis et cruris was the only combination in the past, varied combinations involving up to five sites were there in 2019.

Direct microscopy for fungus was positive in 76.6% in 2011 and 79.6% in 2019. Though the direct microscopy was positive in more than 3/4ths of the patients in 2019, the culture positivity rate was very low compared to 2011 (12.5% vs. 50.8%, P < 0.0001). Prior treatment with antifungals may affect culture positivity and despite a positive KOH preparation, it may not be possible to grow a fungal culture.

More than 2/3rds of the patients were already on topical and/or systemic treatment at the time of hospital visit in 2019 and may explain the low

culture positivity rates. T. rubrum, T. mentagrophytes, and M. gypseum were the isolates common to both the time frames. The predominant isolate in 2011 was T. rubrum whereas, in 2019, there was a shift in species, with 73.6% of isolates as T. mentagrophytes compared to 32.8% in 2011 (P <0.0001). T. schoenleinii and E. floccosum though isolated in 2011, were not isolated in 2019.

In India, T. rubrum was the major isolate, until a few years back[5,7,8,11]. Recent multicentre study from the North, South, East, and West of India data shows an epidemiological shift to T. mentagrophytes[13].The mycological characteristics of T. mentagrophytes, enabling its emergence as a major species in India, are currently unknown.

High viability of the spores of T. mentagrophytes, almost twice that of T. rubrum, a distinct Indian genotype of T. mentagrophytes ITS Type VIII capable of man to man transmission (Anthropization) and abuse of topical steroids are suggested as a cause for the epidemiological shift to T.mentagrophytes[2,13].

Conclusion: Though many studies have quoted the great Indian epidemic of dermatophytosis, to our knowledge, none has compared the past and present data in the same institution, to study the reasons behind the present epidemic. In our teaching hospital, dermatophytosis cases have almost doubled in a span of eight years.

The significant changes observed were the predominance of females, chronicity, increased atopic diathesis, irrational use of topical and systemic antifungals, abuse of steroids, and a shift in the species from T. rubrum to T. mentagrophytes. A preference for tight-fitting clothing and a change in healthcare-seeking behaviour might have led to female predominance.

Most of the patients received a potpourri of medicines from general practitioners and over the counter. The unprecedented increase in the irrational usage of topical and systemic antifungals might have led to resistance and chronicity.

Topical steroid abuse has increased and resulted in extensive infection, refractory disease, tinea incognito, tinea pseudo imbricata, and preferential selection of Indian genotype of T. mentagrophytes. General practitioners and other specialists need to be trained regarding the management of dermatophytosis and a countrywide uniform protocol is the need of the hour. Patient education regarding personal hygiene, adherence to the prescribed treatment schedule, the importance of treating all family members, and avoidance of over-the-counter medications need to be a part of the holistic management of dermatophytosis.

The observed findings, if put into practice, can to some extent halt the progress of the current epidemic of dermatophytosis.

Limitations: The observations may not truly reflect the corresponding change in the community due to the referral status of the study setting. Financial constraints and lack of facilities hindered the genetic typing of the species.

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