Research Article

Isolation and Identification of Dermatophytes Causing Dermatophytosis at a Tertiary Care Hospital in Bangladesh

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Abstract

Background: Dermatophyte, a keratinophilic fungus which can invade keratinized tissue cause dermatophytosis. It is one of the major superficial fungal infections. According to World Health Organization (WHO), 20-25% world population is affected by dermatophytes. The aim of this study was to identify different species of dermatophytes causing dermatophytosis at a tertiary care hospital in Bangladesh.

Methods: Total 246 skin, nail and hair samples were collected from Dermatology and Venereology department of Dhaka Medical College Hospital (DMCH), Dhaka, Bangladesh. Dermatophytes were identified by microscopy, culture, biochemical test (urease test and hair perforation test) and polymerase chain reaction (PCR). Fungal elements were observed under microscope. Sabouraud Dextrose Agar (SDA) and Dermatophyte Test Medium (DTM) were used to culture the specimen. Species identification was confirmed by biochemical test and PCR.

Results: Among 246 clinically diagnosed cases of dermatophytosis, 91 (36.98%) cases were observed among the age group of 21-30 years. Female were more affected than male (male-female ratio was1:1.34). Eighty-five (34.55%) cases were positive by microscopy and 76 (30.89%) cases were positive in culture. *Trichophyton mentagrophyte* was the common etiological dermatophyte species which was 59.21% followed by *Trichophyton rubrum* (40.79%). All culture isolates were further evaluated by biochemical test and PCR. Most of the tinea corporis was caused by *Trichophyton mentagrophyte* which was 64.81%.

Conclusion: Dermatophytosis is a common infection in young adults specially females. *Trichophyton mentagrophyte* is more frequent type of dermatophyte. Majority of dermatophytes could be identified by both direct microscopy and culture methods.

Keywords: Dermatophyte; Dermatophytosis; Teniasis; Trichophyton; Polymerase Chain Reaction (PCR)

1. Introduction

Earth has been documented as a natural territory for fungi which cover individual kingdom with evolution [1]. Among all fungus, dermatophyte is one of the cutaneous fungi. They have both keratinophilic and keratinolytic properties [2] [3]. They are capable of invading human and animal keratinized tissue causing dermatophytosis [4]. Dermatophytosis has several distinct cutaneous manifestations [3, 4]. The severity of the disease depends on various factors including- strain or species of infecting dermatophyte, the sensitivity of the host and the site of infection [5]. Dermatophyte belongs to three group named as *Trichophyton*, *Epidermophyton* and *Microsporum* [4]. Further they are divided into anthopophilic, zoophilic and geophilic according to their natural habitat [4, 5].

Dermatophytosis lesion is called annular lesion. It takes single or multiple ring shape lesions with inflammatory edges. Itching, redness, and scaling edges with blister is also notifiable [6]. Another term used as tinea infection according to their anatomical location like tinea capitis, tinea barbae, tinea corporis, tinea cruris, tinea manuum, tinea pedis and tinea unguium [4, 7].

Both healthy and immune compromised patients are affected with this infection [7]. The estimated lifetime risk of acquiring dermatophytic infection is 10-20% [8]. Their geographical distribution is widely variable [9]. Climate, lifestyle, involvement of outdoor activities, pre-existing co-morbidities (diabetes mellitus, hypothyroidism, malnutrition etc) are responsible for the heterogeneous prevalence [9, 10]. Prevalence of dermatophytosis varies between 13% to 49% depending on the geographical distribution of the countries [11-16]. Although dermatophytes are not life-threatening fungus, it turns into major public health problem due to high morbidity as well as cosmetic damage [17]. Dermatophytic infections have some typical features [17]. Sometimes it is confused with other skin disorders [17]. A tinea corporis eruption that is more papulosquamous in presentation may be mistaken for psoriasis, nummular eczema, seborrheic dermatitis or pityriasis rosea [18]. The crural region may be infected by other dermatophytes that present comparable clinical features as tinea cruris [13]. Inverse psoriasis, seborrheic dermatitis, candidiasis, erythrasma, lichen simplex chronicus, darier's disease, and pemphigus vegetans may be mistaken for tinea cruris [14]. Vaginal candidiasis, which often affects women, may be distinguished from tinea cruris of males; satellite lesions and white pustules of candida may be seen, whereas dermatophytes do not [16]. Therefore, to avoid a misdiagnosis, identification of dermatophyte infections requires prompt and methodical laboratory diagnosis [17, 18].

Fungal culture and light microscopic mycological examination are required for identification of dermatophyte infections phenotypically [18]. Microscopic examination is easy, rapid and inexpensive diagnostic test; but it may show false negative results up to 15% cases [19]. While culture methods are specific diagnostic tests for dermatophyte identification, although culture of species takes approximately 4 weeks for the growth of the fungus [19]. Molecular approaches have been developed to provide more accurate alternatives for dermatophyte identification [20]. Sequencing methods targeting the ITS region are the most popular techniques used for definitive identification of a fungal strain [20, 21]. The accuracy in diagnostic methods is important to provide definitive treatment of dermatophytosis [20, 21]. This study was aimed to identify different dermatophytes species causing dermatophytosis at a tertiary care hospital (DMCH) in Bangladesh by microscopy, culture, biochemical tests, and PCR.

2. Materials and Methods

This cross-sectional study was conducted from July 2018 to June 2019 in the Department of Microbiology, Dhaka Medical College Hospital (DMCH), Dhaka, Bangladesh. The study was approved by the Ethical Review Committee, Dhaka Medical College, Dhaka, Bangladesh. A total of two hundred and forty-six (246) study subjects were selected following selection criteria. Patients at any age of either sex, who attended the outpatient department of Dermatology and Venereology, DMCH, Dhaka, Bangladesh during the study period, were enrolled. Patients with clinically suspected cases of ring worm infection, without using any antifungal drugs for last one month were included in this study. Patients having concomitant other skin infections like- pityriasis versicolor, saborrheic dermatitis, eczema, lichen planus, psoriasis vulgaris etc were excluded from the study.

2.1. Different types of teniasis [22]

2.1.1 Tinea capitis: Dermatophytosis of scalp and hair.

2.1.2 Tinea corporis: The lesion which affects the body is called tinea corporis.

2.1.3 Tinea manuum: Tinea manuum is fungal infection one or both hands.

2.1.4 Tinea unguium: Tinea infection in the nail is called tinea unguium or onychomycosis.

2.1.5 Tinea cruris: Dermatophytosis of groin is known as tinea cruris.

2.1.6 Tinea pedis: Tinea infection in the foot is called tinea pedis.

2.2. Specimen collection

After a detailed clinical history along with all aseptic precaution lesions of the study patients were examined carefully under proper light. The affected area was cleaned properly (with 70% ethyl alcohol), then following standard procedure skin scales/crusts and pieces of nails were collected by gentle scrapping across the inflamed margin of the lesions. Hairs were epilated aseptically with sterilized tweezers.

2.3. Microbiological methods

2.3.1 Microscopic examination of the specimen: A drop of 20% potassium hydroxide (KOH) solution was taken in a glass microscope slide then transferred a small piece of specimen to the drop of KOH and covered with a cover slip. The slide was left for at least 20-30 minutes for skin and hair in a petri dish. In case of nail, samples were dipped in 20% KOH solution overnight for study on the next morning. Branching and septate hyphae with angular or spherical arthroconidia (arthrospores) usually in chain were recognized under the microscope as a dermatophyte. All specimen of skin and nail of ringworm fungi have similar appearance, while arthroconidia within hair was found (endothrix).

2.3.2 Culture of the specimen: Sabouraud Dextrose Agar (SDA) and Dermatophyte Test Medium (DTM) with antibiotics were used for primary isolation of the fungus. Cycloheximide stock solution and Chloramphenicol were added to inhibit saprophytic fungi and bacteria, respectively. Samples (skin, hair, and nail) were inoculated directly on to the medium by pressing the specimen lightly into the surface of the medium with a sterile wire loop and blunt forceps. All plates containing SDA and DTM with antibiotic were incubated at room temperature (27°C). The inoculated petri dishes were examined at every alternate day from the day of inoculation. SDA and DTM plates were observed for 4 weeks and 2 weeks, respectively. The evidence of growth was considered as positive. By colony morphology on media, microscopic characteristics of the colony and other relevant biochemical tests were performed for further evaluation for detection of dermatophyte species.

2.4. Biochemical tests

In this study urease test and hair perforation test were performed to detect dermatophytes.

2.4.1 Urease test: Test tube containing Christensen's urea agar was used to see the urease activity of the isolated dermatophyte species. The slant surface of media was inoculated with pure culture of test fungi and incubated at room temperature (27°C) for 7 days. Change in color (straw to pink color) in the media indicated positive test result, no color change was considered as negative.

2.4.2 Hair perforation test: The hair perforation test determines an organism's ability to produce an enzyme which penetrates and invades the shaft resulting in the perforation of bodies or cones. Several fragments of hair about 1 cm length were sterilized by autoclaving. Then 5 ml sterile distilled water and 2 drops of sterile 10% yeast extract were added in screw cap bottles. Fragments of hair and small amount of fungus grown on SDA was added in the screw cap bottle and incubated at room temperature (27°C). After 10 days incubation, some hairs were removed aseptically from bottles and mounted in lactophenol cotton blue for microscopic examination. Transverse perforation (wedge shaped) of the hairs were looked for. When perforation was not seen after 10 days, the microscopic examinations were repeated at intervals of up to 28 days. Wedge shaped perforation of hair shaft that surrounded by test fungi indicated a positive test.

2.5. Molecular method

2.5.1 Fungal pellet formation

The colonies of the desired fungus were subcultured into Potato Dextrose Agar media at room temperature (27°C) for 3-5 days. A loop full of fungal colonies was inoculated into a micro centrifuge tube containing normal saline. After incubated overnight the micro centrifuge tubes were centrifuged at 4000 rpm for 10 minutes at 4°C temperature, then supernatant was discarded, and the deposit was kept at -20°C temperature as pellet until DNA extraction.

2.5.2 DNA extraction from culture

300 µl distilled water was mixed with fungal pellet and vortexed until mixed well. The micro centrifuge tube was kept in block heater at 100°C for 10 minutes for boiling. After boiling the tube was kept on ice immediately. After that, the tube was centrifuged at 4°C temperature at 14000 rpm for 6 minutes. Finally, supernatant was taken using micropipette and was used as template DNA for PCR. This DNA was kept at -20°C temperature for further use.

2.5.3 Mixing of master mix and primer with DNA template

Derm Primer for all dermatophytes species- and species-specific primer for *Trichophyton rubrum* and *Trichophyton mentagrophytes* were used to detect the species from culture. Primers were mixed with Tris-EDTA buffer according to manufacturer's instruction. For each sample, PCR was performed in a final reaction volume of 25 µl. In a PCR tube, containing 12.5 µl of master mix (mixture of dNTP, Taq polymerase enzyme, $MgCl_2$ and PCR buffer), 2 µl forward primer, 2 µl reverse primer, 2 µl of DNA template and 6.5 µl nuclease free water. After a brief vortex, the tubes were centrifuged in mini spin for 7 seconds for 3 times.

2.5.4 Amplification through thermal cycler

Each PCR run comprised of pre-heat at 94°C for 5 minutes followed by 30 cycles of denaturation at 94°C for 30 seconds, annealing at 54°C for 30 seconds, extension at 72°C for 30 seconds with final extension at 72°C for 10 minutes.

PCR products were detected by electrophoresis on 1.5% agarose gel. After electrophoresis, the gel was stained with staining buffer for 30 minutes and de-stained water for 15 minutes.

Fungus		Primer Sequence (5`-3`)	Size (bp)
Dermatophytes	F	GAA GCC TGG AAG AAG ATT GTC G	
	R	CCT TGA TTT CAC CGC AGG CAC	432
Tricophyton rubrum	F	CCC CCC ACG ATA GGG ACCG	
	R	GAC TGA CAG CTC TTC AGA GAA TT	214
Tricophyton mentagrophyte	F	GCC CCC CAC GAT AGG GCC AA	
	R	CTC GCC GAA CGG CTC TCC TG	132

Table 2.1: Above Forward (F) and Reverse (R) primers were used in this study [20].
bp= base pair.

2.5.5 Visualization and interpretation of results

The gel was observed under UV trans-illuminator for DNA bands. The DNA bands were identified according to their molecular size by comparing with the molecular size marker (100 bp DNA ladder) loaded in a separate lane. Samples showing the presence of corresponding bp band were considered positive for the presence of that organism.

3. Results

This study was intended to isolate different types of dermatophytes causing dermatophytosis at a tertiary care hospital in Bangladesh. A total of 246 samples were included in this present study. Of which, 224 were skin samples, 16 were nail samples and 6 were hair samples. Among 246 samples, 92 (37.40%) were yielded presence of dermatophytes (Table 3.1).

Table 3.2 shows age and gender distribution of the study population. Out of 246 cases, 105 (42.68%) were male and 141 (57.32%) were female with a male-female ratio was 1:1.34. Among total study population, 91 (36.98%) cases were observed among the age group of 21-30 years, 65 (26.43%) cases were in the age group of 31-40 years, 37 (15.04) cases were in the age group of 11-20 years, 27 (10.98) cases were in the age group of 41-50 years, 15 (6.10) cases were in the age group of 1-10 years and11 (4.47) cases were >50 years.

Table 3.3 shows clinically suspected case of dermatophytosis from the study population. Among total 246 cases; 140 (56.91%) cases were tinea corporis, 45 (18.30%) cases were tinea cruris, 25 (10.16%) cases were tinea pedis, 16 (6.50%) cases were tinea unguium, 10 (4.07%) cases were tinea manuum, 6 (2.44%) cases were tinea capitis, and 4 (1.62%) cases were tinea faciei.

Table 3.4 shows the distribution of clinical types of dermatophytosis in relation to age and gender of the study population. Among 140 tinea corporis; 64 were male and 76 were female, most (35.71%) of the tinea corporis cases were at the age group of 31-40 years followed by 21-30 age group (32.1%). Out of 45 tinea cruris; 19 were male and 26 were female and maximum (62.22%) cases were at the age group of 21-30 years. Out of 25 tinea pedis; 8 were male and 17 were female and maximum (40.0%) cases were at the age group of 11-20 years. Out of 16 tinea unguium; 6 were male and 10 were female and

maximum (43.8%) cases were at the age group of 21-30 years. Out of 10 tinea manuum; 4 were male and 6 were female and maximum (50.0%) cases were equally distributed at the age group of 1-10 years and 11-20 years. Out of 6 tinea capitis; 4 were male and 2 were female and maximum (66.7%) cases were at the age group of 1-10 years. In total 4 tinea faciei cases, all were female and were at the age group of 21-30 years.

Table 3.5 demonstrates the detection of dermatophytosis positive by microscopy and/or culture. Among 92 positive cases, 62 (67.40%) were tinea corporis, 14 (15.22%) cases were tinea pedis, 7 (7.60%) were tinea cruris, 6 (6.52%) cases were tinea unguium, 2 (2.17%) were tinea manuum and 1 (1.09%) was tinea capitis.

Types of sample	**Positive by microscopy and/or culture**	**Negative by microscopy and/or culture**	**Total**
	n (%)	**n (%)**	**n (%)**
Skin	85 (37.95)	139 (62.05)	224 (100.00)
Nail	6 (37.5)	10 (62.5)	16 (100.00)
Hair	1(16.67)	5 (83.33)	6 (100.00)
Total	**92 (37.40)**	**154 (62.60)**	**246 (100.00)**

Table 3.1: Distribution of dermatophytes from skin, hair and nail samples detected by microscopy and/or culture methods (N=246).

Age	**Male**	**Female**	**Total**
(years)	**n (%)**	**n (%)**	**n (%)**
1-10	6 (2.44)	9 (3.66)	15 (6.10)
11-20	17 (6.91)	20 (8.13)	37 (15.04)
21-30	38 (15.44)	53 (21.54)	91 (36.98)
31-40	30 (12.20)	35 (14.23)	65 (26.43)
41-50	12 (4.88)	15 (6.10)	27 (10.98)
> 50	2 (.81)	9 (3.66)	11 (4.47)
Total	**105 (42.68)**	**141(57.32)**	**246 (100.00)**

Table 3.2: Age and gender distribution of the study population (N=246)**.**

Clinical types	**Total**
	n (%)
Tinea corporis	140 (56.91)
Tinea pedis	25 (10.16)
Tinea cruris	45 (18.30)
Tinea manuum	10 (4.07)
Tinea faciei	4 (1.62)
Tinea unguium	16 (6.50)
Tinea capitis	6 (2.44)
Total	**246 (100.00)**

Table 3.3: Clinically suspected cases of dermatophytosis from study population (N = 246).

Clinical types	**Age group**						Gender		**Total**
	n (%)						**n (%)**		**n (%)**
	01-10	11-20	21-30	31-40	41-50	>50	Male	Female	
Tinea corporis	6 (4.3)	22 (15.7)	45 (32.1)	50 (35.7)	15 (10.7)	2 (1.4)	64 (45.7)	76 (54.3)	140 (100.0)
Tinea pedis	0 (0.0)	10 (40.0)	5 (20.0)	6 (24.0)	4 (16.0)	0 (0.0)	8 (32.0)	17 (68.0)	25 (100.0)
Tinea cruris	0 (0.0)	0 (0.0)	28 (62.2)	3 (6.7)	7 (15.6)	7 (15.6)	19 (42.2)	26 (57.8)	45 (100.0)
Tinea manuum	5 (50.0)	5 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (40.0)	6 (60.0)	10 (100.0))
Tinea faciei	0 (0.0)	0 (0.0)	4 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (100.0)	4 (100.0)
Tinea unguium	0 (0.0)	0 (0.0)	7 (43.8)	6 (37.5)	1 (6.3)	2 (12.5)	6 (37.5)	10 (62.5)	16 (100.0)
Tinea capitis	4 (66.7)	0 (0.0)	2 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)	4 (66.7)	2 (33.3)	6 (100.0)
Total	15 (6.1)	37 (15.0)	91 (36.9)	65 (26.4)	27 (10.9)	11 (4.5)	105 (42.7)	141 (57.3)	246 (100.0)

Table 3.4: Distribution of clinical types of dermatophytosis in relation to age and gender among the study population (N =246).

Clinical types	Detected by microscopy and/or culture
	n (%)
Tinea corporis (n =140)	62 (67.40)
Tinea pedis (n = 25)	14 (15.22)
Tinea cruris (n = 45)	7 (7.60)
Tinea manuum (n=10)	2 (2.17)
Tinea faciei (n = 4)	0 (0.00)
Tinea unguium (n=16)	6 (6.52)
Tinea capitis (n=6)	1 (1.09)
Total (N=246)	**92 (100.00)**

Table 3.5: Detection of dermatophytosis by microscopy and/or culture (n=92).

Clinical types	Only microscopy	Only culture	Both microscopy and culture methods
	n (%)	**n (%)**	**n (%)**
Tinea corporis (n=62)	8 (12.90)	3(4.84)	51 (82.26)
Tinea pedis (n=14)	2 (14.28)	0 (0.00)	12 (85.72)
Tinea cruris (n=7)	5 (71.43)	0 (0.00)	2 (28.57)
Tinea manuum (n=2)	0 (0.00)	0 (0.00)	2 (100)
Tinea unguium (n= 6)	0 (0.00)	4 (66.67)	2 (33.33)
Tinea capitis (n= 1)	1 (100)	0 (0.00)	0 (0.00)
Total (n= 92)	**16 (17.40)**	**7 (7.60)**	**69 (75.00)**

Table 3.6: Distribution of dermatophytosis by microscopy, culture and both methods.

It was observed that among total 92 cases of dermatophytosis; 16 (17.40%) cases were detected by direct microscopy, 7 (7.60%) cases were detected by culture method and 69 (75.00%) cases were detected by both microscopy and culture methods (Table 3.6).

Table 3.7 shows the distribution of dermatophyte species isolated from different clinical types of dermatophytosis by culture method. It was found that, tinea corporis and tinea pedis caused by *Trichophyton mentagrophytes* were 35 (64.81%) and 7 (58.33%) respectively. Five (83.33%) of 6 tinea unguium cases were produced by *Trichophyton rubrum* and rest 1 (16.67%) case was caused by *Trichophyton mentagrophyte*. While 2 (100%) cases of tinea cruris were caused by *Trichophyton rubrum* and 2 (100%) cases of tinea manuum were produced by *Trichophyton mentagrophyte*.

Table 3.8 shows the comparison results of microscopy with culture method in diagnosis of dermatophytosis. Out of 85 microscopy positive cases, 69 (28.05%) were detected by culture; 154 (62.60%) cases were negative by both methods. Sixteen [16 (6.50%)] cases were detected only by microscopy and 7 (2.85%) cases were positive only by culture method. According to the diagnostic validity test, sensitivity and specificity of KOH mount microscopy was 90.79% and 90.59% respectively considering culture as a gold standard.

Table 3.9 shows detection of dermatophyte species by biochemical test (urease test and hair perforation test) and PCR from culture positive cases. It was observed that, none of the *Trichophyton rubrum* was positive in urease test and hair perforation test, while all *Trichophyton mentagrophyte* species were positive by urease test and hair perforation test. On the other hand, all culture isolated species were positive by PCR.

Clinical types	***T.rubrum***	***T.mentagrophytes***	**Total**
	n (%)	**n (%)**	**n (%)**
Tinea corporis	19 (35.19)	35 (64.81)	54 (100.00)
Tinea pedis	5 (41.67)	7 (58.33)	12 (100.00)
Tinea cruris	2 (100.00)	0 (0.00)	2 (100.00)
Tinea manuum	0 (0.00)	2 (100.00)	2 (100.00)
Tinea capitis	0 (0.00)	0 (0.00)	0 (00.00)
Tinea unguium	5 (83.33)	1(16.67)	6 (100.00)
Total	**31 (40.79%)**	**45 (59.21%)**	**76 (100.00)**

Table 3.7: Distribution of dermatophyte species from different clinical types of dermatophytosis by culture method (n= 76).

Microscopy	**Culture**		**Total**
	Positive	**Negative**	**n (%)**
	n (%)	**n (%)**	
Positive	69 (28.05)	16 (6.50)	85(34.55)
Negative	7 (2.85)	154 (62.60)	161(65.45)
Total	**76 (30.90)**	**170 (69.10)**	**246 (100.00)**

Table 3.8: Comparison of microscopy with culture in diagnosis of dermatophytosis (N=246).

Result obtained from Diagnostic validity test.

Note: Sensitivity of KOH mount microscopy = 90.79%.

Specificity of KOH mount microscopy = 90.59%.

Culture	Biochemical test		PCR
	Urease test	Hair perforation test	
Trichophyton mentagrophyte (n= 45)	45 (100.00)	45 (100.00)	45 (100.00)
Trichophyton rubrum (n= 31)	0 (0.00)	0 (0.00)	31 (100.00)

Table 3.9: Detection of dermatophytes species by biochemical test and PCR from culture positive cases (n=76).

4. Discussion

Dermatophytosis is a common cutaneous infection around the world and has become a public health problem. Dermatophyte is one of the predominant fungi in tropical and subtropical countries. The epidemiology of dermatophyte has been changed significantly in the last century as a result of migration, lifestyle, drug therapy and socioeconomic conditions of people [13]. Dermatophytosis are increasingly prevalent in these countries due to several contributing factors like-hot and humid climate, congested living condition, unhygienic working environment, low socio-economic condition, poor knowledge about health education, lack of health care facilities and increased outdoor activities etc.Therefore it is important to rapid and precise identification of the dermatophytes causing dermatophytosis with good laboratory methods for appropriate treatment and prevention measures.

The present study was designed to detect dermatophyte species from skin, nail and hair samples collected from the patients attending at the out-patient Department of Dermatology and Venereology, Dhaka Medical College Hospital (DMCH), Dhaka, Bangladesh.

In this present study, the prevalence of dermatophytic infection was 37.40%, which was consistent with a similar previous study and that was 38.75% [14]. In a previous study the reported dermatophytic infection was 84%, which was much higher than the present study [23]. This difference may be due socio-economic and cultural diversity. Regarding the gender distribution of the study patients, it was found that, the females were comparatively more sufferer than the male patients (male-female ratio was 1:1.34). In accordance Awal *et al*. reported that, out of 12,798 study patients, females (56.17%) were more affected than the males (43.83%) [24]. A study in Brazil reported that 76% female patients were affected by dermatophytic infections [25]. The reason of female predominance could be due to dermatophytosis suspected part in the body of the females remains covered by clothes, which keep the body moist and sweaty. Sweating is a precipitating factor for fungal infection that may provide favorable environment for the growth of fungus [25].

Majority (36.98%) of the study subjects were at the age group of 21-30 years in this present study. This finding was in an agreement with related previous studies [26-28]. The probable reason for the highest prevalence of dermatophytosis in this age group of the patient could be due to more physical activities that cause sweating and increased exposure to wet works for which their body remains moist for a long time.

In this present study tinea corporis was the most common (56.91%) clinical types of dermatophytosis and it also contributed the highest positivity by microscopy and/or culture (67.40%). This finding was nearly close to the previous studies [11, 29]. It was reported that, living in damp or humid areas, wearing tight clothing, sharing clothings/beddings with others may create favorable environments for tinea corporis infection [11, 29].

In our study all specimens were detected by direct microscopy and/or culture method. It was observed that, 34.55% cases were detected by direct microscopy in this present study which was supported by similar previous studies [27] [30]. On the other hand, 30.89% cases were detected by culture method and this finding was almost similar to the related previous studies [14, 27].

In this current study, all culture positive cases were further evaluated by biochemical test (urease test and hair perforation test) and PCR. It was observed that, none of the *Trichophyton rubrum* was positive in urease test and hair perforation test, while all *Trichophyton mentagrophyte* species were positive by urease test and hair perforation test. On the other hand, all culture isolated species were positive by PCR In accordance a couple of previous studies demonstrated that PCR technique could identify the dermatophyte species [31, 32].

In this current study *Trichophyton mentagrophyte* was the predominant species (59.21%) followed by *Trichophyton rubrum* (40.79%) isolated in our study population. No mixed infection was found. *Trichopyhton mentagrophyte* was found to be the main etiological dermatophyte species (23.40%) responsible for dermatophytosis in a previous study [28]. In another previous study, *Trichophyton mentagrophyte* was the most predominant dermatophyte followed by *Trichophyton rubrum* comprising 63.5% and 34.6% respectively [33]. Similarly, Nasim uddin *et al.* reported *Trichophyton mentagrophyte* was isolated as a common species (38.75%) for dermatophytosis followed by *Trichophyton rubrum* (27.31%) [34]. The plausible explanation for this may be *Trichophyton rubrum* is a slow growing organism, and it generally linked to chronic dermatophytosis [33]. In this present study most of the cases were acute dermatophytosis which was the reason behind lower proportion of *Trichophyton rubrum* in our study.

This study demonstrated that dermatophytosis is common among young adults especially in females. *Trichophyton mentagrophyte* is the commonest dermatophyte causing dermatophytosis in Bangladesh. All the clinically suspected fungal infections could be confirmed by direct microscopy and culture methods. The PCR technique could be implemented to know the exact prevalence of particular dermatophyte.

5. Conclusion

This study concluded that dermatophytosis is a common infection in young adults and more frequent in females. Among different types of dermatophytes, *Trichophyton mentagrophyte* species is the commonest aetiological agent of dermatophytosis. Majority of dermatophytes could be identified by both direct microscopy and culture methods.

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Conflicts of interest

The authors declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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