

## Original Research Article

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## Prevalence of Dermatophytic Infection among Diabetic and Non-Diabetic Patients in a Tertiary Level Hospital in Chennai, India

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### ABSTRACT

Diabetes mellitus is the most common endocrine disorder and takes on pandemic proportions. Dermatophytosis remains a significant public health problem. The objective of the study was to study the prevalence of Dermatophytic infection among diabetic and non-diabetic patients. It is a cross sectional study conducted during July 2011 to July 2012. All clinically diagnosed cases of dermatophytosis attending the Dermatology OPD of were included in the study. Among those 40 diabetic and 40 non-diabetic Patients were included. Clinical materials were collected from the patients suffering from various types of dermatophytoses and processed according to standard protocols. 80 Samples from 80 patients suspected of dermatophytic infections were collected and processed. It includes 40 diabetic patients and 40 non-diabetic patients. The male /female ratio was 51%: 48%. Patients above 40 years of age were taken from both diabetic and non-diabetic patients. A 16.3% of cases gave a history of contact with possible source of infection. Of the 40 diabetic samples collected 7 samples (17.5%) were both negative for both KOH wet mount and culture, remaining 33 samples (82.5%) were positive for both KOH mount and culture. Out of the 40 non-diabetic patients 12 samples (30%) were negative for both KOH mount and culture, remaining 28 (70%) were positive for both KOH mount and culture. The samples were skin scrapings, hair, and nail. Of the culture positive cases, 58.7% belonged to *Trichophyton* spp., 15% *Microsporium* spp. and 2.5% to *Epidermophyton* spp. The predominant isolate from all samples were *T. rubrum*, 40% from both diabetic and non-diabetic patients. *T. rubrum* was found predominantly in diabetic patients with an isolation rate of 45% than in the non-diabetic patients were the isolation rate is 35%. *T. mentagrophyte* isolation rate was 18.7% from both diabetic and non-diabetic patients. Isolation rate of *T. mentagrophyte* was more from non-diabetic patients (20%) than the diabetic patient with the isolation rate of 17.5%. *Microsporium gypseum* isolation rate was 15% from both diabetic and non-diabetic patients. Isolation rate of *M. gypseum* (15%) was same among both diabetic and non-diabetic patients. *Epidermophyton floccosum* was the least isolated dermatophyte with an isolation rate of 5% and it was isolated only from diabetic patients. The predominant isolate from all samples were *T. rubrum*, 40% from both diabetic and non-diabetic patients.

#### Keywords

*Trichophyton rubrum*, *T. mentagrophyte*, *Epidermophyton floccosum*, Diabetic patients, Non-diabetic patients

#### Article Info

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## Introduction

Diabetes mellitus is the most common endocrine disorder and takes on pandemic proportions.

Worldwide, over 246 million people suffer from the disease in 2007 and estimates for 2025 are depicted at a total of 380 million patients (Van Houtum, 2008). Diabetes mellitus (DM) is characterized by state of relative or complete insulin deficiency, leading to gross defects in glucose, fat and protein metabolism (Bub and Olerud, 2003). It is very unfortunate that India tops the list in diabetic population. World health organisation (WHO) estimates the diabetic population in India in 2000 is 31.7 million and in 2030 it is likely to rise to 79.4 million (Wilds Roglic *et al.*, 2004).

A wide variety of cutaneous infections in man are present worldwide in which the integuments and its appendages the hair and the nail are involved. Majority of the infections are caused by a homogenous group of keratophilic fungus called the dermatophytes. Dermatophytes are fungi that can cause infections of the skin, hair and nails due to their ability to utilize keratin. The fungi are the commonest infective agent of man and no group of people or geographical areas are without taenia or ringworm infection (taenia-latin for worm). Evolutionary development towards an accommodating host parasite relationship can be seen among the dermatophyte which is absent among other fungal agent of human disease. This group of disease is collectively referred to as dermatophytosis.

Depending on the species, the organism may be viable in the environment for up to 15 months.

There is an increased susceptibility to

infection when there is a pre-existing injury to the skin such as scars, burns, excessive temperature and humidity.

Dermatophytes are classified as anthropophilic, zoophilic or geophilic according to their normal habitat.

Anthropophilic dermatophytes are restricted to human hosts and produce a mild, chronic inflammation.

Zoophilic organisms are found primarily in animals and cause marked inflammatory reactions in humans who have contact with infected cats, dogs, cattle, horses, birds, or other animals. This is followed by a rapid termination of the infection.

Geophilic species are usually recovered from the soil but occasionally infect humans and animals. They cause a marked inflammatory reaction, which limits the spread of the infection and may lead to a spontaneous cure but may also leave scars.

### At the National Centre for Mycology

About 58% of the dermatophyte species isolated are *Trichophyton rubrum*

27% are *T.mentagrophytes*

7% are *T.verrucosum*

3% are *T.tonsurans*

Infrequently isolated (less than 1%) are *Epidermatophyton floccosum*, *Microsporum audouinii*, *M.canis*, *M.equinum*, *M.nanum*, *M.persicolor*, *Trichophyton equinum*, *T.kanei*, *T.raubitschekii*, and *T.violaceum*.

Skin manifestations in diabetes mellitus are common and expressed in numerous forms. If one considers metabolic effects on microcirculation and changes in skin collagen, prevalence approaches 100%. Findings range

from the presenting manifestations of the disease to signs of long term involvement, and serious or even life threatening problems. For all of these, recognition is the key to treatment and/or prevention (The Electronic textbook of Dermatology). Non-Diabetic patients are also prone to dermatophytic infection because of their poor hygiene in low socio economic group and the environment they live in also plays as an etiological cause. The common dermatophyte encountered in non-diabetic patients is *T.rubrum*, *T.mentagrophyte*, *M.gypseum*.

Superficial fungal infections of the foot (tinea pedis and onychomycosis) are common among elderly patients. Although most authorities believe that patients with diabetes mellitus have an increased predisposition to dermatophytic infections, some controversies still remain. Because these infections disrupt the skin integrity and provide an avenue for bacterial superinfection, elderly diabetic patients with dermatophytic infection should be promptly treated with an antifungal agent. For most dermatophytic infections of the foot, topical agents are usually effective and less expensive than oral agents (Foot Fungus in Diabetics, 2004).

Recent studies show greater incidence of skin infections in diabetic patients. Incidence ranges from 20-50%, (Hattemn *et al.*, 2008) mostly in type 2 diabetes mellitus and often associated with poor glycemic control (Nigham and Pande, 2003). Infections constitute the main bulk of cutaneous manifestations of diabetes mellitus (Mahajan *et al.*, 2003).

Association of dermatophyte infection with diabetes is controversial but recent data shows a statistically significant relationship (Aananthi and Sarayu, 2005). Common superficial infections are caused by *Trichophyton rubrum*, *T.mentagrophytes*, and *Epidermophyton floccosum*.

In diabetic patients, onychomycosis or tinea pedis should be monitored and treated, as it can be part of entry for infection. This is especially true for patients with neurovascular complications and intertrigo.

Signs of *T.rubrum* infection are noninflamed, white, powdery scaling of skin creases on the palms and soles, often with nail involvement. *T.mentagrophytes*-associated intertrigo or interdigital infection presents as maceration and superficial scaling with an active red border (Hattemn *et al.*, 2008).

To isolate the dermatophytes from clinical specimens like skin, nail and hair obtained from patients attending Dermatology OP. To speciate the isolates of dematophytes.

To study the correlation of fungal isolates and the clinical manifestations.

To determine the commonest prevalent genus and species of dermatophytes in and around Chrompet Chennai.

To determine the antifungal susceptibility of the isolates by different methods

## **Materials and Methods**

### **Materials**

Sterilized equipments were used at all times to avoid contamination by non-pathogenic fungi and bacteria. The following equipments and the media were used for the collection of specimens from the patients and the isolation and identification of the etiologic agents.

### **Equipments**

Ultraviolet lamp  
Woods lamp  
Epilated forceps  
Nail clipper

Scalpel  
Scissors  
Inoculating needles  
Sterile test tubes and petri-dishes  
Clean slides  
Sterile cotton

### **Reagents**

Seventy percent alcohol  
  
Ten to fifteen percent Potassium hydroxide solution  
  
Cycloheximide and chloramphenicol

### **Stain**

Lactophenol cotton blue

### **Specimen**

The clinical material collected from the patients includes:  
Skin scraping  
Nail clipping  
Hair from infected area

### **Media used**

For the isolation and identification of the etiological agents the following media were used.

### **Sabourauds cycloheximide and chloramphenicol medium.**

This is a selective medium (69) for the isolation of pathogenic fungi from heavily contaminated clinical materials such as hair, skin scrapings and nail Clippings. Chloramphenicol inhibits the growth of most contaminating bacteria and cycloheximide suppresses the growth of many saprophytic fungi.  
Clinical materials were collected from the

patients suffering from various types of dermatophytes. Proper selection of clinical materials was very important for both direct examination and culture. The types of specimen collected include:-

### **Skin scrapings**

Scraping was obtained from the lesions involving the skin with a sterile scalpel after carefully washing the site with 70 percent alcohol. Scrapings taken from active border areas of lesions were placed in sterile petri-dish for laboratory examination and culture. In some lesions vesicles were present which were carefully clipped off with small sterile scissors and successful microscopic and cultural examinations were made (fig:)

### **Nail clipping**

Ringworm infected nails were found to be thickened and deformed. Clipping of nail, especially near the bed of the nail were collected in a sterile petri-dish for microscopic examination and culture. (fig:)

### **Hair**

The patients suffering from dermatophytic infection were examined under normal light for area without hair, scaling, crust formation, hair stumps and erythema. The tinea capitis patients were then subjected to woods light examination in a dark room to determine the fluorescence. The basal portion of the hair or the hair tufts were collected as the fungus is usually found in this area

### **Sample Population**

Cross sectional study from January 2010 to July 2012. All clinically diagnosed cases of dermatophytosis attending the Dermatology OPD of Sree Balaji Medical College and Hospital were included. Among those 40

DIABETIC and 40 NON DIABETIC Patients were included. Patients using antifungal treatment for >3 weeks were excluded. Direct microscopy and culture of relevant samples were done.

### **Microscopic examination of clinical materials**

The clinical material so obtained was dissolved in two drops of 10 percent potassium hydroxide on a glass slide. If the nail clipping were thick 15 percent potassium hydroxide was used. After putting the cover slip the slide was heated for few seconds over spirit lamp taking care that the material should not boil. The preparation was observed under the low power of the microscope in reduced light. Presence of mycelia fragments and the distribution of spores on or inside the hair were noted. For a detailed microscopic morphology of the etiologic agent in clinical material, the slide preparation was studied under the high power of the microscope and the observation was recorded as follows.

### **Direct examination in potassium hydroxide mount**

#### **Skin scraping and nail**

Branching mycelia elements with or without chains of arthrospores or mycelium and masses of arthrospores, some in chains

#### **Hair**

Endothrix or ectothrix infection, sheath of small spores in mosaic inside or outside the hair, or mycelium with hair.

### **Isolation of etiological agents**

#### **Medium**

Sabourauds cycloheximide chloramphenicol medium was used for the isolation of the dermatophyte from the clinical material.

### **Inoculation of slant**

Slants were inoculated by placing hair, skin scrapings or nail clipping with the help of a sterile needle on slant surface of the medium.

### **Incubation**

All the tubes inoculated were incubated at room temperature about 27°C to 30°C for one to three weeks. Slants were examined every four to six days. If any saprophytic fungi appeared, the suspected colony of dermatophyte was transferred to other slant.

### **Identification**

After incubation the slant were examined for any growth, different dermatophyte show different type of growth and colour variation.

### **Microscopic examination of fungi by lactophenol cotton blue preparation**

This is to identify the filamentous fungi

Different methods are followed to prepare fungal cultures for microscopic examination by Lacto phenol cotton blue (LCB) preparation. They are

Tease mount preparation

Scotch tape preparation

Slide culture

### **Lactophenol cotton blue stain**

Phenol crystals - 20.00 grams

Lactic acid - 20.00 grams

Glycerol - 40 ml

Distilled water - 20 ml

Dissolve the ingredients by heating the container in a hot water bath. Add 0.05 gram cotton blue.

### **Scotch Tape Preparation**

Fungal growth adheres to the adhesive side of the tape so that the colony can be easily examined by touching them with the tape

#### **Method**

Place a drop of LCB on a clean slide

Touch the adhesive side of the tape of transparent scotch tapes on the surface of the colony at a point intermediate between its center and the periphery

Fix the adhesive side of the tape over an area on the glass slide containing the LCB. Examine microscopically the preparation under 10x, 45x.

### **Tease Mount Preparation**

Place a drop of lactophenol cotton blue on a clean glass microscopic slide

With a straight wire slightly bent at the tip remove a small portion of the colony and the supporting agar at a point mid-way between the centre and periphery and place it in the drop of LCB

With the help of another straight wire or needle tease the fungal culture into small bits and spread in LCB

Place a cover slip and apply gentle pressure over the agar bits to spread evenly.

Examine microscopically after giving sufficient time for the structures to take up the stain, usually 30 minutes

### **Slide Culture**

Place inside a 9 cm glass petridish a v shaped bent glass rod, a microscopic glass slide, and two cover slip. Wrap them in brown paper and sterilize in a hot air oven at 160°C for 1 hour.

Flame sterilize the scalpel, cool and cut a small square agar block from SDA plate and place it on the glass slide.

With the help of an inoculating needle, remove the growth from the colony with the supporting agar and place it on the glass slide.

With the help of inoculating needles tease it into small bits and transfer them to the corners and edges of the agar block.

Place a cover slip over the agar and gently press it to seat firmly on the agar.

Pour about 10 ml sterile distilled water into the petridish, cover and incubate at room temperature (25-30°C).

Examine the preparation every 48 hours for the growth to occur over the cover slip and slide.

When sufficient growth has occurred the cover slip is removed with a sterile forceps and transferred to a drop of LCB on a glass microscopic slide.

Remove the agar block and discard in the discarding jar. Add a drop of LCB to the growth on the glass slide and cover it with a cover slip. Thus we get two LCB mounts from one slide culture preparation

Examine LCB mount at 10x, 45x for characteristic morphology.

### **KOH Preparation**

Direct examination of clinical specimens provides an immediate presumptive diagnosis of type of fungal infections. It also aids in the selection of appropriate culture media for the isolation of the etiological agent. KOH clears out the background scales or cell membranes

that may be confused with hyphal elements of fungi. Clearing is usually accelerated by gently heating.

A drop of 10% KOH is kept on a microscopic slide and emulsify the specimen with the help of loop and place a cover slip, leave it for 10 minutes and examine under microscope.

### **General characteristic of dermatophyte**

#### ***Trichophyton rubrum***

Rugal folds are seen on the surface

The reverse side of the colony is yellow when young and becomes reddish to rose purple with age

Macroconidia are generally absent

Microconidia present in large numbers

#### ***Trichophyton mentagrophyte***

Fluffy granular white growth is seen in tube

Reverse is buff or reddish brown

Macroconidia rarely seen

Microconidia produced in large numbers

#### ***Epidermophyton floccosum***

Velvety to powdery surface

Surface is folded in number of radiating furrows

Macroconidia are calvate, smooth, and fairly thick walled

Microconidia not produced.

#### ***Microsporium gypseum***

Cinnamon coloured, reverse of the colony is light tan

Large number of macroconidia are produced

Microconidia are rarely seen

### **Results and Discussion**

The work represents a comprehensive study of the dermatophytic infections in the Department of Dermatology and Central Microbiology Laboratory of Shree Balaji Medical College and Hospital, Chrompet, Chennai. A total of 80 cases of various types of dermatophytes were studied, diagnosed clinically and confirmed by culture and other tests. Patients who were above 40 years were taken, which includes both male and female. Among these, 40 patients belong to DIABETIC population, 18 females and 22 males were included and 40 patients belong to NON-DIABETIC population which includes 21 females and 19 males.

#### **The relative incidence of different dermatophytes**

The number of cases studied and the percentage of incidence of various dermatomycoses is given in the following table.

The most commonly isolated Dermatophyte was *Trichophyton rubrum* (45%) and the next common was *Trichophyton mentagrophyte* (17.5%) followed by *Microsporium gypseum* (15 %), *Epidermophyton floccosum* (5%). 7 samples didn't have significant growth (17.5 %)

The most commonly isolated Dermatophyte among Non-diabetic patients is *Trichophyton rubrum* (35%) and the next common was

*Trichophyton mentagrophyte* (20%) followed by *Microsporium gypseum* (15%), 12 samples didn't show any significant growth with 30%. 7 samples didn't have significant growth, with 17.5 %.

### ***Trichophyton rubrum***

Totally 32 patients were infected with 40 % of incidence among both Diabetic and Non-diabetic

### ***Trichophyton mentagrophyte***

Totally 15 patients were infected with 17.5% of incidence among both diabetic and non-diabetic patients.

### ***Microsporium gypseum***

Totally 12 patients were infected with 15% of incidence among both diabetic and non-diabetic patients

### ***Epidermophyton floccosum***

Totally 2 patients were infected with 2.5% of incidence among both diabetic and non-diabetic patients

The incidences of dermatophyte infection are quite higher in Chennai<sup>(106)</sup>. In this study 80 samples were taken, 40 Diabetic and 40 Non-Diabetic patients samples were taken in which among the diabetic patients 22 (55%) were males and 18 (45%) were females. In Non-Diabetic patients 19 (47.5%) were males and 21 (52.5%) were females.

Chuku Aleruchi *et al.*,<sup>(107)</sup> in May 2012 showed that males were more prone to get dermatophytic infection than the females. The lower incidence in females may be because of the social stigma prevailing. Higher incidence in male may be correlated with the occupational hazards related to their nature of work, interaction with different people of the

society, environmental conditions also plays an important role such as hot and humid weather, poor personal hygiene and low illiteracy rate plays an important role in frequency of dermatophytosis in this part of the country which was observed by Kamalam A, Thambiah AS (1976)<sup>(108)</sup>; Nwadiaro 2003<sup>(109)</sup>.

In this study patients above 40 years of age were taken from both diabetic and non-diabetic patients. Dermatophyte infection is more common above 20 years as shown in the studies of Sing D, Patel DC, Rogers K, Wood N, Riley D, Morris AJ<sup>(110)</sup>.

A total number of 80 samples were collected,

Skin scrapings – 64

Nail clippings – 15

Hair sample - 1

Dermatophytes require keratin for growth, they are restricted to superficial skin, hair, nail. This is the reason why they do not invade the mucosal surface.

Some dermatophyte spread directly from one person to another (Anthrophillic dermatophytes). Others live in and are transmitted to humans from soil (geophilic organisms), and still others spread to humans from animal hosts. Transmission of dermatophytes also can occur indirectly from fomites (e.g., upholstery, hairbrushes, & hats).

Anthropophilic organisms are responsible for most fungal skin infections. Transmission can occur by direct contact or from exposure to desquamated cells. Direct inoculation through breaks in the skin occurs more often in persons with depressed cell-mediated immunity. Once fungi enter the skin, they germinate and invade the superficial skin layers.

**Dermatophytes are classified as anthropophilic, zoophilic or geophilic according to their normal habitat**

ANTHROPOPHILIC	ZOOPHILIC	GEOPHILIC
<i>Epidermophyton floccosum</i>	<i>Microsporium canis</i>	<i>Microsporium gypseum</i>
<i>Microsporium audouinii</i>	<i>Microsporium equinum</i>	<i>Trichophyton ajelloi</i>
<i>Microsporium ferrugineum</i>	<i>Microsporium nanum</i>	<i>Trichophyton terrestre</i>
<i>Trichophyton concentricum</i>	<i>Microsporium persicolor</i>	
<i>Trichophyton kanei</i>	<i>Trichophyton equinum</i>	
<i>Trichophyton megninii</i>	<i>Trichophyton mentagrophyte</i>	
<i>Trichophyton mentagrophytes</i>	<i>Trichophyton simii</i>	
<i>Trichophyton raubitschekii</i>	<i>Trichophyton verrucosum</i>	
<i>Trichophyton rubrum</i>		
<i>Trichophyton schoenleinii</i>		
<i>Trichophyton soudanense</i>		
<i>Trichophyton tonsurans</i>		
<i>Trichophyton violaceum</i>		
<i>Trichophyton yaoundei</i>		

**Comprehensive study of the dermatophytic infections in the Department of Dermatology and Central Microbiology Laboratory**

	MALE	FEMALE
DIABETIC	22	18
NON-DIABETIC	19	21

Fig.1

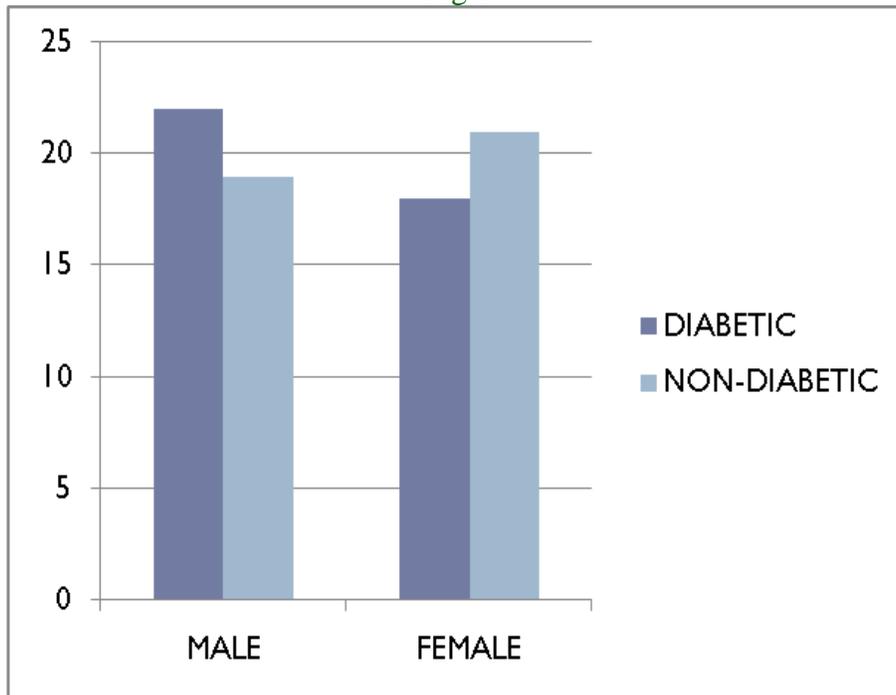
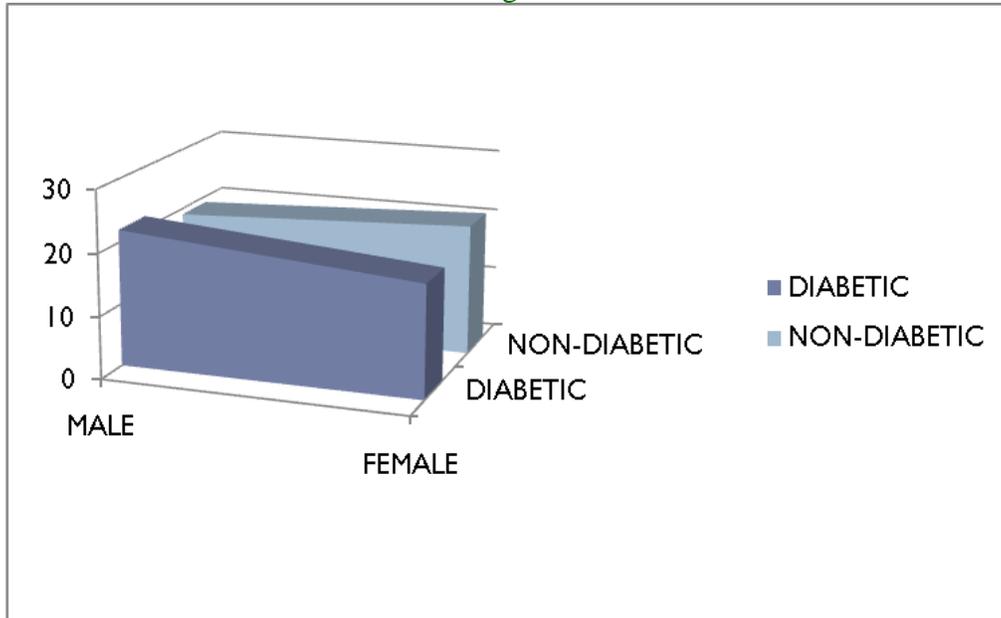


Fig.2



The male and female ratio in Diabetic population is 11:9  
 The male and female ratio in non-diabetic patients is 9:10

**Percentage of specimens from different sites of collection**

TOTAL NO.OF SPECIMEN	SKIN SCRAPPING	NAIL CLIPPING	HAIR
80	64	15	1

Fig.3 Frequency of incidence

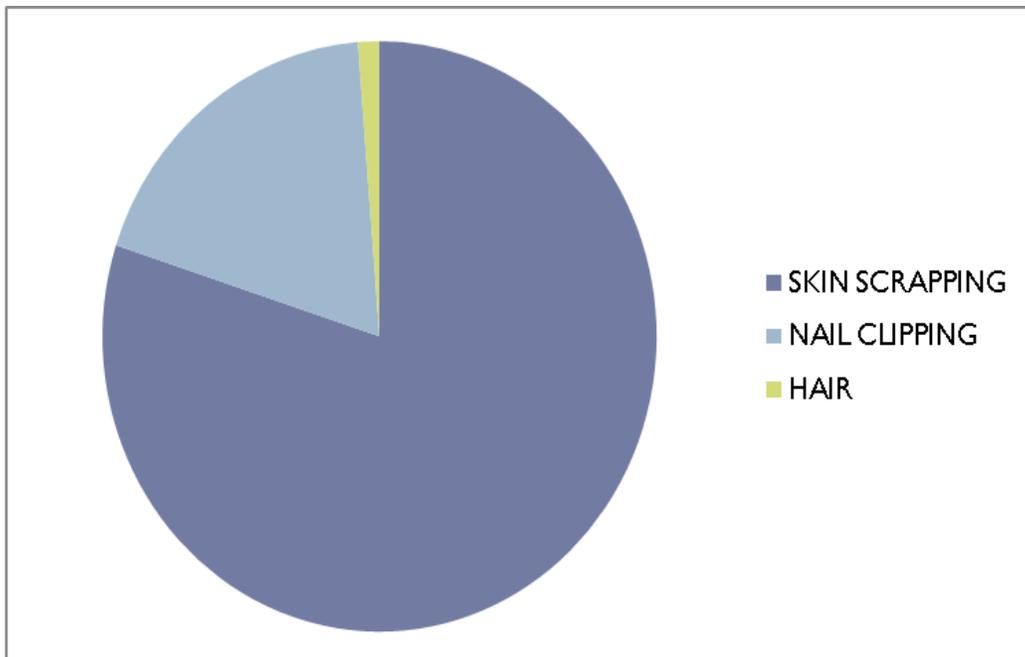
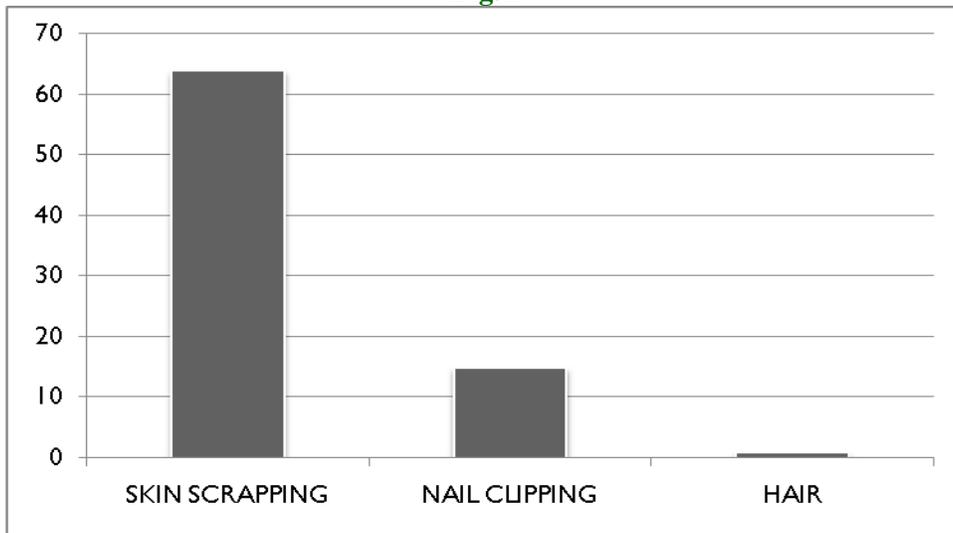


Fig.4

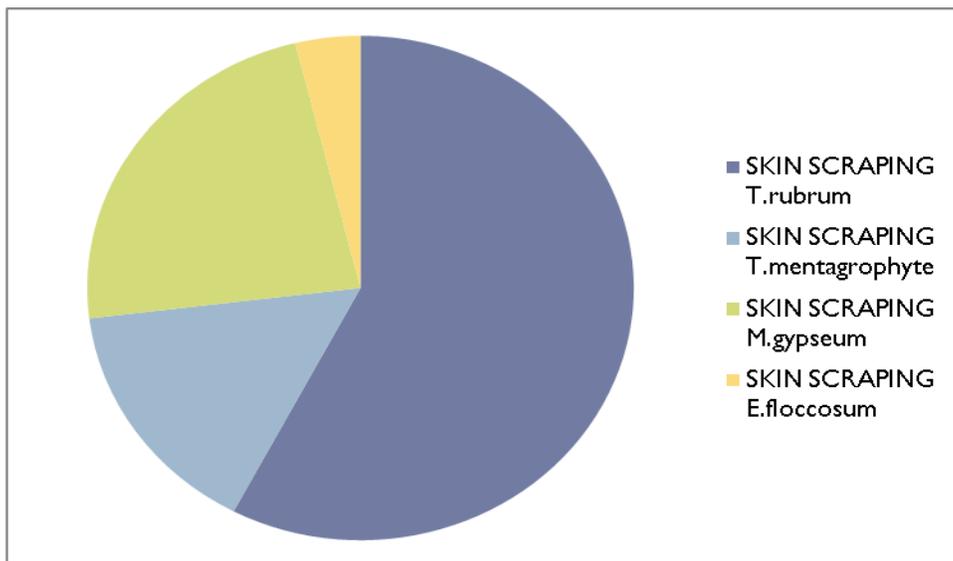


Out of 80 specimens collected, 64 were skin scrapings, 15 were nail clippings and 1 was hair sample.

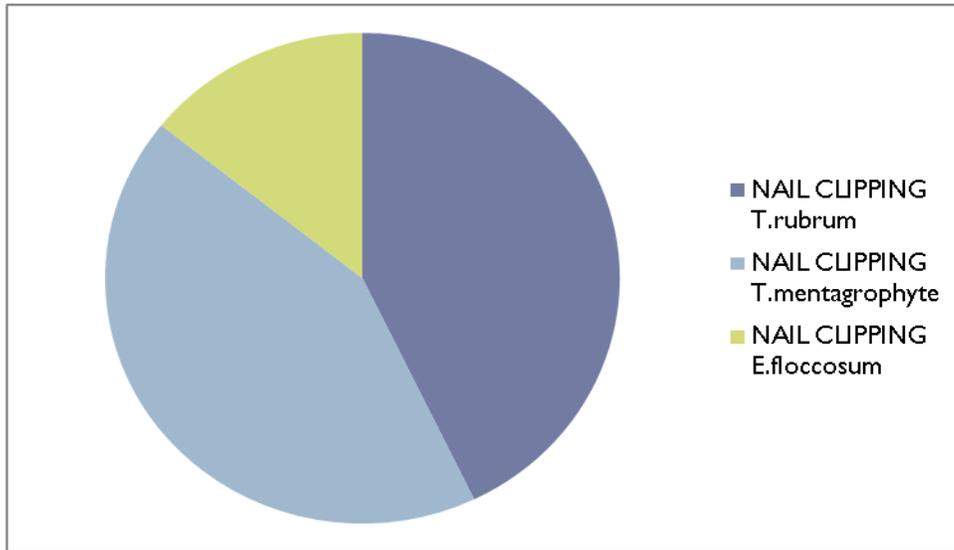
**Types of dermatophytes in diabetic**

SPECIMEN COLLECTION	TYPE OF DERMATOPHYTE	NO.OF CASES	PERCENTAGE
SKIN SCRAPING	<i>T.rubrum</i>	15	37.5
	<i>T.mentagrophyte</i>	4	10
	<i>M.gypseum</i>	6	15
	<i>E.floccosum</i>	1	2.5
HAIR	No growth	1	2.5
NAIL CLIPPING	<i>T.rubrum</i>	3	7.5
	<i>T.mentagrophyte</i>	3	7.5
	<i>E.floccosum</i>	1	2.5

Fig.5 Pie chart showing number of dermatophytes in skin scraping



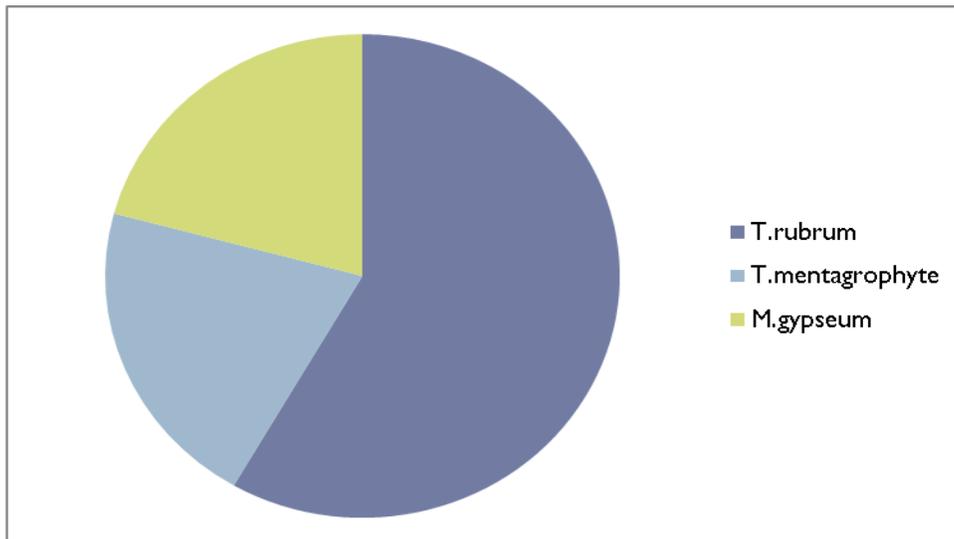
**Fig.6** Pie chart showing number of dermatophytes in Nail clipping:



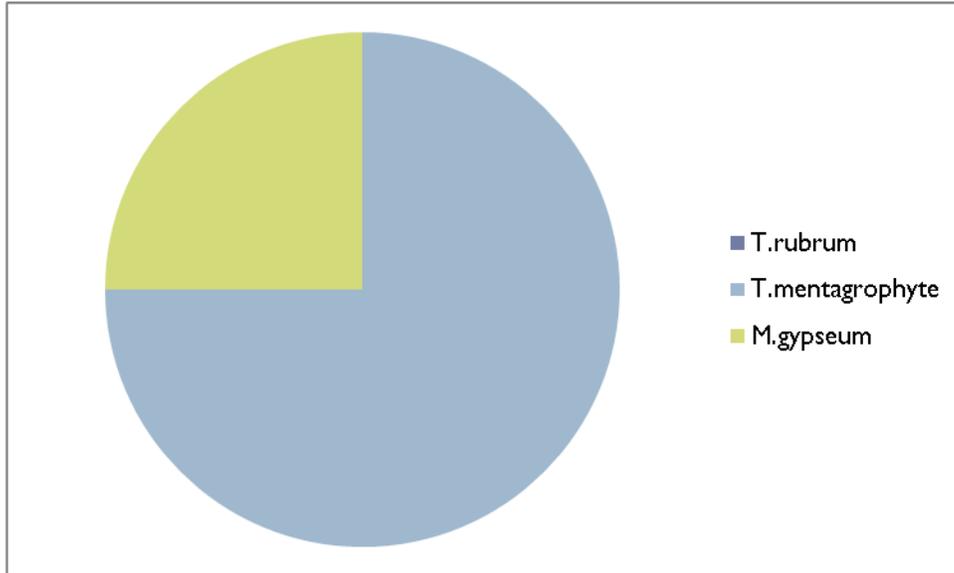
**Total number of dermatophyte in non-diabetic patients**

SPECIMEN COLLECTION	TYPE OF DERMATOPHYTE	NO.OF CASES	PERCENTAGE
SKIN SCRAPING	<i>T. rubrum</i>	14	35
	<i>T. mentagrophyte</i>	5	12.5
	<i>M. gypseum</i>	5	12.5
HAIR	No growth	0	0
NAIL CLIPPING	<i>T. rubrum</i>	0	0
	<i>T. mentagrophyte</i>	3	7.5
	<i>M. gypseum</i>	1	2.5

**Fig.7** Pie chart showing number of dermatophytes in Skin scrapping



**Fig.8 Pie chart showing number of dermatophytes in Nail clipping**



**Diabetic Patients**

DERMATOPHYTE	NUMBER OF CASES	FREQUENCY OF INCIDENCE (IN PERCENTAGE%)
Trichophyton rubrum	18	45
Trichophyton mentagrophyte	7	17.5
Microsporum gypseum	6	15
Epidermophyton floccosum	2	5

**Fig.9 Number of cases**

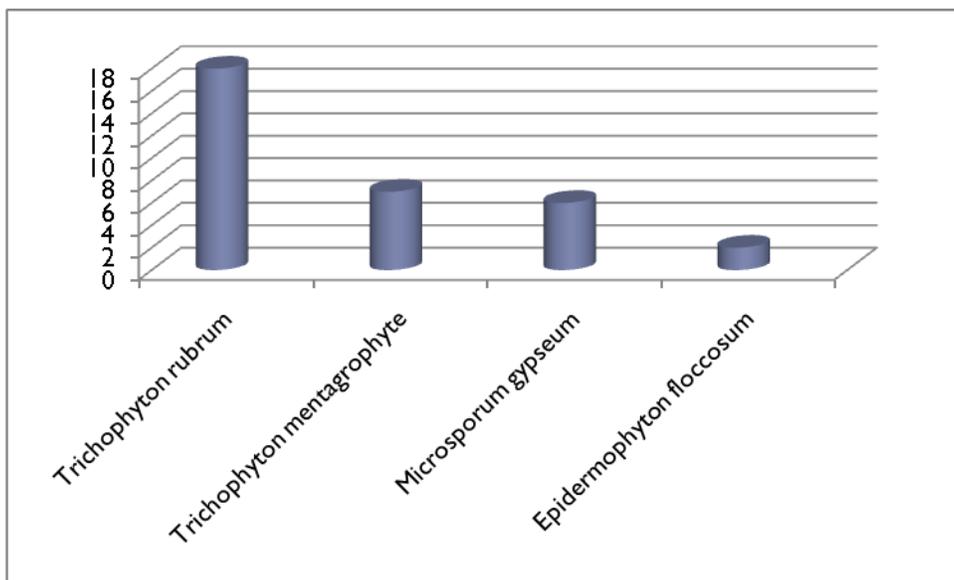
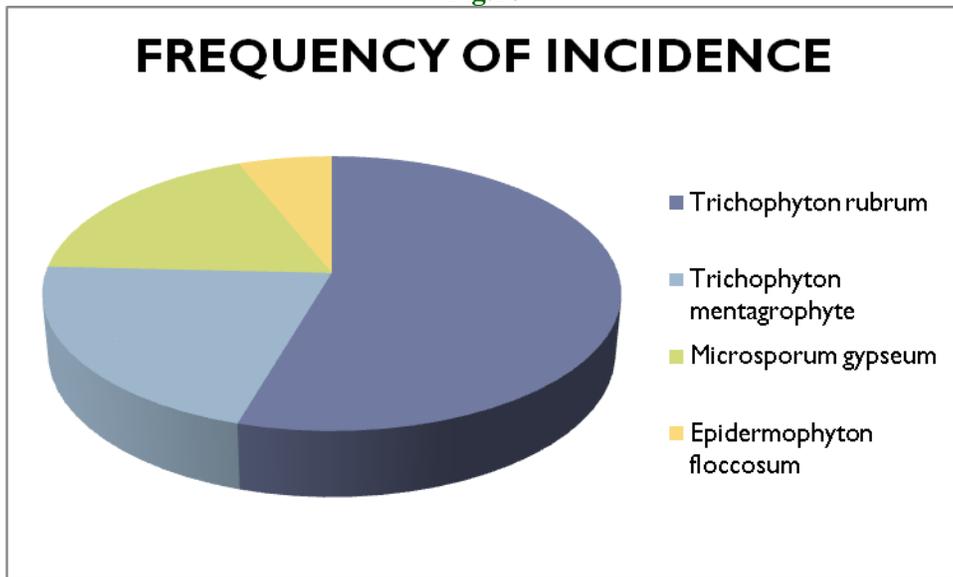


Fig.10



#### Non-Diabetic

DERMATOPHYTE	NUMBER OF CASES	FREQUENCY OF INCIDENCE (PERCENT %)
Trichophyton rubrum	14	35
Trichophyton mentagrophyte	8	20
Microsporum gypseum	6	15
Epidermophyton floccosum	0	0

Fig.11

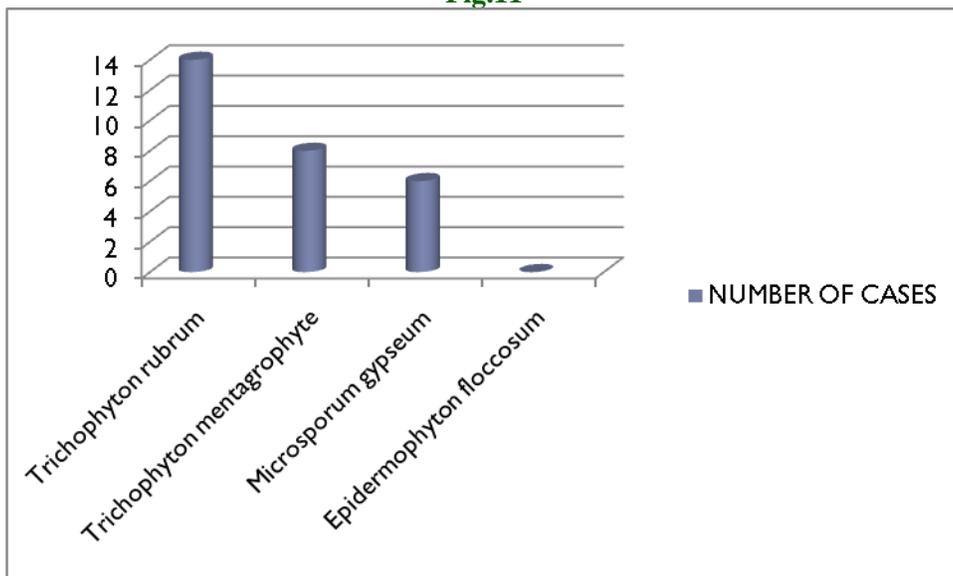
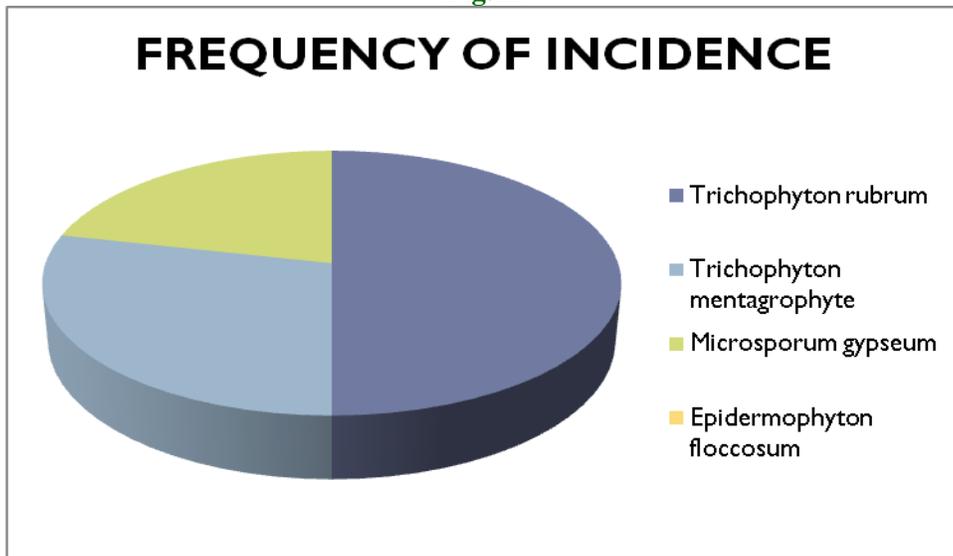


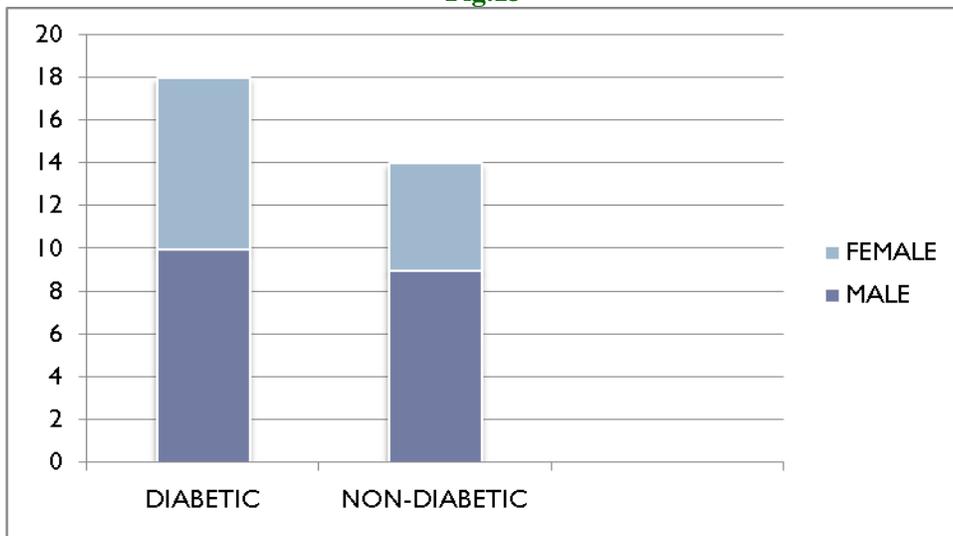
Fig.12



*Trichophyton rubrum*

SEX	DIABETIC	NON-DIABETIC
MALE	10	9
FEMALE	8	5
RATIO	5:4	2:1

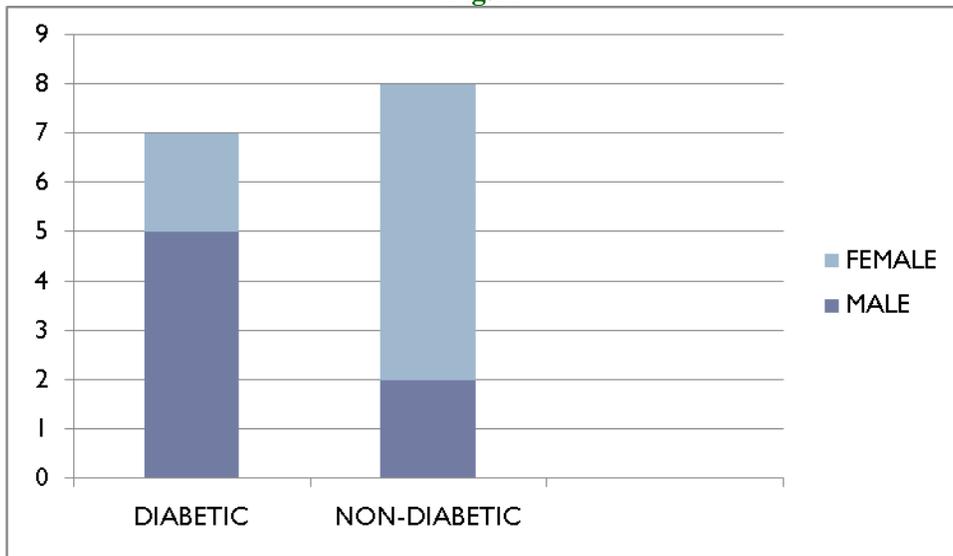
Fig.13



*Trichophyton mentagrophyte*

SEX	DIABETIC	NON DIABETIC
MALE	5	2
FEMALE	2	6
RATIO	2.5:1	3:1

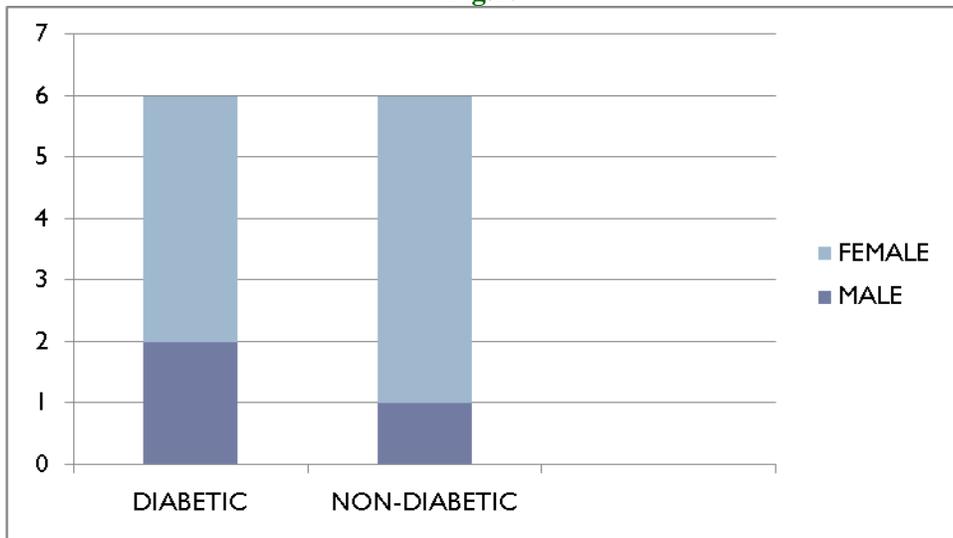
Fig.14



*Microsporium gypseum*

SEX	DIABETIC	NON DIABETIC
MALE	2	1
FEMALE	4	5
RATIO	1:2	1:5

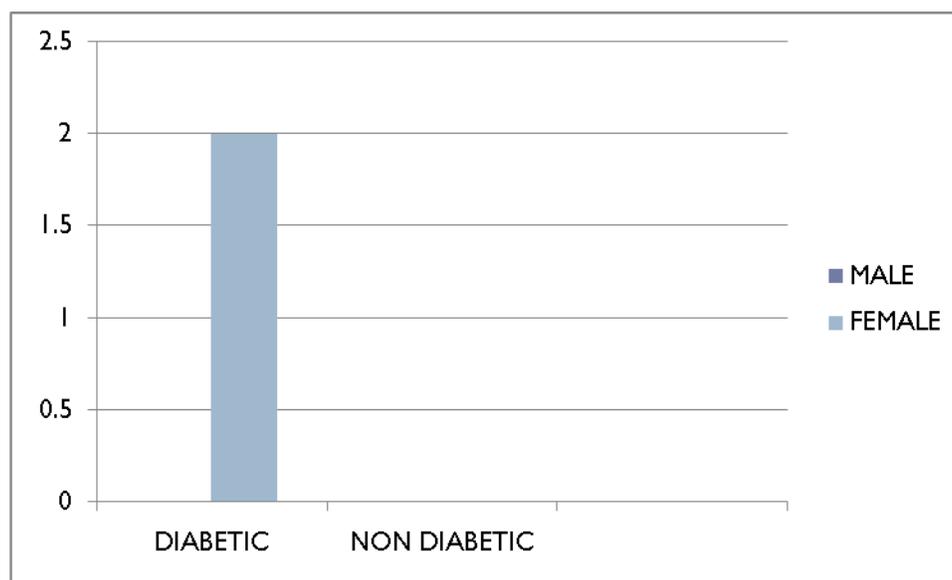
Fig.15



*Epidermophyton floccosum*

SEX	DIABETIC	NON DIABETIC
MALE	0	0
FEMALE	2	0
RATIO	0:2	0:0

Fig.16



The global incidence of onychomycosis is increasing and it continues to spread and persist as shown by studies of R Kaur, B Kashyap, P Bhalla<sup>(111)</sup>, Mashkoor Ahmad, Sanjay Gupta, Satish Gupte<sup>(112)</sup>, Vera Leibovici, Klilah Hershko, Arie Ingber, Maria Waterman, Nurit Leviatan-Strauss, Malka Hochberg<sup>(113)</sup>

The higher incidence of dermatophytic infection in skin is because dermatophyte requires keratin for their growth as said by Barry L. Hainer<sup>(114)</sup>

Out of the 40 diabetic isolates, 25 (62.5%) isolates belong to *Trichophyton* spp. of which *T. rubrum* was the predominate isolate (45%) followed by *T. mentagrophyte* (17.5%) In Kannan *et al.*,<sup>(115)</sup> studies *T. rubrum* was the main isolate (81%). This coincides with most of the earlier works of Pandey, 1970; Verenker, 1991; Summana and Singaracharya, 2004.

*T. mentagrophyte* was the second most commonly isolated species 7/40 (17.5%) this is confirmed by the studies of Urmil Mohan *et al.*, where the isolation rate was 28.2%. Mehta

JP *et al.*, and Nagakatti PS *et al.*, have also recorded an isolation rate of 22% and 29%. Further, 6(15%) belong to *Microsporium* spp. of which one species *M. gypseum* was isolated. Two isolates belonged to *Epidermophyton floccosum* (5%).

The members of the genera of *Epidermophyton* spp. 2 of 40 (5%) and *Microsporium* spp. 6 of 40 (15%) accounted for lower percentage of infection when compared to *Trichophyton* spp. as in Kannan *et al.*,<sup>(115)</sup> 2006 studies, where 2 of 53 (3.7%) infections were due to *Epidermophyton* spp. Out of the 40 non-diabetic patients 14 of 40 isolates belong to *T. rubrum* (35%) remains the predominant dermatophyte followed by *T. mentagrophyte* 8/40 (20%). Total number of *Trichophyton* spp. isolated accounts for 22(55%) followed by *M. gypseum* which accounts for 6 (15%). In the non-diabetic group also *Microsporium* spp. accounts for lower percentage of infection when compared to *Trichophyton* spp. in Kannan *et al.*, 2006<sup>(115)</sup> studies.

In an epidemiological survey of dermatophytosis in Tehran 2000 to 2005

Shahindokht *et al.*,<sup>(116)</sup> have found that *Epidermophyton floccosum* accounted for 85% of the infections, which is the most prevalent fungal pathogen.

### ***Trichophyton rubrum***

In this study out of the 80 patients 32 isolates were *T. rubrum*. *T. rubrum* is the most common dermatophytic infection and this finding is confirmed by a study done by Suman S, Beena PM in Gujarat India, same finding was shown by a research work done by Suganthi in Chennai. The climatic condition, socioeconomic status and the geographical location in which this part of Chennai falls prove to be an important cause for the higher incidence. Overall, 18/32 patients were diabetic and 14 of 32 were non-diabetic patients. There is a higher prevalence of *T. rubrum* in diabetic patients when compared to non-diabetic patients. As shown by Farheen *et al.*, *T. rubrum* was most prevalent in males than the females. *T. rubrum* infection is usually transmitted from man to man. In this connection the work done by English in Great Britain Rothman and Many in United States shows significant *T. rubrum* infection in families and have found the familial transfer of this infection. Rare instances of *T. rubrum* infections in animals are available in literature. Kaplan and Gump have reported the occurrence of *T. rubrum* infections in dog. *T. rubrum* is an anthropophilic dermatophyte. Two types of *T. rubrum* have been distinguished: *T. rubrum* downy type and *T. rubrum* granular type. The downy strain has become the most widely distributed dermatophyte of man. The granular strain is a frequent cause of tinea corporis.

### ***Trichophyton mentagrophyte***

Totally 15 isolates of *T. mentagrophyte* were isolated from 80 patients. Among these 7

patients were diabetic and 8 were non-diabetic patients. *T. mentagrophyte* is the second most commonly isolated to *T. rubrum* this is confirmed by the studies of Urmil Mohan *et al.*, There were 5 males and 2 females among the diabetic patients and 2 males and 6 females among non-diabetic patients. *T. mentagrophyte* var. *T. mentagrophyte* is the zoophilic form of *T. mentagrophytes* with a worldwide distribution and a wide range of animal hosts including mice, guinea pigs, kangaroos, cats, horses, sheep and rabbits. This is the reason for lower incidence of *T. mentagrophyte* as they are found more common in animals than the humans.

### ***Microsporum gypseum***

Totally 12 isolates of *M. gypseum* were isolated from 80 patients. Among these 6 patients were diabetic and 6 were non-diabetic. 2 patients were male and 4 patients were female among the diabetic, and 1 was male and 5 females in non-diabetic patients. Genus *Microsporum* contains a number of important species that are the principle causative agents of animal and human dermatophytoses<sup>(119)</sup> it is the most common cause for tinea and ringworm infection. This is usually found in children's and rural workers in warm humid weather, this may be the reason why there is a lower incidence of *M. gypseum* in this study as the study population is more than 40 years of age.

### ***Epidermophyton floccosum***

Totally 2 isolates of *E. floccosum* were isolated from 80 patients. Both the isolates are from diabetic patients who were females. *E. floccosum* represents the species with the lowest predominance in the study period considered. This result could be interpreted as indicative of species that nowadays have a low clinical relevance and may tend to

disappear from our community this is confirmed by the work done by Sara Asticcioli, Adriano Di Silverio, Laura Sacco, Ilaria Fusi, Luca Vincenti, Egidio Romero from Italy<sup>(118)</sup>. *E. floccosum* causes tinea pedis, tinea corporis, and onychomycosis. It is not known to invade hair in vivo and no specific growth requirement has been reported. *E. floccosum* infection may become epidemic among personnel using common shower or gym facilities, e.g. athletic teams, troops, ship crews and inmates of institutions.

Out of the four different types of dermatophytes isolated among 40 diabetic patients, 18 samples showed *T. rubrum* with 45 % isolation rate. *T. rubrum* is the most commonly isolated dermatophyte, similar results have been shown by a study done by Nita Patwardhan from Aurangabad were the isolation rate of *T. rubrum* was 28.12%, in another study the isolation rate was 46% which was done by Isac Alteras and Ety Saryt from Israel. Further, 15 isolates of *T. rubrum* was positive from skin scrapings and 3 was from nail clippings. The higher incidence of *T. rubrum* from skin scrapings may be because of the reason that dermatophytes require Keratin for their growth as shown by Barry I. Hainer<sup>(114)</sup> 2003, it is also increased by human to human contact, socioeconomic status, and it is mostly found in the rural population. Geographical conditions also play an important role. Among the non-diabetic patients 14 samples were positive for *T. rubrum*. As shown by Isac Alteras and Ety Saryt in both diabetic and non-diabetic patients *T. rubrum* was the most common dermatophyte, 45% in diabetic patient and 57.5% among non-diabetic patients as compared to this study which shows 45% for diabetic and 35% for non-diabetic patients.

Next to *T. rubrum*, the second most commonly isolated dermatophyte in diabetic population is *T. mentagrophyte* and it was isolated from 7 samples (17.5%). This

observation is confirmed by work done by Suman Sing, P.M. beena<sup>(118)</sup>. Similar study by Isac Alteras and Ety Saryt from Israel show an isolation rate of 21% and 25% was the isolation rate from a study done by Nita Patwardhan from Aurangabad. Four samples were isolated from skin scrapings and 3 samples were isolated from nail clipping the reason for this because of the utilization of keratin by dermatophyte has shown by Barry Hainer 2003<sup>(114)</sup>.

Among non-diabetic patients 8 samples were positive for *T. mentagrophyte*, 5 samples were taken from skin scrapings and 3 samples from nail clippings

*M. gypseum* is the third commonly isolated dermatophyte among the diabetic population, 6 samples showed *M. gypseum* growth with an isolation rate of 15%. All the samples were isolated from skin scrapping this is confirmed by the study done by chowdhary which shows an isolation rate of 0.59%. Among the non-diabetic patients 6 samples were positive for *M. gypseum*, 5 were taken from skin scrapping and 1 sample from nail clipping

*E. floccosum* was the least isolated species among diabetic population, 2 samples had growth of *E. floccosum* with an isolation rate of 5% this is confirmed by a similar study done in Chennai by Suganthi which showed an isolation rate of 7.1%, in another study done by Khalique from Aurangabad the isolation rate is 5.8%.

There was only one hair sample and there was no significant growth, further culture and KOH also showed negative.

80 Samples from 80 patients suspected of dermatophytic infections were collected and processed. It includes 40 diabetic patients and 40 non-diabetic patients.

The male /female ratio was 51%: 48%.

Patients above 40 years of age were taken from both diabetic and non-diabetic patients. A 16.3% of cases gave a history of contact with possible source of infection.

Of the 40 diabetic samples collected 7 samples (17.5%) were both negative for both KOH wet mount and culture, remaining 33 samples (82.5%) were positive for both KOH mount and culture.

Out of the 40 non-diabetic patients 12 samples (30%) were negative for both KOH mount and culture, remaining 28 (70%) were positive for both KOH mount and culture.

The samples were skin scrapings, hair, and nail. Of the culture positive cases, 58.7% belonged to *Trichophyton* spp., 15% *Microsporum* spp. and 2.5% to *Epidermophyton* spp.

The predominant isolate from all samples were *T. rubrum*, 40% from both diabetic and non-diabetic patients. *T. rubrum* was found predominantly in diabetic patients with an isolation rate of 45% than in the non-diabetic patients were the isolation rate is 35%.

*T. mentagrophyte* isolation rate was 18.7% from both diabetic and non-diabetic patients.

Isolation rate of *T. mentagrophyte* was more from non-diabetic patients (20%) than the diabetic patient with the isolation rate of 17.5%.

*Microsporum gypseum* isolation rate was 15% from both diabetic and non-diabetic patients.

Isolation rate of *M. gypseum* (15%) was same among both diabetic and non-diabetic patients.

*Epidermophyton floccosum* was the least isolated dermatophyte with an isolation rate

of 5% and it was isolated only from diabetic patients.

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