

## Cutaneous Mycoses among Diabetes Patients

Hussein Al-Nasrawi<sup>1\*</sup>

<sup>1</sup>Southern Technical University– Amarah Technical Institute - Nursing Department / Iraq

\*Corresponding author : h.alnasrawi@stu.edu.iq

### Abstract

There are few studies dealing with the spread of cutaneous mycoses associated with different parts of human body , exclusively the infections by types of Tinea .The perfect ecological niche for inhabiting dermatophytes is human body specially folds of the skin which provided physical factors for growth of medical fungi .Dermatophytes are widely spread among patients who suffer from immunodeficiency ,tissue transplant , cancer patients take chemical drugs, in addition to diabetes mellitus type 1 and type 2 patients

The present study investigated skin fungal infections in the different parts of human body exclusively focus on Tinea infections among diabetics in Iraq . 80 samples were taken from patients suffering from diabetes mellitus type 1 and 50 patients with diabetes mellitus type 2 ,admitted to Maysan diabetes center in Maysan province - Iraq during 2019 . Scraps of infected skin were taken from infected areas of the patient bodies , divided in to cohorts , first one examined directly under light microscope and the second were cultured on fungal culture medium Sabouraud Dextrose agar (SDA) . 100 samples were also taken from control group ( people without diabetes ) . Results of the present study revealed infections among 20% of patients with diabetes mellitus Type 1 and 60% with diabetes mellitus Type 2 whereas only 1% with control group .

**Key words:** Cutaneous , Mycoses , Diabetes mellitus .

### Introduction

Diabetes mellitus is a medical term refer to an endocrine disorder due to inactivation of insulin production by pancreas leads to hyperglycemia resulted in damage of human systems and organs such as vascular system , eyes and nerves .There are two common types of diabetes , Diabetes mellitus Type 1 (children diabetes / juvenile diabetes) the disease in which the immune system destroys beta cells in the pancreas, for reasons that have not been identified, and the second type is Diabetes mellitus Type 2 ( adult diabetes) the disease in which beta cells in the pancreas are destroyed due to genetic reasons(1,2,3,4,5 , 6).

Diabetes mellitus Type 1 and Type 2 leads to decline of human immunity that object human organs to different pathogenic enemies specially fungal infections which encouraged during weakened immunity . Due to hyperglycemic rate associated with diabetics , humoral and cell-mediated immunity in Diabetes mellitus patients decline and human body be more susceptible to microbial infections , and the most targeted area in human body susceptible to mycoses are skin , mucous membrane , nails , hair and other keratinous substrates(6,7,8 , 9).

Mycoses are medical fungal infections of human and animals , Dermatophytes ,are a term refers to fungi infect skin, hair and nail , belongs to cutaneous mycoses , the third group of

human fungal infections follow superficial and subcutaneous mycoses .The main causative agents of this group are the genera *Microsporum* , *Trichophyton*, and *Epidermophyton* , which commonly invade keratinized materials(10,11,12). The infections by Dermatophytes called tinea or ringworms and the term Dermatophytes is limited to skin infections whereas Onychomycoses limited to nail infections . The occurrence of human fungal infections associated with skin , hair and nails environment has been widely increased during recent years exclusively with wet and low oxygen concentration atmospheres . The most common fungal infections distributed in human skin are opportunistic mycoses caused by the main genera of dermatophyte fungi , *Microsporum* , *Trichophyton* and *Epidermophyton* , the causative agents of most dermatophytes .Distribution of dermatophyte started with the folds of skin in foot up to upper human body . Dermatophyte may onset from nail or foot infections which spread from such locations toward the groin.(13,14,15)

Mycoses are more common infections in diabetics and nondiabetics .The vast majority of people with diabetes mellitus poses a dry skin due to high sugar concentration in the blood, so the normal mechanism of human body is to decrease the excess of glucose concentration in the blood by increasing urination process which means loss of more fluids in addition to stopping process of sweating leading to dry cracked skin. Foot fungal infections ( athletes foot) increased among healthy individuals specially athletics who familiar with aquatic sports , the preferable ecological niche for growing and development of fungal infections due to high humidity and low oxygen concentration .Comparison with healthy people , diabetics are more likely to be with high rates of infection by mycoses specially foot , groin , Armpit , nails and scalp infections.(16,17,18,19,20,21, 22)

Increasing of glucose level in the blood can object diabetic patients to developing fungal infection with medical importance by different cutaneous mycoses such as *Tinea cruris* . (cause jock itch disease )due to infection by the genus *Trichophyton* ( *T. rubrum* , *T. interdigitale* and one species of the genus *Epidermophyton* ( *E. floccosum*) . The causative agents of Tinea cruris seem to be more favorable conditions for heavy growth such as sweating, decreasing of oxygen concentration association with number of human diseases like diabetes and immunodeficiency incidences . Diagnosis of tinea cruris occurs by taking skin scraping from peripheral infected areas of groin examined under light microscope to isolate dermatophyte fungi , confirmed by SabouraudDextrose agar culture media . The vast majority of Type 1 and Type 2 diabetes patients with high risk against cutaneous mycoses specially onychomycoses , suffer from several kinds of nail damage with break of skin tissue . (23,24,25,26,27).

## Materials and methods

### Collection of samples :

Skin and nail scraps from suspected fungal infections were collected from 50 patients with Type 1 Diabetes mellitus and 100 samples from Type 2 Diabetes mellitus patients, administered to Diabetes mellitus center in Amarah city during 2019 . The skin and nail scrapings samples were cultured on Sabouraud Dextrose Agar(SDA) without treatment process.

**Direct microscopy :**

Scraping samples from suspected skin and nails infected with pathogenic fungi were gathered on sterilized filter paper . Samples washed carefully by 10% KOH dropped on cleaned glass slide and placed on the base of light microscope to be examined for fungal hyphae and micro / macro conidia .

**Sample culturing and processing :**

Skin scrapings from suspected fungal infection and nail fragments from infected nail were collected carefully by sterilized spatula and placed on surface of solid Sabouraud Dextrose Agar treated with antibacterial ( chloramphenicol) . Nails scrapings were scattered on Sabouraud Dextrose Agar (SDA) plates supplemented with chloramphenicol. Petri dishes were sealed to protect air born microbial contamination , incubated under 20 °C for 5-14 days . Pure culture of fungal species were sub-cultured and incubated again. Fungal species were classified according to fungal literatures . By using a sterile wire loop , inoculation from isolated fungal species were streaked on SDA plates in different directions. Testing of fungal isolates were done by treating isolated against different antifungal agents such as Amphotericin B, Itraconazole, Miconazole and Griseofulvin ,by measuring the diameter of inhibition zones after incubation period under 25 °C, for 48 hrs.

**Results**

Table 1 - Genera and species of fungi isolated from body locations among Type 1 Diabetes mellitus (T1DM ) and Type 2 Diabetes mellitus ( T2DM).

	Head	Armpit	Groin	Foot	Nails
Fungi associated with (T1DM)	Microsporum canis Trichophyton verrucosum	T. rubrum	T. rubrum	T. rubrum, E. floccosum	T. rubrum
Fungi associated with (T2DM)	Microsporum canis M. audouinii M. distortum M. ferrugineum M. gypseum M. nanum Trichophyton verrucosum	T. rubrum	T. rubrum T. interdigitale Epidrmophyton floccosum	T. rubrum, T. interdigitale E. floccosum	T. rubrum T. interdigitale

Table 2- Prevalence of Tinea types among Diabetes mellitus patients.

Type of Tinea	Location	Type 1 Diabetes mellitus patients.	Type 2 Diabetes mellitus patients.
Tinea capitis	Head	+	+
Tinea corporis	Armpit	—	++
Tinea cruris	Groin	+	+++
Tinea pedis	Foot	+	+++

Tinea unguium	Nails	—	+
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++= Moderate infection + = Mild infection

+++ = High infection - = No infection

Table 3 - prevalence of Tinea types among Type 1 Diabetes mellitus patients.

Tinea type	4 – 7 y age	8 – 11 y age	12 – 15 y age	≥16 y age	Total no.(%) n=50
Tinea unguium	0	0	2	1	3(6%)
Tinea pedis	2	1	1	3	7(14%)
Tinea cruris	2	1	3	3	9 (18%)
Tinea corporis	0	2	2	0	4(8%)
Tinea capitis	1	1	0	1	3(6%)
Tinea barbae	0	0	1	0	1(2%)

Table 4- prevalence of Tinea types among Type 2 Diabetes mellitus patients.

Tinea type	40-49 y age	50-59 y age	60-96 y age	70 y age≥	Total no.(%) n=100
Tinea unguium	4	2	7	5	17 (17%)
Tinea pedis	6	3	6	2	18 (18%)
Tinea cruris	8	7	9	12	36 (36%)
Tinea corporis	2	2	3	2	9 (9%)
Tinea capitis	1	2	2	1	6 (6%)
Tinea barbae	-	1	2	1	4 (4%)

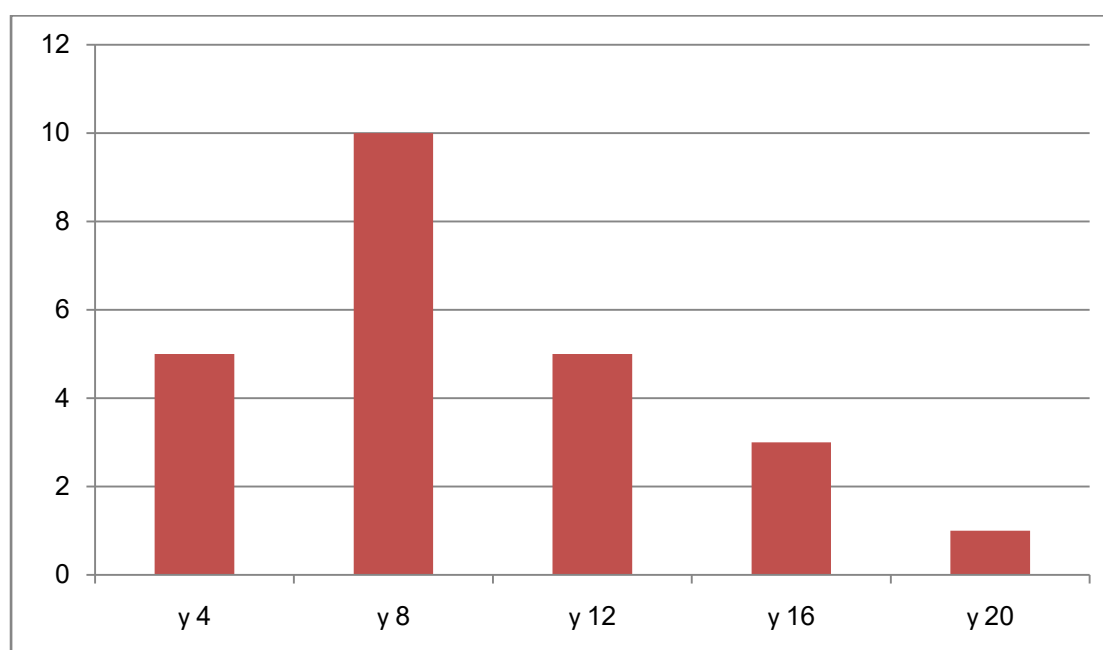
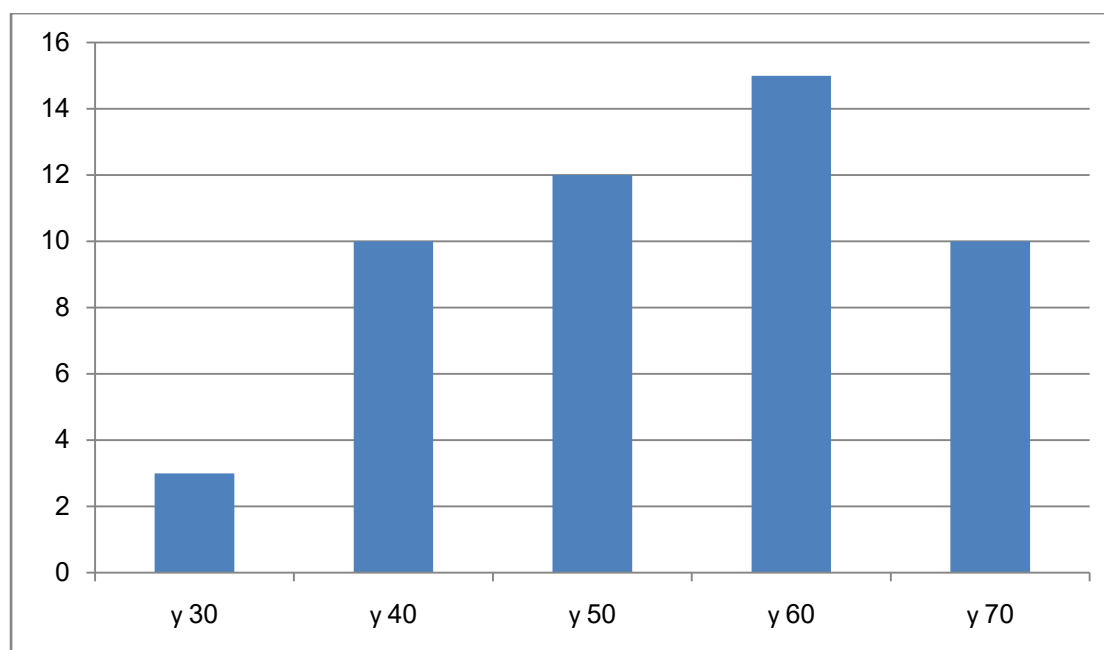


Figure 1- Percentage of cutaneous mycoses among Type 1 diabetes mellitus patients



**Figure 2- Percentage of cutaneous mycoses among Type 2 diabetes mellitus patients**

## Discussion

Table 1 shows distribution of dermatophytes ( *Microsporum* , *Trichophyton* and *Epidermophyton*) associated with Type 1 Diabetes mellitus patients . The most common fungal species related with the head are *Microsporumcanis* , *Trichophytonverrucosum* whereas *T.rubrum* is the common fungal species isolated from Ampit , Groin ,Foot and Nails. Fungi associated with the head of Type 2 Diabetes mellitus patients are *Microsporumcanis* , *M. audouinii*, *M. distortum* , whereas fungi isolated from Groin are *M.ferrugineum*, *M. gypseum* ,*M. nanum* and *Trichophytonverrucosum* .Generally , Diabetes mellitus patients due to an adequate insulin action , glucose levels increased in the blood vessels which damage the cell wall of vascular system and leads to immune Dysfunction , that means immune system fail to be active against attack of the invaders ( bacteria , virus and fungi ) in parallel with increasing the pathogenicity of dermatophytes to cause cutaneous mycoses (American Diabetes Association AD, 2014 ).

Table 2- shows the Prevalence of two Tinea types among Type 2 Diabetes mellitus patients (T.pedis and T.cruis ) with high rate of infections compared with infections of Type 1 Diabetes mellitus patients , may be due to defects in immunity,as aresult of weakness of the blood vessel system that transport high glucose concentrated of blood which increase the possibility of blood vascular damage in addition to neuropathy and kidney disease that reduces the body's resistance to microbial injuries, especially fungal infections (28-30) .

Table 3 and 4 shows prevalence of Tinea types among Type 1 and Type 2 Diabetes mellitus patients. The highest percentage of cutaneous infections demonstrated 18% and 36% of Tinea cruicis among Type1 and type2 Diabetes mellitus patients respectively, followed by Tinea pedis 7% among Type 1 Diabetes mellitus patients whereas 18 % among Type 2 Diabetes mellitus patients . Fungi attack skin and nails(onychomycosis) are common among diabetes

mellitus patients. Infections of skin and nails leads to disrupt keratin materials , the main skeletal element of skin and nails leads to thickened nail base. The most common fungal genera attack skin and nails are *Microsporum* , *Trichophyton* and *Epidermophyton* which are consider the suitable niche for fungi to inhabit such environments causing cutaneous mycoses specially among swimmers and athletics during a wet areas (31-33) .

Figure 1 and figure 2 shows high Percentage of cutaneous mycoses among Type 1 and Type 2 Diabetes mellitus patients. The high percentage of cutaneous mycoses among Type 1 Diabetes mellitus demonstrated among 8 year old patients whereas 60 years old patients with Type 2 Diabetes mellitus demonstrated high cutaneous mycoses . The decline of innate immunity among DM patients may be contributes in increasing the chance of pathogenic fungi to be more active with high virulence power leads to adherence of such microbes to diabetic cells to increase prevalence of infections.

## Conclusion

Diabetes mellitus patients should be more care about the importance of increasing awareness regarding control of glucose levels in the body with keeping a dry and healthy skin and using an educated foundation to protect body organs from fungal infections , with early medications by antifungal drugsto skip from microbial colonization by pathogenic microorganisms among Type 1 and Type 2 Diabetes mellitus patient .

## References

- 1- Weitzman, I. and Summerbell, R.C. (1995). Clinical Microbiology Reviews, p. 240–259 Vol. 8, No. 2 . American Society for Microbiology.
- 2- Graser, Y. Monod, M. , Bouchara, J.P., Dukik, K., Nenoff, P., Kargl, A., Kupsch, C., Zhan, P., Packeu, A. , Chaturvedi, V. and de Hoog, S. (2018) New insights in dermatophyte research, *Medical Mycology*, 56, S2–S9.
- 3- Gupta , A.K. (2006). Dermatophytes: Diagnosis and treatment. *Journal of American Academy of Dermatology*. Volume 54, Issue 6.
- 4- Powers AC (2005). "Diabetes Mellitus. Chapter 323, Vol 2, 16th edition.
- 5- Wild, S., Roglic, G. and Green A. (2004). Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes care*; 27(5):1047-53.
- 6- Geerlings, S.E. and Hoepelman, A.I.M. (1999). Immune dysfunction in patients with diabetes mellitus (DM). *FEMS Immunology and Medical Microbiology* 26 (1999) 259-265.
- 7- Berbudi, A., Rahmadika, N., Tjahjadi, A.I. and Ruslami, R. (2020). Type 2 Diabetes and its Impact on the Immune System. *Current Diabetes Reviews*, 16, 442-449.
- 8- American Diabetes Association (2014). Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care* Volume 37, Supplement 1.
- 9- Geerlings SE, Hoepelman AI. (1999). Immune dysfunction in patients with diabetes mellitus. *FEMS Immunol Med Microbiol* ; 26(3-4):259-65.

- 10- Simpanya MF. Dermatophytes: their taxonomy, ecology and pathogenicity. In: Kushwaha RKS, Guarro J, editors. *Biology of dermatophytes and other keratinophilic fungi*. Bilbao: Revista Iberoamericana de Micología; 2000.
- 11- Ghannoum MA, Isham NC. Dermatophytes and dermatophytoses. In: Anaissie EJ, McGinnis MR, Pfaller MA, editors. *Clinical mycology*. 2nd ed. New York: Churchill Livingstone; 2009, p. 375-84.
- 12- Weitzman I, Summerbell RC. The dermatophytes. *Clin Microbiol Rev* 1995; 8(2): 240-59.
- 13- Hainer BL. (2003). Dermatophyte infections. *American Family Physician*; 67(1): 101-108.
- 14- Papini ,M., Cicoletti,M., Fabrizi,V. and Landucci , P.(2013).Skin and nail mycoses in patients with diabetic foot.*Gital Dermatol Venereol.*;148:603-8.
- 15- Reddy ,KR.(2017)Fungal Infections (Mycoses): Dermatophytoses (Tinea, Ringworm).J-GMC-N,Vol.10 , issue1.
- 16- Maysaer,P.,Hensel,J,Thoma W.,Podobinska M.,Geiger,M.,Ulbricht,H.andHaak,T.(2014).Prevalence of fungal foot infections in patients with Diabetes Mellitus Type 1 –Underestimation of Moccasin-Type Tinea.*Exp Clin Endocrinol Diabetes*;112 :264-268.
- 17- Achterman RR, White TC. Dermatophyte virulence factors:Identifying and analyzing genes that may contribute to chronic or acute skin infections. *International J of Microbiology*. 2012;2012: 8.
- 18- Santhosh ,YL, Ramanath KV, Naveen MR(2011). Fungal infections in Diabetes Mellitus :An overview. *International Journal of Pharmaceutical Sciences Review and Research Volume 7, Issue 2* .
- 19- Hillson,R.(2016).Fungi and diabetes,Practical Diabetes ,Vol.33,No.5.
- 20- Duff,M., Demidova,O., Blackburn,S.andShubrook,J.(2015) Cutaneous Manifestations of Diabetes Mellitus,Clinical Diabetes Journals org. Volume 33 , Number 1.
- 21- Eba,M., Njunda,A.L.,Mouliom,R.N..Kwenti,E.T. Fuh,A.N., Nchanji,G.T., and Atashili,J.(2016).Onychomycosis in diabetic patients in Fako Division of Cameroon: prevalence causative agents, associated factors and antifungal sensitivity patterns,BMC Res Notes 9:494.
- 22- Kareliya,H., Bichile,L., Bal,A., Varaiya,A. and Bhalekar,P.(2019) Fungal Infection in Diabetic Foot A Clinicomicrobiological Study.*Acta scientific Microbiology*.Volume 2 Issue 7 .
- 23- Al-Mutairi, N., Eassa , B.I., Al-Rqobah, D.A.(2010) Clinical and mycologic characteristics of onychomycosis in diabetic patients. *ADC*. 18:84–91.
- 24- Hrynciewicz-Gwóźdź, A., Kalinowska, K., Plomer-Niezgoda, E., Bielecki, J. and Jagielski, T.(2013). Increase in resistance to fluconazole and itraconazole in *Trichophyton rubrum* clinical isolates by sequential passages in vitro under drug pressure. *Mycopathologia*.176:49–55.
- 25- Mohammad, T. and Noorbala, P.K. (2010).Evaluation of onychomycosis among diabetic patients of Yazd diabetic center. *JPAD*. 20:217–21.
- 26- Rich,P.(2000). Onychomycosis and tinea pedis in patients with diabetes.*J Am Acad Dermatol* .43:S130-4.
- 27- Kaliyamoorthi, D.(2018). Prevalence of Dermatophytic Infection among Diabetic and Non-Diabetic Patients in a Tertiary Level Hospital in Chennai, India .*Int.J.Curr. Microbiol.App.Sci* 7(6): 2516-2536.
- 28- Qasim MT, Al-Mayali HK. Investigate the relation between Baicalin effect and Gene expression of LH, FSH, Testosterone in male rats treated with Gemcitabine drug. *Research Journal of Pharmacy and Technology*. 2019 Sep 30;12(9):4135-41.

- 29- Qasim MT, Al-Mayali HK. The immunological and protective role of Baicalin in male rats treated with chemotherapy (Gemcitabine). In *Journal of Physics: Conference Series* 2019 Jul 1 (Vol. 1234, No. 1, p. 012065). IOP Publishing.
- 30- Tahmasebi S, Qasim MT, Krivenkova MV, Zekiy AO, Thangavelu L, Aravindhana S, Izadi M, Jadidi-Niaragh F, Ghaebi M, Aslani S, Aghebat-Maleki L. The effects of Oxygen-Ozone therapy on regulatory T-cell responses in multiple sclerosis patients. *Cell biology international*. 2021 Mar 16.
- 31- Mousa HM, Qasim MT. Microbial Infection and IL-6 Urine Levels for Pregnant women in Thi-Qar Province. *World J. Pharma. Res.* 2015 Mar 6;4(05):358-65.
- 32- Ahmed Jassem AL-Naely, Maytham T. Qasim, Hussein Abbas Al-Hamadawi. Transfusion of Blood Components in the Newborn Service of the Hospital. *Annals of RSCB [Internet]*. 2021Apr.7 [cited 2021Apr.14];:952-8..
- 33- Zainab I. Mohammed, Maytham T. Qasim. Correlation of AMH and LH Levels in PCOS Patients with Pregnancy Rate. *Annals of RSCB [Internet]*. 2021Apr.7 [cited 2021Apr.14];:945-51.