East African Medical Journal Vol. 98 No. 7 July 2021
THE CLINICAL PRESENTATIONS, ETIOLOGY AND FACTORS ASSOCIATED WITH FOOT MYCOSES AMONG PATIENTS ATTENDING DERMATOLOGY CLINIC AT MBARARA REGIONAL REFERRAL HOSPITAL, MBARARA, UGANDA

Jean Marie Vianney Rukanikigitero, Department of Dermatology, Faculty of Medicine, Mbarara, Uganda, P. O. Box 1410, Mbarara, Grace Mulyowa, Department of Dermatology, Faculty of Medicine, Mbarara, Uganda, P. O. Box 1410, Mbarara, Taseera Kabanda, Department of Internal Medicine, Faculty of Medicine, Mbarara, Uganda, P. O. Box 1410, Mbarara, Hebert Itabangi, Department of Microbiology, Faculty of Medicine, Mbarara, Uganda, P. O. Box 1410, Mbarara, Desire Aime Nshimirimana, Research & Innovation, Mount Kenya University, Thika, Kenya, P.o.Box 00100-03786, Nairobi, Pietro Nenoff, Tropical and Travel Dermatology, University of Leipzig, D-04571 Rotha OT Molbis, Germany

Corresponding author: Jean Marie Vianney Rukanikigitero, Department of Dermatology, Faculty of Medicine, Mbarara, Uganda. Email: jmrv1827@gmail.com

THE CLINICAL PRESENTATIONS, ETIOLOGY AND FACTORS ASSOCIATED WITH FOOT MYCOSES AMONG PATIENTS ATTENDING DERMATOLOGY CLINIC AT MBARARA REGIONAL REFERRAL HOSPITAL, MBARARA, UGANDA

J. M. V. Rukanikigitero, G. Mulyowa, T. Kabanda, H. Itabangi, D. A. Nshimirimana and P. Nenoff

ABSTRACT

***Background*: Foot mycosis is one of the most common fungal infections of the skin worldwide. The magnitude of the problem in terms of clinical presentations, etiology and associated factors remain as poorly established in low-income countries especially in Uganda.**

***Objective*: To study the clinical presentations, etiology and factors associated with foot mycoses among patients attending Mbarara Regional Referral Hospital, Mbarara, Uganda (MRRH). Materials and methods: This was a cross-sectional study that recruited 110 patients attending the skin clinic at MRRH between November 2018 and May 2019. The subjects were examined physically, and skin scrapings of suspected lesions were collected for laboratory processing.**

***Results*: Out of 110 suspects for foot mycoses 101 (91.8%) were diagnosed with a fungal. Fungal culture confirmed foot mycosis in 67 (60.9%) of the cases. Of the 67 fungal culture growth, dermatophytes were 39.5%, followed by yeasts with 32.6% and non-dermatophyte molds (NDMs) with 27.9%. The commonest associated factors were age and wearing occlusive shoes.**

***Conclusion*: The study reveals that foot mycosis is a common clinical entity at our dermatology clinic and interdigital was the most common clinical presentation, highlighting dermatophytes as the commonest etiological agents. Age and shoe design remain the most significant associated factors of the infection.**

Keywords: Clinical presentations, Etiology, Foot Mycoses,

INTRODUCTION

Foot mycosis is a fungal infection of the foot that often involves the toe web spaces, the lateral sides or the plantar areas of the feet[1]. It can be a chronic or recurring cosmetic disorder[2]. The etiology of foot mycosis is often linked with dermatophytes such as *Trichophyton*(*T.*) *rubrum*, *T.interdigitale*, and *E. floccosum*, yeasts like *candida* spp. non-dermatophyte molds such as Neoscytalidium (*S.)dimidiatum* and Neoscytalidium *hyalinum*[2]. Whereas tinea pedis or athlete's foot imply fungal infection of the feet caused by dermatophytes[3]. *Trichophyton rubrum*, has also been implicated as common etiology for foot mycosis in Germany and other parts of the world[4]. The condition is divided into four clinical forms: Moccasin form, Interdigital form, inflammatory or vesicular form and erosive form. The lesions are macerated with scaling borders and typically start in between the fourth and fifth toes before spreading to the lateral dorsal and plantar surfaces. The erosive form is often associated with secondary bacterial infection[5,2]. Fungal infection of the feet can have different clinical manifestations, unfortunately they resemble other cutaneous infections. They can be misdiagnosed as other diseases of the feet[6]. Foot mycosis mostly begin in the toe web spaces or side areas with itching, erythema, hyperkeratotic, dry, scaly lesions, small blisters and later on macerated, oozing, and erosive lesions on one or both feet[7]. The predisposing factors to foot mycoses include sharing of communal showers and pools, wearing of occlusive shoes for long periods[8], and immunosuppressive disorders like HIV/AIDS and diabetes[9]. The diagnosis of foot mycoses is based on detection of fungi by direct microscopic examination using potassium hydroxide or calcofluor white and culture[4]. The management of foot mycoses is based on clinical manifestations and mycological detection of causative fungi[10]. The management of foot mycoses at Mbarara hospital skin clinic is based on studies from developed countries[11]. Foot mycosis is the most common fungal infection of skin worldwide[12]. Its prevalence is estimated to be over 50% in Central and Northern Europe and almost 28% and 25% in Singapore and Mediterranean region respectively[2]. It is a common skin disease among Tunisian people with a prevalence of 22.5%[5]. A study done in Dar es Salaam, Tanzania in December 2010 reported 2.6% of the school children as having tinea of the feet[13]. In Uganda, data on the prevalence of foot mycoses is not available however, more attention is usually given to invasive fungal diseases such as cryptococcosis[14], but little attention or no attention to the non-invasive fungal diseases such as tinea capitis[15], onychomycosis and foot mycoses yet are responsible for a number of morbidities. This highlights the necessity to study foot mycoses particularly its predisposing factors, etiology and clinical presentations among patients at Mbarara Regional Referral Hospital (MRRH). To our knowledge, no similar study of the kind has been done in MRRH. This study describes the clinical presentations, etiology and factors associated with foot mycoses among patients attending MRRH.

MATERIAL AND METHODS

Study design and site: This was a hospital based cross sectional study done between November 2018 and May 2019. The study was carried out at Mbarara Regional Referral Hospital (MRRH). The hospital is a public facility with a capacity of 350 beds and serves a population of over four million people from its catchment area.

Study setting and population: The MRRH serves as a teaching hospital for Mbarara University of

Science and Technology (MUST) located in southwestern Uganda, about 260km from Kampala, the capital of Uganda. The skin clinic which is one of the departments of Mbarara hospital was chosen as the site of the study because it is the only skin clinic in the region that perform consultations for dermatological outpatients and inpatients.

Inclusion criteria: Patients with lesion on the feet suggestive of foot mycoses with no age limit.

Exclusion criteria: Patients who were on antifungal therapy including foot mycoses.

Sample size estimation: The sample size was calculated using the formula established by Kish (1965) for cross-sectional studies of prevalence[16]. A 10% for possible dropouts was added and the prevalence of 7% was selected based on skin clinic records at MRRH where foot mycoses was reported in 240 over 3600 total consultations performed in 2017 which represent 6.6%. Therefore, the sample size was 110 patients.

Study procedures and data collection: Participants were recruited by the researcher (JMV) during consultation at the skin clinic of MRRH. All patients consulting for skin diseases were examined and those who met the inclusion criteria were enrolled consecutively until the sample size was met. A semi-structured questionnaire in English was completed by the researcher (JMV) to get information from the participants. A research assistant was recruited and trained from health workers in the dermatology department to help in completing translated questionnaire and data collection. The data collected included demographic characteristics such as age, sex, religion, occupation and district of origin, clinical presentations and predisposing factors, chronic diseases and mycology findings. The fungal culture was considered as dependent variable while all other variables stated above were independent variables. The samples were collected by the researcher at the skin clinic and carefully packed in MycoTranskit to avoid contamination and transported to the mycology laboratory where tests were performed by a qualified and experienced mycologist.

Screen for presence or absence of fungi by direct microscopic examination: Skin scraping was obtained using surgical blade number 15, the patient material (skin scraping) was put on slide, a drop of staining solution 10-20% potassium hydroxide (KOH) or calcofluor white (CFW) was put on object slide with a pre-wetted inoculation loop for all samples, the sample was covered with a cover slip, incubation of the sample for at least 20 minutes and examined under a fluorescence microscope (Olympus Deutschland GmbH, Germany). Fungal material was distinguished by a bright blue fluorescence and morphologic fungal features.

Identification of fungi by culture: The researcher (JMV) together with the laboratory technician, performed fungal culture on Sabouraud's Dextrose Agar (SDA) which contained 4% peptone, 1% glucose, agar, and water. It was used as isolation media for dermatophytes on which most morphologic descriptions were based. The cultures were prepared from patient material by plating scales into Sabouraud's dextrose agar (SDA) and Potato dextrose agar (PDA) plates which were closed with duct tape to prevent desiccation, incubation of the cultures at temperatures of 26-32°C, optimally at 28°C, for 3 or 4 weeks. Macroscopic evaluation of the plates was performed on weekly basis; record was made for any identified fungal growth. Macroscopic identification of dermatophytes was based on characteristics of colony. Microscopic evaluation of fungal cultures was performed by putting a drop of lactophenol blue staining solution on an object slide. Transfer fungal material to the object slide using an adhesive tape that was carefully pressed into the colony surface to transfer fungal material to the adhesive side of the tape and placed the tape on

the object slide with the lactophenol blue. Microscopic evaluation was done using a light microscope. The results were quantified and counted by the researcher and the laboratory technician at the mycology laboratory of MRRH. The culture samples were assessed by hyphae formation, type and number of micro conidia, presence and shape of macro conidia, as well as appearance of chlamydospores[17].

Data management and analysis: Data entry was carried out by the researcher (JMV) using Epi data 1.4.2.0 whereas, STATA version 13 was used for data analysis. Continuous variables were expressed as the mean, while categorical variables were expressed as proportions and percentages. Data analysis mostly involved descriptive statistics for social demographic variables. The frequency distribution/cross tabulation was used to determine clinical types of foot mycoses. Categorical variables were compared using the Chi square test (P value <0.05). Univariate and multivariate analysis were used to analyze the relevance of potential associated factors.

RESULTS

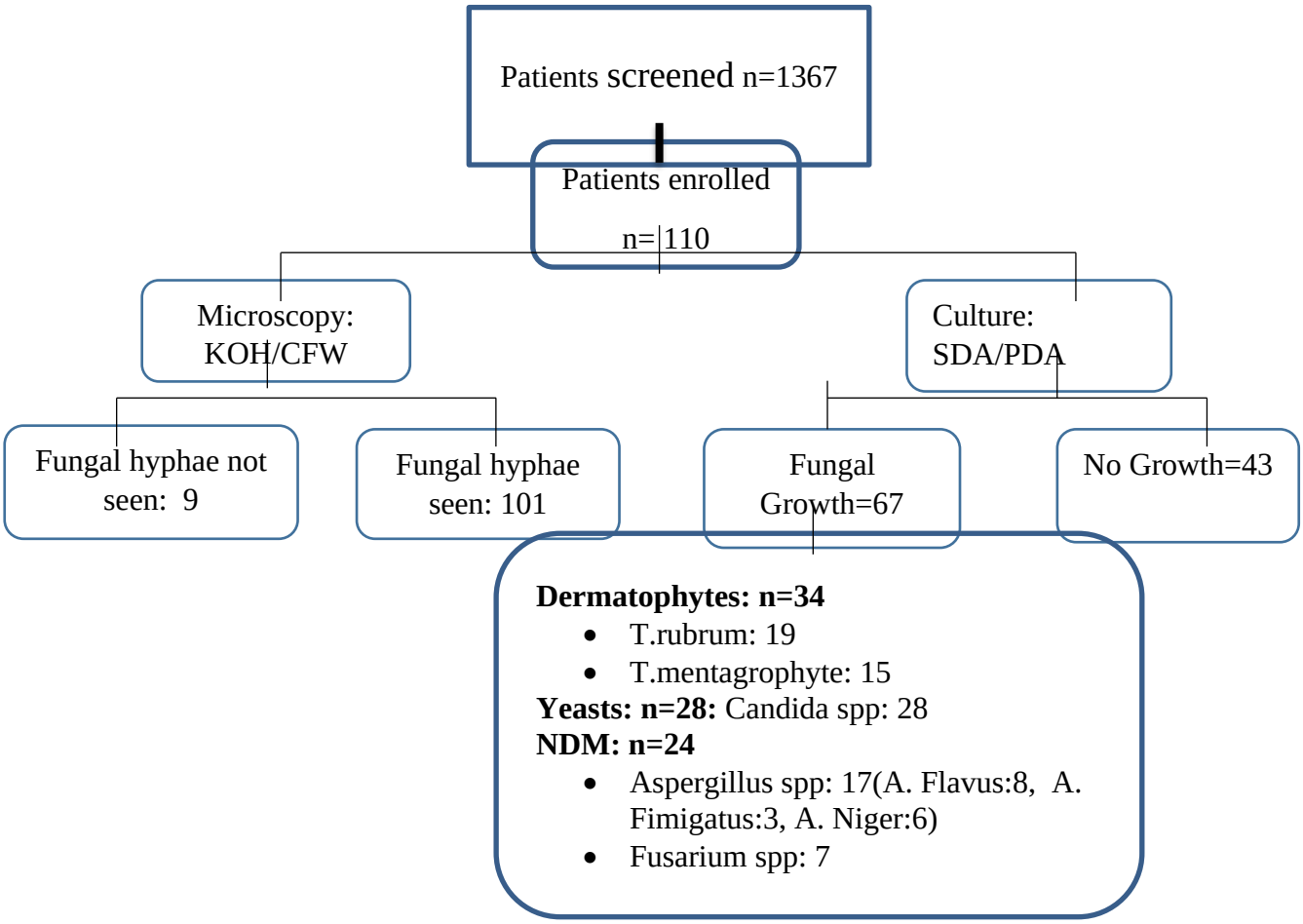

Figure1. Study Profile

Figure1 shows clinical examination using direct microscopic examination, fungal hyphae seen was 101 out of 110 participants (Fig 1). Following fungal culture, 67/110 had growths of which dermatophytes were 34, yeasts were 28 and NDMs were 24 and was no growth for 43/110. The study revealed that 10 (14.9%) participants had dermatophytes and yeasts; 8 (11.9%) had dermatophytes and NDMs; 7 (10.4%) had yeasts and NDMs and 2 (3%) had dermatophytes, yeasts and NDMs.

Table 1

Demographic data

Variable name	**Variable category**	**N (%) (n=110)**
Age (years)	<18	9 (8.2)
	18-29	26 (23.6)
	30-49	55 (50.0)
	>=50	20 (18.2)
Gender	Male	58 (52.7)
	Female	52 (47.3)
District	Mbarara	85 (77.3)
	Isingiro	8 (7.3)
	Ibanda	7 (6.4)
	Others	10 (9.1)
Occupation	Farmers	51 (46.4)
	Business	27 (24.5)
	Professional	15 (13.6)
	Student	17 (15.4)
Religion	Christian	100 (90.91)
	Muslims	6 (5.4)
	Others	4 (3.6)

A total of 110 patients from different districts in Western region of Uganda (Table 1) were included in this study, 58 (52.7%) males and 52 (47.3 %) females, with an age range between 6 and 65 years with an average of 36 years. Farmers were 51 (46.3%), Christians were 100 (90.9%), Muslims were 6 (5.4%) and 85 (77.2%) of the participants came from Mbarara district (Table 1).

Table 2

The percentage of positive results of microscopy and culture of foot mycoses

Sensitivity	**N**	**Frequency**	**% (95% Confidence Interval)**
Microscopy based	110	101	91.8 (84.9 - 95.7)
Culture based	110	67	60.9 (51.4 - 69.7)

In this study a total of 110 patients were identified with clinical presentation suggestive of foot mycoses (Table 2). Among these, fungal hyphae were seen in 101 (91.8%) patients while cultured samples showed 60.9% growth of fungi.

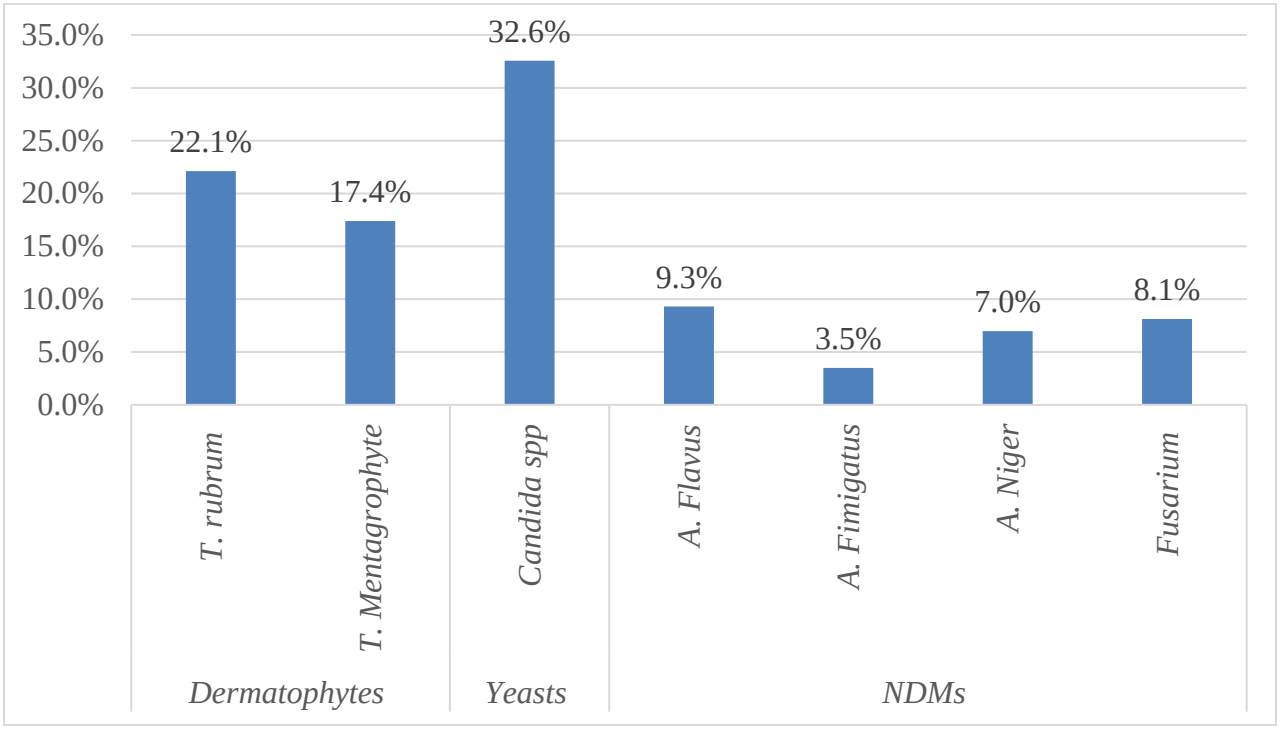

Figure 2. Etiology of foot mycoses

Of a total of 67 fungal culture growth, the most prevalent fungi was dermatophytes with 39.5% (*T. rubrum* 22.1% and *T. interdigitale*17.4%), followed by yeasts with 32.6% (*Candida spp*.) and NDMs with 27.9% (*Aspergillus* 19.8% and *Fusarium* 8.1%) (Fig 2).

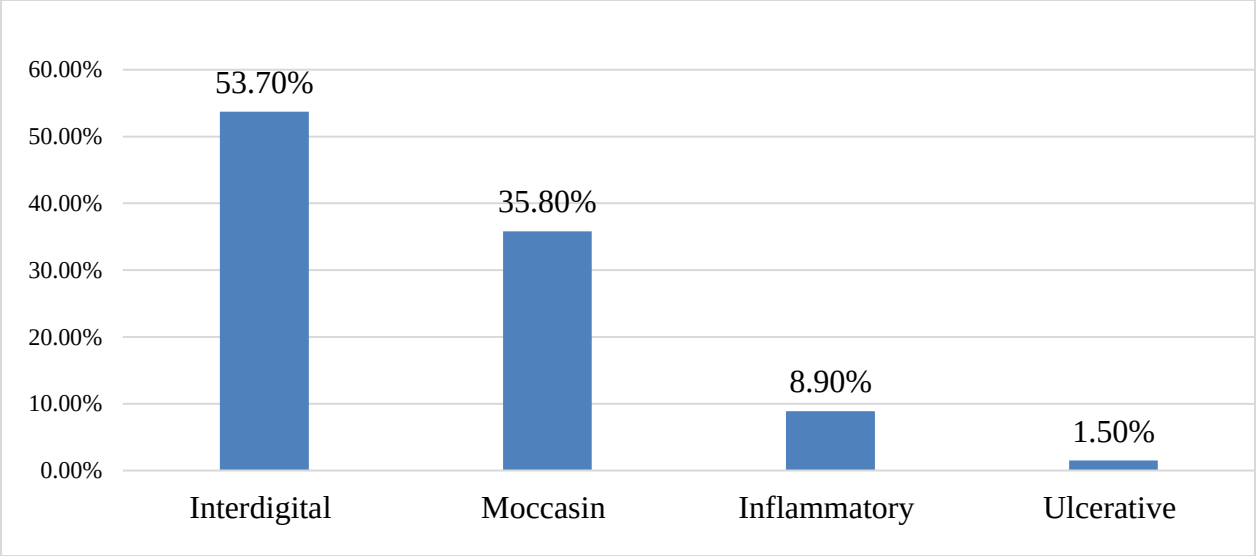

Figure 3. Foot mycoses by clinical presentation

The figure above shows that interdigital type was the most predominant form with 53.7%, followed by moccasin type with 35.8%, inflammatory type with 8.9% and erosive type with 1.5% (Fig 3)

Figure 4. Images showing different clinical presentations of foot mycoses
A: interdigital B: inflammatory C: Moccasin type D: Erosive type

Figure 4: Images showing different clinical presentations of foot mycoses

Table 3

Distribution of foot mycoses by demographic characteristics and associated factors by univariate analysis

Variables	Categories	Culture Positive n: 67 (%)	OR (95% CI)	*p* value
Age (years)	<18	8 (11.9)	7.7 (0.90-65.9)	*0.062*
	18-29	17 (25.4)	1.8 (0.69-4.78)	*0.224*
	30-49	28 (41.8)	1.0	
	>50	14 (20.9)	2.25 (0.75-6.71)	*0.146*
Gender	Male	37 (55.2)	1.0	
	Female	30 (44.8)	0.8 (0.35-1.66)	*0.513*
District	Mbarara	51 (76.1)	1.0	
	Isingiro	3 (4.5)	0.4 (0.08-1.78)	*0.230*
	Ibanda	5 (7.5)	1.66 (0.30-9.08)	*0.555*
	Others	8 (11.9)	2.66 (053-13.32)	*0.232*
Occupation	Farmers	34 (50.7)	1.0	
	Business	13 (19.4)	0.49 (0.18-1.30)	*0.154*
	Professional	11 (16.4)	1.77 (0.42-7.31)	*0.430*
	Student	9 (13.4)	0.59 (0.19-1.83)	*0.367*
Religion	Christian	60 (89.6)	1.0	
	Muslim	4 (6.0)	1.33 (0.23-7.62)	*0.746*
	Others	3 (4.5)	2.0 (0.20-19.91)	*0.554*
Wear closed shoes	No	34 (50.7)	1.0	
	Yes	33 (49.3)	2.66 (1.17-6.04)	*0.019*
Use communal shower	No	54 (80.6)	1.0	
	Yes	13 (19.4)	0.90 (0.35-2.35)	*0.845*
HIV status	Negative	66 (98.5)	1.0	
	Positive	1 (1.5)	0.63 (0.04-10.45)	*0.752*
Diabetes	No	62 (95.4)	1.0	
	Yes	3 (4.6)	1.93 (0.19-19.26)	*0.573*
Obesity (BMI)	<18.5	3 (4.5)	2.23 (0.22-22.4)	*0.495*
	18.5-24.9	43 (64.2)	1.0	
	>=25	21 (31.3)	11.11 (0.44-2.80)	*0.815*

A univariate analytic approach (Table 3) was performed to determine the correlation between the distribution of foot mycoses and age, gender, geographical location, occupation, religion and associated factors and thus this analysis revealed that wearing occlusive shoes was the only factor associated with having foot mycoses with p=0.019 (Table 3). All factors with a p-value of 0.25 or lower were considered for multivariate analysis.

Table 4

Distribution of foot mycoses by demographic characteristics and wearing occlusive shoes by multivariate analysis

Variables		**Adjusted OR (95% CI)**	***p*-value**
Wear occlusive shoes	No	1.0	
	Yes	3.68 (1.52-8.87)	*0.004*
Age	<18	13.28 (1.47-119.15)	*0.021*
	18-29	2.23 (0.80-6.21)	*0.125*
	30-49	1.0	
	>50	2.74 (0.86-8.70)	*0.086*
District	Mbarara	1.0	
	Isingiro	0.52 (0.10-2.65)	*0.436*
	Ibanda	1.67 (0.22-12.6)	*0.617*
	Others	1.56 (0.26-9.30)	*0.623*
Occupation	Farmers	1.0	
	Business	0.67 (0.22-2.02)	*0.483*
	Professional	2.35 (0.50-11,10)	*0.279*
	Student	0.47 (0.10-2.09)	*0.323*

A multivariate analytic approach (Table 4) was performed to determine the correlation between the distribution of foot mycoses and age, geographical location, occupation and wear occlusive shoes and thus this analysis revealed that the odds of having foot mycoses were 3.7 times higher among participants who wear closed shoes compared to those who don't (p=0.004) with 95% CI (1.52-8.87) (Table 4). Therefore, wearing occlusive shoes is a risk for having foot mycoses. Afterwards, the odds of having foot mycoses among participants below 18 years old were 13.3 times higher as compared to those above (p=0.021) with 95% CI (1.47-119.15) (Table 4). Therefore, the age below 18 years is a risk of having foot mycoses.

DISCUSSION

The age range of participants being between 6 and 65 years with the mean age of 36 ± 13.5 years, this is comparable with other studies done in Crete, Greece (18) and in Tunisia[5]. In this study, 58 (52.7%) participants were male and 52 (47.3%) were female (Table 1). This is in concordance with other studies done in Dakar [19], where male were more represented than female. In this study, we found a significant difference between the microscopic and fungal culture-sensitivity of foot mycoses with 91.8% and 60.9% respectively (Table 2). This is comparable to the study conducted in Tunisia where the direct microscopy was positive in 79.3% and positive culture in 61.6%[5,20]. The variation between microscopy and culture results may be explained by the presence of non-viable fungal elements in some cases which don't grow on culture and possible non-reported partial treatment with antifungal agents. In this study, the sensitivity of fungal culture of 60.9% (Table 2) is slightly less than the one of 65.3% conducted in Senegal[21] and higher compared to 44.7% reported in Japan[9]. These differences between studies may be due to poor hygiene conditions and geographical differences as the distribution of fungal agents vary with geographic location[22]. Patients most affected were aged between 30 and 65 years old (Table 1). This agrees with a study reported in Tunisia where the sensitivity of fungal culture of

foot mycoses was highest among people aged 31-60 years[5]. In Senegal the most affected group was between 44 and 54 years (26%)[21]. This may be explained by many conditions such as wearing occlusive footwear, sweating during full-time work activities, communal areas expose these specific population to increased incidence of foot mycoses[23,24]. In the results of this study, males (64%) were more commonly affected than females (36%) (Table 1). This is in agreement with other studies in Treasure Island (8), in New Zealand[25]. The risk of foot mycoses has been shown to be higher in men (55.2%) than in women (44.8%)[19]. This gender differences can be explained by lifestyle of wearing open shoes which is common in women and differences in hormone levels that result in a different capacity to inhibit fungal growth[26]. In the present study, interdigital type was the most predominant clinical presentation of foot mycoses (Fig 1). These results are similar with others studies carried out in Tunisia[5], in Germany[12] and in Turkey[27]. In contrast, the results of this study showed that interdigital type of foot mycoses was predominantly caused by *Candida* species followed by *T. interdigitale*. This is different from other studies where interdigital type was most commonly caused by *T. rubrum* and *T.interdigitale* both known as the causes of tinea pedis in Turkey[27], USA[2], Germany[28] and Tunisia [5]. This may be explained by the fact that yeasts are part of normal flora and geographical environment[5]. Moccasin type which was the second most prevalent after interdigital type of foot mycoses is also most commonly caused by *T. rubrum*[1]. This is consistent with our results where moccasin type was the second clinical type and predominantly caused by *T. rubrum.* In this study, inflammatory and erosive form of foot mycoses were predominantly caused by *T. rubrum*, this is similar to other studies done in Germany[11] and USA[10]. Most common cause of foot mycoses were dermatophytes with 39.5%, followed by yeasts with 32.6% and NDMs with 27.9% (Fig 2). This is comparable with a study done in Tunisia where dermatophytes were isolated in 70.5% followed by yeasts (17.7%) and NDMs in 8%[5].

CONCLUSION

This study demonstrates that foot mycoses is a common clinical entity among the middle age group especially in male population as the most common clinical presentation. Most importantly the identified predisposing factors here appear to be age and wearing occlusive shoes. The associated etiological agents are dermatophytes and yeasts. The study recommends that more studies be carried out to establish antifungal profiles for easy diagnostic and treatment

REFERENCE

1.Griffiths C, Barker J, Bleiker T, Chalmers R, Creamer D. Rook's textbook of dermatology: John Wiley & Sons; 2016.

2.Ilkit M, Durdu M. Tinea pedis: the etiology and global epidemiology of a common fungal infection. Critical reviews in microbiology. 2015;41(3):374-88.

3.Nweze E. Dermatophytosis in Western Africa: a review. Pak J Biol Sci. 2010;13(13):649-56.

4.Nenoff P, Krüger C, Schaller J, Ginter-Hanselmayer G, Schulte-Beerbühl R, Tietz HJ. Mycology–an update part 2: dermatomycoses: clinical picture and diagnostics. JDDG: Journal der Deutschen Dermatologischen Gesellschaft. 2014;12(9):749-77.

5.Toukabri N, Dhieb C, El Euch D, Rouissi M, Mokni M, Sadfi-Zouaoui N. Prevalence, Etiology, and Risk Factors of Tinea Pedis and Tinea Unguium in Tunisia. Canadian Journal of Infectious Diseases and Medical Microbiology. 2017;2017.

6.Burgdorf W. Braun-Falco's dermatology: Springer Heidelberg; 2009.

7.Bardazzi F, Antonucci V, Patrizi A, Alessandrini A, Tengattini V, Odorici G, et al. Interdigital psoriasis of the feet (psoriasis alba): not a distinct form of psoriasis. Dermatology. 2013;227(2):130-3.

8.Nigam PK, Boktor SW. Tinea, Pedis. 2017.

9.Kawai M, Suzuki T, Hiruma M, Ikeda S. A retrospective cohort study of tinea pedis and tinea unguium in inpatients in a psychiatric hospital. Medical mycology journal. 2014;55(2):E35-E41.
10.Bolognia JL, Schaffer JV, Duncan KO, Ko CJ. Dermatology essentials E-book: Elsevier Health Sciences; 2014.
11.Nenoff P, Krüger C, Paasch U, Ginter-Hanselmayer G. Mycology–an update Part 3: Dermatomycoses: topical and systemic therapy. JDDG: Journal der Deutschen Dermatologischen Gesellschaft. 2015;13(5):387-411.
12.Shi TW, Zhang JA, Zhang XW, Yu HX, Tang YB, Yu JB. Combination treatment of oral terbinafine with topical terbinafine and 10% urea ointment in hyperkeratotic type tinea pedis. Mycoses. 2014;57(9):560-4.
13.Komba EV, Mgonda YM. The spectrum of dermatological disorders among primary school children in Dar es Salaam. BMC Public Health. 2010;10(1):765.
14.Parkes-Ratanshi R, Achan B, Kwizera R, Kambugu A, Meya D, Denning D. Cryptococcal disease and the burden of other fungal diseases in Uganda; Where are the knowledge gaps and how can we fill them? Mycoses. 2015;58(S5):85-93.
15.Wiegand C, Mugisha P, Mulyowa GK, Elsner P, Hipler U-C, Gräser Y, et al. Identification of the causative dermatophyte of tinea capitis in children attending Mbarara Regional Referral Hospital in Uganda by PCR-ELISA and comparison with conventional mycological diagnostic methods. Medical mycology. 2016;55(6):660-8.
16.Kish L. Survey sampling. 1965.
17.Sahoo AK, Mahajan R. Management of tinea corporis, tinea cruris, and tinea pedis: A comprehensive review. Indian dermatology online journal. 2016;7(2):77.
18.Maraki S, Mavromanolaki VE. Epidemiology of dermatophytoses in Crete, Greece. Medical mycology journal. 2016;57(4):E69-E75.
19.Diongue K, Diallo M, Ndiaye M, Badiane A, Seck M, Diop A, et al. Causative agents of superficial mycoses isolated in Dakar, Senegal: Retrospective study from 2011 to 2015. Journal de mycologie medicale. 2016;26(4):368-76.
20.Hassab-El-Naby HM, Mohamed YF, Abdo HM, Kamel MI, Hablas WR, Mohamed OK. Study of the etiological causes of toe web space lesions in Cairo, Egypt. Dermatology research and practice. 2015;2015.
21.Diongue K, Ndiaye M, Diallo M, Seck M, Badiane A, Diop A, et al. Fungal interdigital tinea pedis in Dakar (Senegal). Journal de mycologie medicale. 2016;26(4):312-6.
22.Metintas S, Kiraz N, Arslantas D, Akgun Y, Kalyoncu C, Kiremitçi A, et al. Frequency and risk factors of dermatophytosis in students living in rural areas in Eskişehir, Turkey. Mycopathologia. 2004;157(4):379-82.
23.Djeridane A, Djeridane Y, Ammar-Khodja A. Epidemiological and aetiological study on tinea pedis and onychomycosis in Algeria. Mycoses. 2006;49(3):190-6.
24.Field LA, Adams BB. Tinea pedis in athletes. International journal of dermatology. 2008;47(5):485-92.
25.Robbins CM. Tinea Pedis. 2007.
26.Gupta S, Gupta BL. Evaluation of the incidences of dermatophillic infection in Rajastahan: Case studies from Rajasthan, India. International Journal of Medicine and Medical Sciences. 2013;5(5):229-32.
27.Balci E, Gulgun M, Babacan O, Karaoglu A, Kesik V, Yesilkaya S, et al. Prevalence and risk factors of tinea capitis and tinea pedis in school children in Turkey. J Pak Med Assoc. 2014;64(5):514-8.
28.Nenoff P, Krüger C, Ginter-Hanselmayer G, Tietz HJ. Mycology–an update. Part 1: Dermatomycoses: causative agents, epidemiology and pathogenesis. JDDG: Journal der Deutschen Dermatologischen Gesellschaft. 2014;12(3):188-210.