ORIGINAL ARTICLE

# Determinants of Risk Factors On Dermatophytes Infections on Patients' Knowledge, Attitude and Hygiene Practice Among Patients Attending Dermatology Department in A Government Hospital in Setif Province, Algeria

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## ABSTRACT

**Introduction:** Dermatophyte infections are superficial infections that affect the skin and are caused by fungi, namely dermatophytes. Objectives: This study aimed to determine the prevalence of dermatophyte infections among patients who attended the Dermatology Department in Setif public hospital, Algeria and to determine the associated risk factors to these infections. **Methods:** A cross-sectional study with a sample size of 400 respondents was designed to collect the data using a validated pre-tested questionnaire from February to June 2019. The collected data was then analyzed using IBM SPSS version 25. **Results:** The response rate was 98.4% (315 respondents) with an overall mean age (SD) of 38.81 (16.37) years old. The prevalence of dermatophyte infections among respondents was 33.7%, 26% of them have single infections. On the other hand, multiple logistic regression analysis showed an increased odd of having dermatophyte infections by three times among patients from low-income families (OR=3.23, 95% CI=1.09- 4.78, p=0.03). Similarly, the presence of chronic diseases led to a twofold increase in the odds of having dermatophyte infection among patients (OR=2.27, 95% CI=1.01-10.49, p=0.045). It was also found that poor attitudes towards preventing dermatophyte infections increased the odds of having dermatophyte infection by near to three times (OR=2.58, 95% CI=1.14-4.74, p=0.002). **Conclusion:** The high prevalence of dermatophyte infections presents a significant concern in Setif Province, Algeria. In this context, further efforts are needed to review the practiced control measures to optimize the effectiveness of these measures, which may reduce dermatophyte infections, especially among patients with chronic diseases.

**Keywords:** Dermatophyte infection, Intensity, Prevalence, Immuno-compromised population, Hammam.

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## INTRODUCTION

Dermatophytes, also namely ringworms, is a group of fungus which cause the infection of the skin. They can cause red, itchy, scaly, circular rash and sometimes hair loss which may occur in the affected area, caused by dermatophytes genera. Dermatophytes are keratinolytic fungus that invades the keratinized tissues causing mostly superficial infections (1,2). Therefore, they are considered amongst the most common causes of skin diseases in the world. Dermatophyte infections are commonly distributed worldwide, but tropical countries are recording a higher prevalence (2,3). The distribution of dermatophyte infections and their etiological agents varies with geographical and cultural characteristics. Several factors, such as lifestyle, type of population, migration of people and climatic conditions, could influence a person to get the infection. Therefore, certain species are widely distributed, whereas others are geographically restricted (4).

Like other countries, dermatophyte infections remain a significant national concern in Algeria, where at least 568,900 (1.41%) of the total population of the country (approximately 40.4 million inhabitants of Algeria) have a severe fungal infection each year (5). Setif Province is one of the most affected provinces by dermatophyte infections in Algeria. However, there is a lack of studies that reports the prevalence and factors associated with this disease in Setif Province. Therefore, this study aimed to determine the prevalence of dermatophyte infection and risk factors associated among patients attending the Dermatology Department in a government hospital in

Setif province.

## MATERIALS AND METHODS

### Study population and design

An analytical cross-sectional study was carried out between February and June 2019 among the patients with a skin disease who attended the Department of Dermatology in a government hospital in Setif Province, Algeria.

A simple random sampling was used to select registered patients in the Department of Dermatology. The estimated sample size was 320 using the formula for hypothesis testing for two groups comparison (6), with power of study 80 percent.

Sample size was calculated from the sample size formula for two portions (6).

$$n = \frac{(Z_{1-\frac{\alpha}{2}}\sqrt{2P(P-1)}+Z_{1-B}\sqrt{p_1(1-p_1)p_2(1-p_2)})^2}{(p_1-p_2)^2}$$

=145.5
n=Sample size estimate
α=0.05
$Z_1$= 1.98
β =1.138
$P_1$ = population proportion of dermatophyte infection among male = 0.37 (7)
P2 = population proportion of dermatophyte infection among female= 0.222 (7)

Hundred and sixty respondents were added for a 10% estimation of non-respondents from the sample size. A sample size of 230 was determined by multiplying the design effect which was two.

### Inclusion and exclusion criteria

During this study, the following inclusion and exclusion criteria were applied. The inclusion criteria were: (i) the participant must be a patient with skin problems; (ii) he/she is registered and receiving medical treatment in the Department of dermatology during the period of data collection; (iii) the patient must be a resident of Setif Province; and (iv) the patient must be aged 10 and above. The exclusion criteria were: (1) respondents who refused to sign the informed consent form; (ii) patients that were severely ill; and (iii) children whose parents did not give written consent.

### Data collection

The pre-tested standardized self-administered questionnaire was used in this study consisted of five sections (section A to E), filled up by the interviewer by interviewing patients before their dermatologic examination. Section F contains clinical details of patients that the dermatologists filled in during their dermatological examination. However, the clinical findings were subject to laboratory confirmations. The sections were as follows:

**Section A:** Socio-demographic characteristics such as age, gender, level of education, occupation, family monthly income, family size, and medical history.

**Section B:** Questions on environment and sanitation, such as disposal system of water supply, district (rural/urban), presence of pets, presence of public baths, presence of swimming pool, presence of fitness studio, and martial arts facilities.

**Section C:** A 25-items on source of information, knowledge on transmission, signs and symptoms, and prevention of dermatophyte infection. There were 20 questions with "Yes" or "No" answers while the other five questions were options with "True", "False" and "Not sure". Knowledge scores were further categorized into two categories which were good knowledge and poor knowledge.

**Section D:** A 10-item questions on attitude (knowledge acquisition about dermatophyte infection, attitude toward severity, preventive hygiene practice, and treatment) using a likert scale of 'strongly disagree' (is given one mark) , 'disagree' (two marks), 'neutral' (three marks), 'agree' (4 marks), and 'strongly agree' (5 marks). The attitude scores were further categorized into poor and good attitude using its mean value (cut-off mark).

**Section E:** A 14-item questions on general hygiene practice focusing on the general hand-washing and showering practices after the contact with pets and after practising sport, and other practices such as sharing combs, towel, bed, and hair-brush. They were evaluated using a likert scale "never" (given as one mark) through "always" (given as five marks). A cut-off point using its mean value was used to categorized the scores into good and poor hygiene practice.

### Data analysis

Data were analyzed using IBM SPSS 25.0 (Software Package for Social Science). Descriptive characteristics were described as mean, frequency and percentages. A Chi-square test was used to analyze the associations between the categorical socio-demographic variables and dermatophyte infections. The comparison between two means was analyzed using an Independent t-test, while one-way ANOVA was used for the comparison of means of more than 2 groups.

Continuous variables were expressed in terms of means with a 95 % Confidence Interval (CI). Meanwhile, univariate logistic regression was used for the calculation of the crude odds ratio. The variables with a p-value of less than < 0.25 were analyzed using the multiple logistic regression model to determine the significant predictors of dermatophyte infections in Setif Province. The results were interpreted based on the obtained adjusted odds ratio and p-value. A p-value of less than 0.05 was considered statistically significant.

**Ethical considerations**

This research obtained approval from JKEUPM (Ethics Committee for Research Involving Human Subject) (Reference No: UPM/TNCPI/RMC/JKEUPM/1.4.18.2 (JKEUPM)/F1, dated 21st February 2014). Permission was also obtained from the Ministry of Health Algeria, State Health Ministry and the Head of Hospital. Written informed consent was obtained from each of the respondents for this research.

## RESULTS

**Response rate**

Out of 320 potential respondents, 315 responses (169 males and 149 females) were received from the participants in this study, with a response rate of 98.4%.

**Socio-demographic characteristics of respondents**

The mean (SD) age of 315 respondents was 38.81 (16.37) years and ranged from 10 to 84 years old. A significant difference was observed between the mean age of males and the mean age of female (t= -0.280, p = 0.002). It was also found that the majority of respondents were male (54 %).

**Prevalence of dermatophyte infection by the intensity of infection**

Table I showed the prevalence of dermatophyte infection by the intensity of infection. The overall prevalence of dermatophyte infection was 33.7%, and the majority (26%) of the infected patients had a single infection. The predominant dermatophyte was tinea corporis 30 (25%), followed by tinea pedis 23 (24%) and tinea cruris 21(22%).

**Knowledge, Attitude and Practice scores**

***Knowledge score***

The score for total knowledge on dermatophyte infection was 19 to 66, and the mean (SD) score was 38(0.5). About 49% of respondents had good knowledge on dermatophyte infection.

The score for knowledge on transmission was 10 to 27, and the mean (SD) score was 17(4.22). Almost two third of respondents had no information about the source of the infection, and about one third had knowledge on different ways of transmission. Worse still, only 21.3% of them knew that dermatophyte infection could be transmitted through sharing towel. One hundred and sixty-two (96.4%) respondents had poor knowledge on the transmission of dermatophyte infection and they also have low level of education (table II).

**Table I: Severity of dermatophyte infection by age and gender among patients attending Dermatology Department in a government hospital in Setif province (n=315)**

| Variables | Severity | | Total (%) |
|---|---|---|---|
| | Single infection (%) | Multiple infections (%) | |
| Age (years) | | | |
| 10-29 | 17 (18.5) | 0 (0.0) | 17 (18.5) |
| 30-49 | 30 (21.5) | 13(9.3) | 43 (30.8) |
| 50-69 | 31 (44.3) | 8 (11.5) | 39 (55.8) |
| ≥ 70 | 4 (30.8) | 0 (0.0) | 4 (30.8) |
| Gender | | | |
| Male | 44 (26.38) | 12 (7.1) | 56 (33.1) |
| Female | 38 (26.02) | 9 (6.2) | 47 (32.2) |

The score for knowledge on symptoms was 5 to 15, and the mean (SD) score was 11(2.38). The results showed that 55% of patients have poor knowledge on symptoms, and more than 70% did not know dermatophytes can affect nails (table II).

Knowledge score on the prevention of dermatophyte infection was 3 to 21 with a mean (SD) score of 12(2.94). The interview with the respondents showed that about half of respondents had knowledge that dermatophyte infection is a preventable disease and 57.8% had knowledge that hand washing after contacting infected pets can prevent from the infection. While only 31% of respondents believed that showering after using public bath and swimming pool can prevent from dermatophyte infection (table 2). However, the results showed that majority of patients with poor knowledge on prevention of dermatophyte infection also have low level education (96.9%).

***Attitude scores***

The score range for total attitude toward dermatophyte infection was 14 to 41, and the mean (SD) score was 34.6 (4.41). Majority (61.6%) of respondents had good attitude toward acquiring knowledge about dermatophyte infection. However, some of the respondents remained neutral with regards to the prevention and seriousness of dermatophyte infection, and almost 50% of the respondents had poor attitude toward receiving treatment (table 3).

***Hygiene practices scores***

The general hygiene practice scores ranged from 33 to 61. The mean (SD) score for general hygiene practice among the patients was 49.31 (6.44) and 63.8% had poor hygiene practice. Fifty percent of the respondents indicated that they walk barefooted in public baths and swimming pool, and 52.1% avoid sharing fomites and towel with others while 32.2% wash their hands frequently after contacting infected pets (table IV).

**Prevalence and association between dermatophyte infection and socio-demographics, environmental and behavioural factors**

Tables V and VI showed that prevalence of dermatophyte infections was associated with age ($\chi^2$= 15.27, p= 0.001), family monthly income ($\chi^2$ =21.81, p=0.001), chronic disease ($\chi^2$= 24.79, p= 0.001), water supply ($\chi^2$ = 6.265, p=0.016), cat existence ($\chi^2$ =10.860, p=0.001), and public bath usage ($\chi^2$ = 51.485, p=0.001). Prevalence

**Table II: Patients knowledge on transmission, symptoms and prevention of dermatophyte infection (n=315)**

| Knowledge on transmission | True n (%) | False n (%) | Not sure n (%) |
|---|---|---|---|
| Dermatophyte infection is caused by fungus | 107(34) | 116(36.8) | 92(29.2) |
| Dermatophyte infection is transmitted through contact with infected persons | 109(34.6) | 121(38,4) | 85(27) |
| Dermatophyte infection can be transmitted after contact with infected pets. | 108(34.3) | 131(41.6) | 76(24.1) |
| Dermatophyte infection can be transmitted through sharing of towels | 67(21.3) | 146(46.3) | 102(32.4) |
| Dermatophyte infection can be transmitted through sharing of fomites | 102(32.4) | 137(43.5) | 76(24.1) |
| Dermatophyte infection can be transmitted through sharing of hair-brushes | 117(37.1) | 119(37.8) | 79(25.1) |
| Dermatophyte infection can be transmitted through fitness studio | 128(40.6) | 122(38.7) | 79(25.1) |
| Dermatophyte infection can be transmitted through martial art competitions such as Judo and wrestling. | 157(49.8) | 105(33.3) | 53(16.8) |
| Dermatophyte infection can be transmitted after using public baths, swimming pools. | 98(31.1) | 147(46.7) | 70(22.2) |
| **Knowledge on symptoms** | | | |
| Dermatophyte infection can affect different parts of the body | 115(36.5) | 117(37.1) | 83(26.3) |
| Dermatophyte infection can manifest with: a red, scaly, itchy or raised patch | 132(41.9) | 132(41.9) | 51(16.2) |
| Dermatophyte infection can manifest with patches may be redder on outside edges | 127(39.4) | 94(29.8) | 94(29.8) |
| Dermatophyte infection can manifest with patches that begin to ooze or develop blister | 124(39.4) | 116(36.8) | 75(23.8) |
| Dermatophyte infection can manifest with bald patches may develop, when the scalp is affected | 104(33) | 129(41) | 82(26) |
| Dermatophyte infection can manifest with nails may thicken, discolor or begin to crack | 101(32.1) | 154(49) | 60(19) |
| **Knowledge on prevention** | | | |
| Dermatophyte infection can affect different parts of the body | 115(36.5) | 117(37.1) | 83(26.3) |
| Dermatophyte infection can manifest with: a red, scaly, itchy or raised patch | 132(41.9) | 132(41.9) | 51(16.2) |
| Dermatophyte infection can manifest with patches may be redder on outside edges | 127(39.4) | 94(29.8) | 94(29.8) |
| Dermatophyte infection can manifest with patches that begin to ooze or develop blister | 124(39.4) | 116(36.8) | 75(23.8) |
| Dermatophyte infection can manifest with bald patches may develop, when the scalp is affected | 104(33) | 129(41) | 82(26) |
| Dermatophyte infection can manifest with nails may thicken, discolor or begin to crack | 101(32.1) | 154(49) | 60(19) |

**Table III: Patients attitude towards dermatophyte infection (n=315)**

| Attitude | Strongly disagree n (%) | Disagree n (%) | Neutral n (%) | Agree n (%) | Strongly agree n (%) |
|---|---|---|---|---|---|
| I see dermatophyte infection as a serious problem | 5(1.6) | 32(10.2) | 176(55.9) | 86(27.3) | 16(5.1) |
| I would like to know about dermatophyte infection because of my safety and health | 2(0.6) | 29(9.2) | 75(23.8) | 195(61.9) | 14(4.4) |
| I will be worried if I have dermatophyte infection | 2(0.6) | 45(14.3) | 106 (33.7) | 29 (9.2) | 39(12.4) |
| washing hands is necessary after every contact with infected pets | 4(1.3) | 45(14.3) | 107(34) | 121(38,4) | 38(12.1) |
| showering is required after every sport practicing and hair-cut | 4(1.3) | 47(14.9) | 121(38.4) | 108(34.3) | 35(11.1) |
| washing others clothes is necessary before using it | 0(0.0) | 63(20) | 123(39) | 107(34) | 22(7) |
| avoiding of wearing others sports shoes is necessary | 4(1.3) | 47(14.9) | 126 (40) | 95 (30.2) | 43(13.7) |
| avoidance of walking with barefoot is required in public baths and swimming pools. | 2(0.6) | 127(40.3) | 121(38.4) | 53(16.8) | 12(3.8) |
| Infected patients with dermatophytosis should receive treatment | 0(0.0) | 33(10.5) | 106(33.7) | 152(48.3) | 24(7.6) |
| Infected pets should be referred to the Vet for receiving treatment. | 7(1.6) | 44(14.1) | 108(34.3) | 125(39.7) | 33(10.5) |

of dermatophyte infections were also associated with the general knowledge about dermatophyte infections ($\chi^2$ = 7.570, p=0.006), attitude towards dermatophyte infection ($\chi^2$ = 21.691, p = 0.001), and hygiene practices ($\chi^2$ = 14.530, p = 0.001). Significant associations were not observed between dermatophyte infections and gender ($\chi^2$ = 0.259; p = 0.634), education ($\chi^2$ = 0.275, p = 0.722), occupation ($\chi^2$ = 1.992, p = 0.174) and district (rural/urban) ($\chi^2$ = 2.529; p = 0.118).

## Predictors for dermatophyte infection

Four factors associated with dermatophyte infection were included in the multivariate logistic regression model as shown in Table VII, which are family monthly income (Adj. OR=3.23, 95 % CI=0.09-4.78, p=0.03), chronic disease (Adj. OR=2.27, 95%CI=1.01-5.07,

**Table IV: Patients hygiene practice towards dermatophyte infection (n=315)**

| Variables | Never n (%) | Rarely n (%) | Sometimes n (%) | Frequently n (%) | Always n (%) |
|---|---|---|---|---|---|
| Do you usually use bodywashes while having a bath/shower | 6(1,9) | 26(8.3) | 93(29.5) | 172(54.6) | 18(5.7) |
| Do you use soap for hand-washing after contacting infected pets | 2(0.6) | 35(11.1) | 104(33) | 158(50.2) | 16(5.1) |
| Do you usually avoid any contact with stray dogs and stray cats | 4(1.3) | 121(38.4) | 117(37.1) | 38(12.1) | 37(11.7) |
| Do you shampoo after haircut | 0(0.0) | 40(12.7) | 117(37.1) | 121(38.4) | 37(11.7) |
| Do you usually shower after using fitness studio | 3(1.6) | 54(17.1) | 107(34) | 113(35.9) | 36(11.4) |
| Do u usually shower after practicing sport | 4(1.3) | 20(6.3) | 95(30.2) | 144(45.7) | 30(9.5) |
| do you usually shower after using public baths and swimming pool | 5(1.6) | 24(7.6) | 175(55.6) | 86(27.3) | 25(7.9) |
| Do you usually avoid walking with barefoot in public baths and swimming pool | 43(13) | 160(50.8) | 74(23.5) | 38(12.1) | 38(12.1) |
| Do you usually avoid sharing cap with others | 6(1.9) | 26(8.3) | 97(30.8) | 140(44.4) | 46(14.6) |
| Do you usually avoid sharing towel with others | 2(0.6) | 29(9.2) | 164(52.1) | 96(30.5) | 24(7.6) |
| do you usually use others sport shoes for playing | 0(0.0) | 30(9.5) | 107(34) | 155(49.2) | 23(7.3) |
| do you usually avoid wearing tight shoes and restrictive clothing in warm climate | 4(1.3) | 38(12.1) | 97(30.8) | 140(44.4) | 36(11.4) |
| do you usually avoid contact with infected pet (cat/dog) | 5(1.6) | 54(17.1) | 107(34) | 113(35.9) | 36(14.4) |
| do you usually avoid sharing bed with others | 5(1.6) | 43(13.7) | 93(29.5) | 144(45.7) | 30(9.5) |

**Table V: Association of socio-demographic factors with dermatophyte infection (n=315)**

| Variable | Infection status | | $\chi^2$ | Univariate logistic regression | | *p*-value |
|---|---|---|---|---|---|---|
| | Yes (%) | No (%) | | COR | 95% CI | |
| Age group (years) | | | | | | |
| 10-39 | 44(14) | 135(42.9) | 15.275 | 0.389 | 0.241-.628 | 0.001* |
| ≥ 40 | 62(19.7) | 74(23.5) | | | | |
| Gender | | | | | | |
| Male | 59(34.9) | 110(65) | 0.259 | 0.885 | 0.553-1.416 | 0.634 |
| Female | 47(32.2) | 99(67.8) | | | | |
| Education | | | | | | |
| Low level | 43(48.9) | 45(15.1) | 0.275 | 1.537 | 0.305-7.748 | 0.722 |
| Good level | 63(27.8) | 164(72.2) | | | | |
| Occupation | | | | | | |
| Not working | 57(41.9) | 79(58.1) | 1.992 | 0.7 | 0.426-1.15 | 0.174 |
| Working | 49(27.4) | 130(72.6) | | | | |
| Family monthly income | | | | | | |
| Low | 19(76) | 6(24) | 21.81 | 7.389 | 2.85-19.13 | 0.001* |
| Good | 87(30) | 203(70) | | | | |
| Family size | | | | | | |
| ≤ 6/ Normal | 67(37.4) | 112(62.6) | 2.652 | 1.488 | 0.921-2.403 | 0.118 |
| ≥7/overcrowded | 39(28.7) | 97(71.3) | | | | |
| Chronic disease | | | | | | |
| Yes | 33(63.5) | 19(36.5) | 24.79 | 4.521 | 2.42-8.45 | 0.001* |
| No | 73(27.8) | 190(72.2) | | | | |

$\chi^2$ = chi-square value. *Significance level $p<0.05$. COR= crude odd ratio

**Table VI: Association of environmental factors, knowledge, attitudes and hygiene practices with dermatophyte infection (n =315)**

| Variables | Infection status | | $\chi^2$ | Univariate logistic regression | | *p*-value |
|---|---|---|---|---|---|---|
| | Yes (%) | No (%) | | COR | 95% CI | |
| District | | | | | | |
| Rural | 51(38.6) | 81(61.4) | 2.529 | 1.465 | 0.914-2.349 | 0.118 |
| Urban | 55(30.1) | 128(67) | | | | |
| Water supply | | | | | | |
| Sufficient | 38(26.4) | 106(73.6) | 6.265 | 0.543 | 0.336-0.878 | 0.016* |
| Not sufficient | 68(39.8) | 103(60.2) | | | | |
| Cat existence | | | | | | |
| Yes | 57(44.2) | 72(55.8) | 10.860 | 2.213 | 1.37-3.56 | 0.001* |
| No | 49(26.3) | 137(73.7) | | | | |
| Dog existence | | | | | | |
| Yes | 24(40.7) | 35(59.3) | 1.606 | 1.455 | 0.813-2.604 | 0.223 |
| No | 82(32) | 174(68) | | | | |
| Using public bath | | | | | | |
| Yes | 73(56.6) | 56(43.4) | 51.485 | 6.044 | 3.62-10.09 | 0.001* |
| No | 33(17.7) | 153(82.3) | | | | |
| General knowledge | | | | | | |
| Not satisfactory | 44(26.7) | 117(37.14) | 5.894 | 0.558 | 0.348-.896 | 0.017* |
| Satisfactory | 62(41.3) | 92(29.2) | | | | |
| General attitude | | | | | | |
| Poor | 77(45) | 94(55) | 21.691 | 3.248 | 1.95-5.39 | 0.001* |
| Good | 29(20.1) | 115(79.9) | | | | |
| General hygiene practices | | | | | | |
| Poor | 83(41.29) | 118(58.7) | 14.530 | 2.783 | 1.62-4.76 | 0.001* |
| Good | 23(20.8) | 91(79.8) | | | | |

$\chi^2$ = Chi-square value. *Significance level $p<0.05$. COR= crude odds ratio

**Table VII: Multiple logistic regression final model showing the adjusted odds ratio**

| Predictors | B-coefficient | Standard error | Adjusted OR | (95% CI) | *p* value |
|---|---|---|---|---|---|
| Family monthly income (Low) | 1.172 | 0.601 | 3.230 | 1.094- 4.78 | 0.030* |
| Chronic disease (have chronic disease) | 0.821 | 0.410 | 2.273 | 1.018 - 5.075 | 0.045* |
| Using public baths (Yes) | 1.571 | 0.316 | 4.812 | 2.592 - 8.932 | 0.001* |
| General attitude toward dermatophyte infection (poor) | 0.950 | 0.309 | 2.586 | 1.410 - 4.742 | 0.002* |

Significance level P<0.05. OR= odds ratio

p=0.045), attitudes towards prevention of dermatophyte infection (Adj. OR=2.58, 95 % CI=1.41-4.74, p=0.002), and the use of public bath (hammam) (Adj. OR=4.81, 95%CI=2.59-8.93, p=0.001).

## DISCUSSION

The majority of patients from the rural area (63 %) were infected with at least one type of dermatophyte infections. Meanwhile, 10 % of them have multiple infections. The findings were in good agreement with previous studies that reported a high prevalence of dermatophyte infections among the rural population, 66% of prevalence reported in Tipaza (5) and 81.3% of prevalence reported in Kenya (8). The high prevalence rate among this group is understood due to their lifestyle and socio-economic status (3,8), highlighting the need for effective control and prevention measures to reduce infections (5). The prevalence and intensity of dermatophyte infection may vary by age, gender, socio-economic background, lifestyle and daily practices (1,3). It also varies between countries and within the country (1,3,9).

In this study, the prevalence of tinea corporis was the most common (29 %), followed by tinea cruris (25 %), tinea pedis (24 %), tinea unguium (14 %), tinea barbae (10 %), tinea manuum (4 %) and tinea capitis (1 %). Same high prevalence of tinea corporis was reported in Ethiopia (10), Unlike other countries such as Tunisia (11), Tinea pedis and tinea unguium were the most prevalent. Compared to other previous studies in African countries, a higher prevalence of different dermatophyte infections was observed in this study. This was attributed to the rural nature of the province (5). Scalp ringworm, or tinea capitis, is the most common dermatophyte infection among children (12,13). However, a low prevalence of Tinea capitis was observed in this study, which could be due to excluding of age-group of fewer than ten years old.

On the other hand, this study demonstrated a higher prevalence among males (34.91 %) than females (32.19 %), which was in line with previous findings reported in Nigeria (14), Guinea (15) and India (16). Other studies prevalence in Ethiopia (10) and Alexandria (17) reported a higher prevalence among females than males. However, the variation in prevalence by gender across countries can be explained by the variation of environmental factors, culture and health and hygiene practices of the individual population (1,17). The findings of this study indicate better hygiene practices among females.

Parallelly, respondents with sufficient water supply were found to be 45% less likely to be infected (COR=0.543, 95%CI=0.336-.878, p=0.016). This was in line with WHO 2001 that reported insufficient water for personal washing and daily hygiene practices as a contributing factor to the prevalence of dermatophyte infections (18). The presence of cats is another factor that was found to cause a higher prevalence of dermatophyte infections in this study (p<0.001). It was reported that 13 % of human ringworm infections (tinea capitis) were caused by an organism that commonly caused ringworm in cats (19). However, the area of residence did not influence the frequency of dermatophyte infection.

The current study results also showed that low monthly income was a significant predictor of increasing the odds of dermatophyte infections almost threefold. (Adj. OR=3.23, 95% CI=1.094- 4.78, p=0.03). This could be due to limited access to medical care compared to patients with good monthly income. According to Havlickova (2008), good monthly income, good housing standard, and a clean environment are considered part of the measures in preventing the spread of dermatophyte genera, especially the spread between members of the family (3).

In the past, public baths (Hammams) represented a cultural heritage for religious and family rituals in Algeria. It is currently used to treat or prevent different dermatological and rheumatological diseases and relaxation and well-being (20). On the other hand, public baths were reported as one of the primary sources of fungal infections, especially among frequent customers and their families (21). This study showed that public baths usage increased the odds of having dermatophyte infection almost five times (Adj. OR=4.812, 95%CI=2.592-8.932, p<0.001).

Chronic diseases such as diabetes mellitus and HIV, are also one of the factors that were reported to increase the prevalence of dermatophyte infections (3,16). According to Rouzaud et al. (2015), patients with chronic disease were more susceptible to dermatophyte infection. The severity of infection may be associated with the length of time the individual had the infection (22). This study showed that chronic disease was a significant predictor with almost three times increased likelihood of dermatophyte infections (Adj. OR=3.23, 95%CI=1.02-5.07, p=0.045). The dermatophyte infection and chronic diseases was significantly associated with age (more than 50 years old) ($\chi^2$ =29.31, $\chi^2$ = 81.19, p<.001). However, the most prevalent type of dermatophyte infection among this age group was *Tinea pedis*, which was secondary to onychomycosis (23).

Previous studies on dermatophyte infection have not been given sufficient attention on the general attitude toward dermatophyte infection and the spread of the disease, to the best of our knowledge. All attention has been centered around the relationship between the prevalence of dermatophyte infection and general knowledge and general practice. However, current findings showed that 49% of respondents had good knowledge of dermatophyte infections regarding the transmission, symptoms and prevention of dermatophyte infections. This was higher than 14 % of respondents with good knowledge reported in Kenya (13). It can be concluded that comprehensive health education is still needed among patients to understand the prevention of dermatophyte infection better. The current study showed that about 53.3 % of patients have a poor attitude towards dermatophyte infections (Adj. OR=2.586, 95 % CI=1.45-4.74, p=0.002), and 63% of patients have poor general hygiene practices. Poor hygiene practice among patients could be interpreted by the negative impact of socio-economic and socio-demographic factors in the rural area (13). However, the interview showed that respondents stayed neutral concerning the prevention and control concept. This could be due to the absence of awareness programs to educate people about these infections.

## CONCLUSION

In conclusion, more attention should be devoted to the awareness of dermatophyte infections, especially in rural areas. Health education remains necessary for the effectiveness of dermatophyte infection control and prevention among patients with skin diseases. Besides that, there is an urgent need to reassess the current control measures and develop effective measures that may reduce dermatophyte infections, especially among patients with chronic diseases.

## ACKNOWLEDGEMENTS

The authors would like to thank the Dean and staff from the Department of Community Health, Universiti Putra Malaysia, for their support. Exceptional thanks to the patients for their participation in this study.

## REFERENCES

1. Hayette M, Sacheli R. Dermatophytosis , Trends in Epidemiology and Diagnostic Approach. Curr Fungal Infect Rep. 2015;9(3):164–79.
2. Sharma V, Kumawat TK, Sharma A, Seth R, Chandra S. Distribution and Prevalence of Dermatophytes in Semi-Arid Region of India. Adv Microbiol. 2015;05(02):93–106.
3. Havlickova B, Czaika VA, Friedrich M. Epidemiological trends in skin mycoses worldwide. 2008;51:2–15.
4. Asticcioli S, Di Silverio A, Sacco L, Fusi I, Vincenti L, Romero E. Dermatophyte infections in patients attending a tertiary care hospital in northern Italy. New Microbiol. 2008;31(4):543–8.
5. Chekiri-Talbi M, Denning DW. Burden of fungal

infections in Algeria. Eur J Clin Microbiol Infect Dis. 2017;36(6):999–1004.
6. Lwanga, S. and Lemeshow S. Lwanga, S. and Lemeshow, S. (1991) Sample Size Determination in Health Studies. A Practical Manual. - References - Scientific Research Publishing [Internet]. 1991 [cited 2021 Apr 21]. Available from: https://www.scirp.org/(S(lz5mqp453edsnp55rrgjct55))/reference/ReferencesPapers.aspx?ReferenceID=2053828
7. Mushi MF, Jonathan E, Mirambo MM, Mshana SE. Prevalence and Predictors of Dermatophyte Infections Among Primary School Children in Ilemela, Mwanza, Tanzania | EA Health Research Journal [Internet]. 2019 [cited 2020 Mar 11]. Available from: https://eahrj.eahealth.org/index.php/eah/article/view/600/1007
8. Bendjaballah-Laliam A, Djazer H. Йpidйmiologie des teignes du cuir chevelu de la banlieue de Tipasa, Algйrie. J Mycol Med [Internet]. 2014;24(2):141–3. Available from: http://dx.doi.org/10.1016/j.mycmed.2014.02.008
9. Coulibaly O, Kone AK, Niarй-Doumbo S, Gonta S, Gaudart J, Djimdй AA, et al. Dermatophytosis among Schoolchildren in Three Eco-climatic Zones of Mali. PLoS Negl Trop Dis. 2016;10(4):1–13.
10. Bitew A. Dermatophytosis : Prevalence of Dermatophytes and Non-Dermatophyte Fungi from Patients Attending Arsho Advanced Medical Laboratory , Addis Ababa , Ethiopia. 2018;2018.
11. Neji S, Makni F, Cheikhrouhou F, Sellami A, Sellami H, Marreckchi S, et al. Epidemiology of dermatophytoses in Sfax, Tunisia. Mycoses. 2009;52(6):534–8.
12. Bourgeois D, Petersen PE, Ogawa H, Estupinan-Day S, Ndiaye C. The Global Burden of Oral Diseases and Risks to Oral Health Policy and Practice The global burden of oral diseases and risks to oral health. Bull World Health Organ [Internet]. 2005 [cited 2019 Dec 18];83(9):661–9. Available from: https://www.researchgate.net/publication/7554914
13. Moto JN, Maingi JM, Nyamache AK. Prevalence of Tinea capitis in school going children from Mathare, informal settlement in Nairobi, Kenya. BMC Res Notes [Internet]. 2015 [cited 2020 Jul 14];8(1):274. Available from: https://pubmed.ncbi.nlm.nih.gov/26116079/
14. Ndako J, Osemwegie O, Spencer T, Olapade B, Yunusa G, Banda J. Prevalence of Dermatophytes and other associated Fungi among school children. Glob Adv Res J Med Med Sci [Internet]. 2012;1(3):49–56. Available from: http://garj.org/garjmms/index.htm
15. Donka- CHU De, Cisse M, Diare FS, Kaba A, Magassouba F, Kenta M, et al. L es teignes du cuir chevelu dans le service de Discussion. 2005;(1):32–3.
16. Mahalakshmi R, Apoorva R, Joshua J. Dermatophytosis: clinical profile and association between socio- demographic factors and duration of infection. 2017;3(2):282–5.
17. Coulibaly O, L'Ollivier C, Piarroux R, Ranque S. Epidemiology of human dermatophytoses in Africa. Med Mycol. 2018;56(2):145–61.
18. Mackenzie DWR, Loeffler W, Mantovani A, Fujikura T. Guidelines for the diagnosis, prevention and control of dermatophytoses in man and animals [Internet]. 1986. Available from: http://apps.who.int/iris/bitstream/handle/10665/61519/WHO_CDS_VPH.86.67.pdf;jsessionid=3141401CD44019E74952A7DFD2CF0892?sequence=1
19. Iorio R, Cafarchia C, Capelli G, Fasciocco D, Otranto D, Giangaspero A. Dermatophytoses in cats and humans in central Italy: Epidemiological aspects. Mycoses. 2007 Nov;50(6):491–5.
20. Benammar L, Menasria T, Chergui A, Benfiala S, Ayachi A. Indoor fungal contamination of traditional public baths (Hammams). Int Biodeterior Biodegrad. 2017 Feb 1;117:115–22.
21. Goksugur N, Karabay O, Kocoglu E. Mycological flora of the Hammams, traditional Turkish bath. Mycoses [Internet]. 2006 Sep [cited 2019 Nov 25];49(5):411–4. Available from: http://doi.wiley.com/10.1111/j.1439-0507.2006.01258.x
22. Rouzaud C, Hay R, Chosidow O, Dupin N, Puel A, Lortholary O, et al. Severe Dermatophytosis and Acquired or Innate Immunodeficiency: A Review. J Fungi [Internet]. 2015 Dec 31 [cited 2019 Nov 25];2(1):4. Available from: http://www.mdpi.com/2309-608X/2/1/4
23. Adams C, Athanasoula E, Lee W, Mahmudova N, Vlahovic TC. Environmental and genetic factors on the development of onychomycosis. Vol. 1, Journal of Fungi. MDPI AG; 2015. p. 211–6.