

Original Research Article

Prevalence and associated risk factors of superficial and cutaneous mycoses among children attending Halibet referral hospital in Asmara, Eritrea

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ABSTRACT

Background: Superficial and cutaneous mycoses are very common among the populations in many African countries. Even though it has not been regarded as a significant problem since the disease is not life-threatening, it may be particularly distressing for the children. The aim of this study was to identify important etiologic agents, proportion of clinical manifestations and related risk factors of superficial and cutaneous mycoses.

Methods: A case control prospective study was conducted among children of age 4-14 from January to June, 2017. A total of 240 children were included in the study. Out of these 120 children who visited Orotta Pediatric hospital for cases apart from skin infections were used as control group and the remaining 120 were children suspected with fungal skin infection who attended Halibet referral hospital. Nail, skin and scalp scrapings were collected and subjected for microscopic examination and culture-based laboratory diagnosis. The associated risk factors which can lead to skin mycoses were also analysed.

Results: Among 120 suspected cases, 87.5% children were positive for superficial cutaneous mycoses out of which 59.2% were males and 40.8% were females. The most prevalent dermatophyte observed was *Trichophyton verrucosum* (15.2%) whereas *Trichosporon* sp. (40%) was predominant among non-dermatophytes. Most of the infections occurred between age groups 4-6 (32.5%). Tinea capitis was the most common disease (57.5%) among the cutaneous mycotic infections, whereas white Piedra (40%) was predominant among the superficial mycotic infections. The important risk factors were intimate association with livestock or pet (50%), playing with children having skin infection (73.3%), sharing of beds (92.5%), sharing of combs (75.3%) and sharing of towels (80.1%).

Conclusions: The present study clearly shows that tinea capitis was the predominant clinical finding in children and *T. verrucosum* was the most common fungus among dermatophytes. At least five risk factors were statistically significant out of all. So public health workers should give attention for increasing the knowledge of society regarding the mode of transmission of skin mycoses, hygiene behaviour and associated risk factors.

Keywords: Superficial and cutaneous fungi, Children, Epidemiology, Risk factors

INTRODUCTION

Superficial skin mycoses are fungal infections of the skin, nail and hair that invade only the most superficial

layer and cause little or no inflammatory response. These mycoses which include Pityriasis versicolor, Tinea nigra, Black piedra and White piedra are mainly caused by the fungi such as *Malassezia* sp., *Hortaea werneckii*,

Piedraia hortae and *Trichosporon* sp. respectively.^{1,2} The majority of fungal infections seen in both temperate and tropical countries are superficial infections of the skin. The prevalence of superficial mycotic infections has risen to such a level in the last decades that skin mycoses now affect more than 20-25% of the world's population, making them one of the most frequent forms of infections.³ Cutaneous mycoses are mainly caused by three different groups of dermatophytes namely *Trichophyton*, *Epidermophyton* and *Microsporum* which infect the keratinized tissue of skin, hair and nails.⁴ Among *Trichophyton* species, *T. mentagrophytes*, *T. rubrum* and *T. tonsurans* which infect nail, beard, skin and scalp are common. Generally, these fungi cause different clinical manifestations such as tinea corporis, tinea cruris, tinea unguium, tinea capitis and tinea pedis based on the site they infect.^{5,6} *Candida* is the most important fungal opportunistic pathogen and can cause superficial infection of the skin, hair, and nails and associated with cutaneous candidiasis and onychomycosis.⁷

Superficial cutaneous mycoses can be associated with different risk factors. The most common risk factors that expose children to fungal infections include socio-demographic factors (sex, occupational types and family income), hygiene behaviour (source of water, use of soap, wiping of body parts, and sharing of towels), low maternal education, low maternal age, shorter birth intervals, large family size, malnutrition, incomplete immunization and low environmental sanitation. School children are also exposed to the typical school hazards: physical injuries, emotional problems and infection. The commonly overcrowded school environment, in developing countries, is a strong dissemination factor as the infectious dermatomycoses have a high chance of spreading among these children.⁸ Host factors such as immunologic status and local factors such as trauma, excessive moisture or occlusive clothing may constitute risk factors when combined with exposure to the etiologic fungi.⁹ Human-to-human transmission usually requires close contact with infected subject or person because dermatophytes are of low infectivity and virulence. In most cases, transmission takes place within families or in situations involving direct contact.¹⁰

Superficial and cutaneous mycoses have become a significant health problem in children as they cause significant morbidity through disfigurement and intractable itches. The information available on common skin diseases among children in Eritrea is scarce and to our knowledge there is no published research regarding skin mycoses. Therefore, this study was carried out to report different etiologic agents associated with superficial and cutaneous mycoses in children who attended Halibet referral hospital in Asmara, Eritrea and to evaluate the associated risk factors for the acquisition of mycoses.

METHODS

Study area and design

The present study was a case control cross sectional hospital based and conducted from January to June 2017 to assess the etiology and associated risk factors of superficial cutaneous mycoses among 120 children of age group 4-14 complaining of skin infection who attended dermatology out-patient department of Halibet referral hospital in Asmara, Eritrea, Northeast Africa. The study also included 120 children of the same age, region and sex who visited Orotta paediatric referral hospital for other cases as control groups for comparing risk factors. A pre-coded and validated questionnaire was used to facilitate data collection. The questionnaire was designed to include the information such as socio-demographic data (age, sex), guardian information (educational background and marital status), and the possible associated risk factors such as hygiene behaviour (frequency of washing, sharing towels, combs, clothes, etc.), family size, exposure to pets and livestock and playing with children having skin infection. Children with deep infections, subcutaneous infections, accidental cases and surgical cases, incomplete questionnaires and those unwilling to give consent were excluded from the study.

Sampling and microbiological analysis

Scrapings from the skin consisting of epidermal scales and from the infected hairs were collected using a sterile scalpel blade on a piece of black paper and tooth brush, respectively, after cleaning the affected sites with 70 v/v alcohol. Scrape specimen from the advancing edge of lesion was used for both skin and hair samples and in the case of nails subungual debris was taken using sterile blade. Each specimen after proper labelling was transported to Microbiology Laboratory of Asmara College of Health Sciences within 3 hours for microscopic examination and culture. Out of the two samples collected, one was used for the demonstration of fungal hyphae and/or spores using KOH (20%) wet mount and the other was used for culture on Sabouraud's dextrose agar (SDA) with chloramphenicol. Fungal isolates were identified on the basis of phenotypic characteristics of the colonies on the medium and microscopic examination of KOH wet mount of the cultures after incubation at room temperature (25°C-28°C) for 2-4 weeks.¹¹

Statistical analysis

Data analysis was carried out by using statistical package for social science (SPSS) version 20 (SPSS INC, Chicago, IL, USA). Responses in the questionnaires was tabulated, coded and processed. Cross tabulations were used to analyze relationship between variables. Chi square was applied to see difference between independent and dependent variables and $p < 0.05$ were considered statistically significant.

RESULTS

In the present study, the control group were matched by age, region, and sex with patients. The study cases were from the five zones of Eritrea in which central zone comprised 96 (80%), while the other zones Debub, Anseba, Gash-barka and Northern red sea consisted 14 (11.7%), 5 (4.2%), 3 (2.5%), and 2 (1.7%) respectively; however, there were no children from Southern red sea zone during our study period. The study cases consisted of 71 (59.2%) males and 49 (40.8 %) females with ratio 1.4:1. The average age (\pm SD) was 8.45 ± 3.084 . The age of the children ranged from 4 to 14 years, in which the number of children between the age groups of 4-6 years, 7-9 years, 10-12 years and 13-14 years were 39 (32.5%), 35 (29.2%), 31 (25.8%) and 15 (12.5%) respectively (Table 1).

Table 1: Socio-demographic characteristics of study cases.

| Variables | | Patients (%) | Control (%) |
|------------|------------------|--------------|-------------|
| Sex | Male | 71 (59.2) | 71 (59.2) |
| | Female | 49 (40.8) | 49 (40.8) |
| Age (Year) | 4-6 | 39 (32.5) | 39 (32.5) |
| | 7-9 | 35 (29.2) | 35 (29.2) |
| | 10-12 | 31 (25.8) | 31 (25.8) |
| | 13-14 | 15 (12.5) | 15 (12.5) |
| Region | Central | 96 (80) | 96 (80) |
| | Debub | 14 (11.7) | 14 (11.7) |
| | Anseba | 5 (4.2) | 5 (4.2) |
| | Gashbarka | 3 (2.5) | 3 (2.5) |
| | Northern Red sea | 2 (1.7) | 2 (1.7) |
| | Southern Red sea | 0 (0) | 0 (0) |

All the samples were examined by both microscopic KOH wet mount and culture method. The result revealed that 97 (80.8%) were positive for both KOH and culture, 8(6.7%) were KOH negative but culture positive, 11 (9.2%) were KOH positive but culture negative and 4 (3.3%) were both KOH and culture negative (Table 2).

Table 2: Correlation of direct microscopy and culture method.

| Test methods | KOH positive (%) | KOH negative (%) | Total (%) |
|------------------|------------------|------------------|------------|
| Culture positive | 97 (80.8) | 8 (6.7) | 105 (87.5) |
| Culture negative | 11 (9.2) | 4 (3.3) | 15 (12.5) |
| Total | 108 (90) | 12 (10) | 120 (100) |

The frequency of dermatophytes and non-dermatophytes isolated from 105 culture positive samples from different

body sites is shown in Table 3. Out of these, 80 (76.2%) were dermatophytes whereas 25 (23.8%) were non-dermatophytes. Among the dermatophytes, *Trichophyton verrucosum* was the major isolate (20%) followed by *T. mentagrophytes* (17.5%). *Microsporum gypseum*, and *Epidermophyton floccosum* were reported only in 2.5% samples. Four different superficial non-dermatophytic fungi, *Trichosporon beigelii*, *Piedraia hortae*, *Hortaea werneckii* and *Candida albicans* were identified from 25 infected children. Out of them, *Trichosporon sp.* was the major isolate (40%).

Table 3: Frequency of dermatophytes and non-dermatophytes in culture positive samples (n=105).

| Fungi Identified | Frequency (%) |
|------------------------------------|---------------|
| Dermatophytes | |
| <i>Trichophyton verrucosum</i> | 16 (20) |
| <i>Trychophyton mentagrophytes</i> | 14 (17.5) |
| <i>Trichophyton tonsurans</i> | 10 (12.5) |
| <i>Trichophyton schoenleinii</i> | 7 (8.75) |
| <i>Trichophyton rubrum</i> | 5 (6.25) |
| <i>Trichophyton violaceum</i> | 5 (6.25) |
| <i>Microsporum canis</i> | 12 (15) |
| <i>Microsporum audouinii</i> | 7 (8.75) |
| <i>Microsporum gypseum</i> | 2 (2.5) |
| <i>Epidermophyton floccosum</i> | 2 (2.5) |
| Non-dermatophytes | |
| <i>Trichosporon Sp.</i> | 10 (40) |
| <i>Piedraia hortae</i> | 9 (36) |
| <i>Hortaea werneckii</i> | 4 (16) |
| <i>Candida albicans</i> | 2 (8) |

Out of 80 children with dermatophytoses, tinea capitis was the major clinical presentation (57.5%) followed by Tinea corporis (21.25%). The major etiologic agent of Tinea capitis was *T. verrucosum* (21.7%) followed by *M. canis* (17.4%). Tinea corporis was mainly caused by *T. mentagrophytes* (23.5%) followed by *T. verrucosum* (23.5%). *T. verrucosum* (18.2%) was the major etiologic agent of Tinea faciei. Tinea unguium was mainly caused by *T. mentagrophytes* (50%). Two cases of Tinea pedis one caused by *T. tonsurans* and another by *E. floccosum* were also reported (Table 4).

Risk factors associated with skin mycoses were evaluated and the results are shown in Table 5. With regard to cases' exposure to livestock (cattle) and pets (cat and dog) there were 16 (13.3%) and 44 (36.7%) and 50% children had no contact with them. But the frequency of exposure of controls to cattle and pet animals were 32 (26.7%) and 5 (4.2%) respectively and 83 (69.1%) had no contact with them and it was found to be statistically significant ($p=0.005$). Also risk factors such as sharing of bed, towels and combs and playing with children with suspected skin infection were found to be statistically significant ($p\leq 0.001$). However other factors like family size, living place and guardian level of education did not have any significant impact.

Table 4: Frequency distribution of dermatophytes in relation to clinical presentations in children.

| Dermatophytes | Tinea capitis (n=46) (%) | Tinea unguium (n=5) (%) | Tinea corporis (n=17) (%) | Tinea pedis (n=2) (%) | Tinea faciei (n=10) (%) |
|-------------------------|--------------------------|-------------------------|---------------------------|-----------------------|-------------------------|
| <i>M.audouinii</i> | 4 (8.7) | 0 (0) | 2 (11.8) | 0 (0) | 1 (9.1) |
| <i>M.canis</i> | 8 (17.4) | 0 (0) | 2 (11.8) | 0 (0) | 2 (18.2) |
| <i>M.gypseum</i> | 2 (4.3) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| <i>E.floccosum</i> | 0 (0) | 1 (25) | 0 (0) | 1 (50) | 0 (0) |
| <i>T.mentagrophytes</i> | 7 (15.2) | 2 (50) | 4 (23.5) | 0 (0) | 1 (9.1) |
| <i>T.rubrum</i> | 2 (4.3) | 1 (25) | 1 (5.9) | 0 (0) | 1 (9.1) |
| <i>T.verrucosum</i> | 10 (21.7) | 0 (0) | 4 (23.5) | 0 (0) | 2 (18.2) |
| <i>T.tonsurans</i> | 7 (15.2) | 1 (25) | 1 (5.9) | 1 (50) | 0 (0) |
| <i>T.schoenleinii</i> | 4 (8.7) | 0 (0) | 1 (5.9) | 0 (0) | 2 (18.2) |
| <i>T.violaceum</i> | 2 (4.3) | 0 (0) | 2 (11.8) | 0 (0) | 1 (9.1) |

Table 5: Risk factors associated with superficial and cutaneous mycoses among patients and controls.

| Risk factors | | Patient (%) | Control (%) | P value (%) |
|--|--------------|-------------|-------------|-------------|
| Intimate association with livestock or pet | Cattle | 16 (13) | 5 (4.2) | 0.005 |
| | Cat | 23 (19.2) | 12 (10) | |
| | Dog | 21 (17.5) | 20 (16.7) | |
| | No | 60 (50) | 83 (69.2) | |
| Playing with children having skin infection | Yes | 88 (73.3) | 15 (12.5) | ≤0.001 |
| | No | 32 (26.7) | 105 (87.5) | |
| Sharing of bed | Yes | 111 (92.5) | 88 (73.3) | ≤0.001 |
| | No | 9 (7.5) | 32 (26.7) | |
| Sharing of comb | Yes | 58 (75.32) | 32 (26.7) | ≤0.001 |
| | No | 19 (24.68) | 88 (73.3) | |
| Sharing of towel | Yes | 85 (80.19) | 62 (51.7) | ≤0.001 |
| | No | 21 (19.8) | 58 (48.3) | |
| Total number of children in family | <2 | 28 (23.3) | 35 (29.2) | 0.662 |
| | 3-4 | 59 (49.2) | 58 (48.3) | |
| | 5-6 | 24 (20) | 21 (17.5) | |
| | >7 | 9 (7.5) | 6 (5) | |
| Residence | Urban | 64 (53.3) | 62 (51.7) | 0.449 |
| | Rural | 56 (46.7) | 58 (48.3) | |
| Guardian level of education | No education | 10 (8.3) | 1 (0.8) | 0.045 |
| | Elementary | 16 (13.3) | 16 (13.4) | |
| | Junior | 35 (29.2) | 43 (35.8) | |
| | Secondary | 48 (40) | 43 (35.8) | |
| | Tertiary | 11 (9.2) | 17 (14.2) | |

DISCUSSION

Superficial mycotic infections are most common in African countries. The clinical appearance and the causative species of such infections vary with geographic region, socioeconomic conditions and habits. In our study, the maximum incidence of skin mycoses was among male children (59.2%) than female children (40.8%). Similarly, in a study Majid et al showed a significantly higher prevalence in boys (61.5%) than in girls (38.5%).¹² Many studies reported a higher infection rate among male children compared with girls.¹³⁻¹⁵ The higher prevalence in boys than in girls may be related to football play-habits in the contaminated soil, wearing old shoes, no periodical bathing and also visiting barbers for

barbers' instruments have been noted to play a role in the spread of these infections. Low prevalence in girls could be associated with the fact that most of the females, especially the older ones, practice general, personal and hair hygiene management.

The present study also assessed relationship of age group with mycotic infections, the highest prevalence was seen in age group 4-6 and 7-9 which was 74 (61.7%) and the least was in children age ≥13 with 15 (12.5%). A similar study conducted in Kenya reported those of age groups between 3-5 and 6-8 had highest prevalence (77.8%).¹⁰ In contrast to our findings, Alem et al reported highest prevalence in age group 11-14.¹⁶ Similarly, many studies found that dermatophytosis prevalence peaked among

children 6 to 11 years of age in East African countries.^{17,18} This could be because most of the children in the five to nine year age group are left to cater to themselves in some communities in terms of personal hygiene. Some are completely ignorant about the methods of prevention and control of skin fungal infections.

The present study showed the frequency of superficial mycoses was more in children whose parents had secondary level of education (40%) when compared with the frequency in children whose parents attained secondary level of education. In contrast, Enemuor et al reported higher prevalence in children whose parents had primary or no education when compared with the frequency in children whose parents had secondary level of education.¹⁹ These results point out the importance of enlightenment programs or health education in control of infections.

KOH positive results indicate that there was fungal element, hyphae and spore under microscope examination of KOH wet mount and culture positive results indicate the growth of fungi on Sabouraud's dextrose agar. In our study, out of 120 clinically suspected cases, 90% were positive while the remaining 10% were negative for fungal hyphae and/or spore. Similar findings have been reported in other studies from different countries.^{16,20,21} Out of 105 positive culture results, 76.2% were dermatophytes while the remaining 23.8% were non-dermatophytes. This was relatively high compared to other study done in Nigeria by Olaied et al.²² This variation of result could be due to the difference in the environmental and climatic conditions of the study areas which probably favoured the growth of other fungi over and above dermatophytes. Also, the use of traditional remedies whose mechanism of action was unknown might have lowered the frequency of dermatophytes.

All 120 samples were examined by both KOH wet mount and culture. The result revealed that 97 (80.8%) were positive for both KOH and culture, 8 (6.7%) were KOH negative but culture positive, 11(9.2%) were KOH positive but culture negative and 4(3.3%) were KOH negative and culture negative result. Janardhan et al reported 23.5% KOH positive cases but culture negative and 5.5% culture positive cases but KOH negative.²⁰ KOH positive culture negative results might have aroused since some fastidious dermatophyte and non-dermatophyte fungal species whose fungal elements were visible under microscope examination of KOH wet mount may not have been isolated in the culture media.

T. verrucosum (20%) was the predominant species among dermatophytes followed by *T. mentagrophytes* (17.5%) and *M. canis* (15%). In contrast to our findings, studies from other countries reported different species of dermatophytes as predominant; *T. violaceum* (38.3%) and (26%) as the predominant dermatophytes in Ethiopia and Ghana respectively, *T. rubrum* (28.2%) in India, *T.*

tonsurans in Kenya and *T. schoenleinii* (28.1%) in Nigeria.^{16,21,23-25} At the same time *T. mentagrophytes* has been reported as the commonest dermatophyte in studies from different Nigerian region.^{18,26} Another study in Tanzania showed *M. canis* as the predominant dermatophyte species.²⁷ Tinea capitis, was the most common encountered infection in our study and accounted for 46 (43.80%) of cases, followed by Tinea corporis 17 (16.1%) and then Tinea faciei 11 (10.47%). Similar findings have been reported in other African countries.^{15,16} In contrast, studies performed in Iran and India showed low occurrence of Tinea capitis.^{12,21} Tinea capitis is highly communicable, especially at family level and the presence of healthy carriers among children and adults from the same families and in schools contribute to the high prevalence of the infection. The reason for the high incidence of skin mycoses especially *T. capitis* and *T. corporis* in Eritrea may be due to the risk factors such as poor infrastructure (residential house and classrooms), overcrowding in school environment, and contact with soil during outdoor activities, intimate association with pet animals and poor personal hygiene which may contribute to the spread of these infections among children. The variations between countries may be because of climate condition, socioeconomic status, and geographical location.

Out of total cases of non dermatophytic superficial infection (23.8%), *Trichosporon* sp. (40%) was the most predominant followed by *P. hortae* (16%). Actual superficial mycoses, white piedra, black piedra, Tinea versicolor and Tinea nigra have been reported in other studies.^{28,29} But to our surprise Olaied et al in Nigeria reported only *Malassezia furfur*.²² The high percentage may be due to the visit of the children to the barber shop for hair cutting and the sharing of the comb. The present study also showed *Candida albicans* (8%). Similarly, in Nigeria, Adefemi et al reported this yeast as predominant among the non-dermatophytes while in another study in the same country no *Candida* was reported.^{15,22} The infection of the skin with *C. albicans* is to be considered serious as it causes onychomycosis.³⁰

Generally highest prevalence of superficial and cutaneous mycoses is expected in rural areas due to more outdoor exposure to environmental dust, improper personal hygiene and unawareness of people. In the present study, most of the children infected were from urban areas (53.3%) than rural areas (46.7%). But it wasn't found to be statistically significant ($p=0.449$). Similar results have been reported in Central Nigeria and Mali.^{31,32} In contrast to our results, a high prevalence of dermatophytosis was reported in rural areas of India and also in African countries such as Ghana, Gabon, and Rwanda and South-eastern Nigeria.^{20,33,34} This difference could be because the study location was in Asmara which is far away from rural areas and the fact that this infection is mostly overlooked comparing with other health conditions.

In this study there was no association between superficial and cutaneous mycoses and number of children in family ($p=0.662$). But Josephine et al reported significant association between Tinea capitis and the family size ($p=0.02$).²⁶ Regarding the relationship between the fungal diseases and the contact with livestock and pets, it was known that 50% of patients were exposed to them and it was found to be significant ($p=0.005$). Many children in this study were infected with *T. verrucosum* and *M. canis* and showed *T. capitis* and *T. corporis*. This could be due to the fact that they are zoophilic species adapted to cats and dogs and also livestock can easily infect children when they had contact with them.³⁵ Belhadj et al also reported similar findings in his study done in Tunisia.³⁶ So the exposure of the children to these animals may act as an important risk factor for the transmission of dermatophytosis. But in contrast to this result, a study in Nigeria reported no significant association between pet animals and Tinea capitis among children.²⁶ The significant association in this study could be because the pets in Eritrea do not get necessary sanitation and care.

In this study there was an association of Tinea capitis with sharing of towels and combs. Similar findings with significant association have been reported elsewhere.^{37,38} In contrast Josephine et al reported no association between Tinea capitis and variables such as sharing of combs.²⁶ The reason for the significant association here is that most of the children are from poor families with unhygienic practice and taking bath once in a week and sharing of dirty unclean towels and combs which poses the risk of transmission of dermatophytosis. Also, it was found that there was an association between sharing beds and superficial mycoses ($p\leq 0.001$). This finding was consistent with other study results.^{37,39} This may be attributed to the spread of the infection through direct contact with infected humans or indirect contact with infected fomites such as bed sheets and also the socioeconomic status of parents as well as living and sanitary conditions. Fungal infections are highly transmitted by direct contact because of their contagious nature. Playing with children having skin infection was found to be significantly associated. The close contact among infected children especially classmates at school and brothers and sisters at home and poor personal hygiene attributes to this significant association.⁴⁰

Limitations

The study participants were drawn from a single hospital and study findings may not be generalizable to all mycoses infected children in Eritrea.

CONCLUSION

The current study confirmed that the frequency of superficial and cutaneous mycoses was high among males than females. *T. verrucosum* was the most common etiologic agent among dermatophytes followed by *T.*

mentagrophytes, while among non-dermatophytes, *Trichosporon* sp. was predominant followed by *P.hortae*. Tinea capitis was identified as the most frequent clinical presentation (43.8%). In relation to the area of residence greater number of patients were from urban areas 64(53.3%) whereas 56(46.7%) were from rural although it wasn't significant. Out of the risk factors assessed sharing of beds, combs, towels, exposure to livestock and pets, playing with children having skin infection were significantly associated ($p<0.05$) while the other factors showed no significant association ($p>0.05$). Mycotic infections are contagious, if possible, family members should not share any personal belongings, if not once they see any sign and symptoms of mycotic infection in one of their family members, they have to separate his/her personal belonging. Most of the time skin mycoses do not get much attention, even there isn't much study regarding to this infection. So, ministry of health should put an attention to this case and also public health workers should give attention for increasing the knowledge of society regarding transmission, hygiene behaviour and other issues related to this infection.

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REFERENCES

1. Azulay RD, Azulay DR, Abulafia LA, Azulay DR. Dermatologia Mycoses Superficiai. 2011;419-39.
2. Bonifaz A, Gómez-Daza F, Paredes V, Ponce RM. Tinea versicolor, tinea nigra, white piedra and black piedra. Clin Dermatol. 2010; 28:140-5.
3. Blanka H, Viktor AC, Markus F. Epidemiological trends in skin mycoses worldwide. Int J Dermatol. 2008;16:543-8.
4. Tainwala R, Sharma YK. Pathogenesis of dermatophytes. Indian J Dermatol. 2011;56:259-61.
5. Kawasaki M, Anzawa K, Wakasa A. Different genes can result in different phylogenetic relationships in trichophyton species. Nippon Ishinkin Gakkai Zasshi. 2008;49:311-8.
6. Olusola A, Ayesha A, Rita O, Obolane B. Prevalence of Tinea Capitis among Primary school Children in a rural setting in south west Nigeria. J public health Afr. 2014;5(1):349.
7. Naglik JR, Moyes DL, Wächtler B, Hube B. Candida albicans interactions with epithelial cells and

- mucosal immunity. *Microbes Infect.* 2011;13:963-76.
8. Narasimhalu, Kalyani M, Somendar SA. Cross-sectional Mycological Research Study of Prevalence, Aetiology, speciation, and sensitivity of superficial Fungi infection in Indian Patients. *J Clin Experimen Dermatol.* 2016;7:324.
 9. Bordenave G. Louis Pasteur (1822-1895). *Microbes Infect.* 2003;5(6):553-60.
 10. Jedidah N, Moto, John MM, Anthony KN. Prevalence of Tinea capitis in school going children from Mathare, informal settlement in Nairobi, Kenya. *Int J Dermatol.* 2015;48(7):704-12.
 11. Martha EK. *Medical Mycology. A Self-Instructional Text.* F.A. Davis company, Philadelphia, Pennsylvania. 1995;111-33.
 12. Majid Z, Maryam P, Ali ZM, Mohamad AM. Prevalence of Superficial Fungal Infection in Primary School Children in Ahvaz, Iran. *Macedonian J Med Sci.* 2011;4(1):89-92.
 13. Celestine CO, Izunna SO, Anthonia CU. Prevalence of superficial fungal infections among primary school pupils in Awka South Local Government Area of Anambra State. *J Mycol Res.* 2015;2(1):15-22.
 14. Fulgence KK, Abibatou K, Vincent D, Henriette V, Etienne AK et al. Tinea capitis in school children in southern Ivory Coast. *Int J Dermatol.* 2013;52:456-60.
 15. Adefemi SA, Odeigah LO, Alabi KM. Prevalence of dermatophytosis among primary school children in Oke-oyi community of Kwara state. *J Med Dental Consult Assoc Nig.* 2011;14(1):23-8.
 16. Alem A, Gebremedhin M, Gizachew, A. Prevalence and Etiologic Agents of Dermatophytosis among Primary School Children in Harari Regional State, Ethiopia. *J Mycol.* 2016;1-5.
 17. Chepchirchir A, Bii C, Ndinya-Achola JO. Dermatophyte infections in primary school children in Kibera slums of Nairobi. *East Afri Med J.* 2009;86(2):59-68.
 18. Woldeamanuel Y, Leekassa R, Chryssanthou E, Mengistu E, Petrini B. Clinico-mycological profile of dermatophytosis in a reference centre for leprosy and dermatological diseases in Addis Ababa. *Mycopathol.* 2006;161:167-72.
 19. Enemuor SC, Amedu AS. Prevalence of superficial mycoses in primary school children in Anyigba, Kogi State, Nigeria. *Afri J Microbiol Res.* 2009;3(2):62-5.
 20. Janardhan B, Vani G. Clinico mycological study of dermatophytosis. *Int J Res Med Sci.* 2007;5(1):31-9.
 21. Raghavendra RM, Padmanabha M, Sowmya GS, Anantharajaur T, Madhuri K. Mycological study of dermatophytosis in a part of South India. *Malay J Microbiol.* 2016;13(1):1-5.
 22. Olaide OO, Olaniyi O, Olayinka AO, Akinlolu GO, Olumayowa AO. The Prevalence and Pattern of Superficial Fungal Infections among School Children in Ile-Ife, South-Western Nigeria. *Dermatol Res Practice.* 2014;1-7.
 23. Hogewoning A, Duijvestein M, Boake D, Amoah AS, Obeng BB. Prevalence of symptomatic tinea capitis and associated causative organisms in the Greater Accra Region, Ghana. *J Dermatol.* 2006;154(5):784-6.
 24. Ayaya SO, Kamar KK, Kakai R. Aetiology of Tinea capitis. *East Afr Med J.* 2000;78:531-5.
 25. Nweze EI. Etiology of dermatophytoses amongst children in north-eastern Nigeria. *Med Mycol.* 2001;39:181-4 .
 26. Josephine D, Seniyat LA, Edward CD. Prevalence of Tinea Capitis among School Children in Nok Community of Kaduna State, Nigeria. *J Pathogens.* 2016;1-6.
 27. Komba EV, Mgonda Y. The spectrum of dermatological disorders among primary school children in Dar es Salaam. *BMC Public Health.* 2010;10:765.
 28. Veasey JV, Avila RB, Miguel BAF, Muramatu LH. White piedra, black piedra, tinea versicolor and tinea nigra: contribution to the diagnosis of superficial mycosis. *An Bras Dermatol.* 2017;92(3):413-6.
 29. Bonifaz A, Badali H, De Hoog GS, Cruz M, Araiza J, Cruz MA, Fierro , Ponce, RM. Tinea nigra by *Hortaea werneckii*, a report of 22 cases from Mexico. *Studies Mycol.* 2008;61:77-82.
 30. Beena S, Sreeja MV, Bhavana PR, Babu, SS. Onychomycosis, prevalence and its etiology in a tertiary care hospital, south India. *Int J Health Sci.* 2013;81-5.
 31. Ayanbimpe GM, Taghir H, Diya A, Wapwera S. Tinea capitis among primary school children in some parts of central Nigeria. *Mycoses.* 2008;51(4):336-40.
 32. Coulibaly, Théra MA, Djimdé AA, Koné AK, Goita S, et al. Dermatophytoses in rural and peri-urban school children in Mali. *Mycoses.* 2011;SI 2:68.
 33. Hogewoning A, Amoah A, Bavinck JNB, Boakye D, Yazdanbakhsh M et al. Skin diseases among school children in Ghana, Gabon, and Rwanda. *Int J Dermatol.* 2013;52:589-600.
 34. Nweze EI, Okafor JI. Prevalence of dermatophytic fungal infections in children: a recent study in Anambra State, Nigeria. *Mycopathol.* 2005;160(3):239-43.
 35. El-Khalawany M, Shaaban D, Hassan H, Abdalsalam F, Eassa B et al. A multicenter clinic- mycological study evaluating the spectrum of adult tinea capitis in Egypt. *Acta Dermatovenerol Alp Pannonica Adriat.* 2013;22:77-82.
 36. Belhadj S, Jeguirim, Anane S, Kaouech E, Kall et al. Dynamics of *Microsporum canis* and *Trichophyton violaceum* tinea capitis in Tunis . *J Med Mycol.* 2007;17:54-7.
 37. Havlickova B, Czaika VA, Friedrich M. Epidemiological trends in skin mycoses worldwide. *Mycoses.* 2008;51:2-15.

38. Ferie J, Dinkela A, Mbata M, Idindili B, Schmid-Grendelmeier P, Hatz C. Skin disorders among school children in rural Tanzania and an assessment of therapeutic needs. *Trop Doct.* 2006;36:219-21.
39. Kalu EI, Wagbatsoma V, Ogbaini-Emovon E, Nwadike VU, Ojide CK. Age and sex prevalence of infectious dermatoses among primary school children in a rural South-Eastern Nigerian community. *Pan Afr Med J.* 2015;20:182.
40. Carod JF, Ratsitorahina M, Raherimandimby HV, Vitrat H, Andrianaja VR et al. Outbreak of tinea capitis and corporis in a primary school in Antananarivo, Madagascar. *J Infect Dev Ctries.* 2011;5:732-6.

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