Communication

Epidemiological Aspects of Tinea Capitis among Children Attending to Koranic Schools in Senegal (Thiés)

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Abstract: Introduction: Scalp ringworms or Tinea capitis are ubiquitous superficial fungal infections of the scalp and hair. They represent the most common dermatophytic in the world. They reach almost exclusively pre-pubescent children and mainly school-aged children. The objective of this study was to assess the prevalence of tinea capitis and its associated factors among residents of koranic schools located in the Thiès region of Senegal. **Patients and Methods**: A cross-sectional study was conducted from February 2019 to March 2020. School children living in Thiès region (Central part of Senegal) were included in this study. Socio-demographic, clinical and biological data were collected standard questionary. Samples collected were examined directly and developed on a medium of Sabouraud-Chloramphenicol and Sabouraud-Chloramphenicol-Actidione. A descriptive analysis was done with the Stata MP. Risk factors were assessed by multivariate survey logistic regression models. Significance level of the different tests was 0.05 two-sided. **Results:** A total of 110 children were included in this study. The mean age was 9 years and the population was predominantly male (96.4%). The average number of residents in Koranic schools was 112. The prevalence of scalp ringworms was 68.2% [(75/110) (95% CI: 53.6 – 85.5)]. The fungal species found were Trichophyton soudanense (93.4%), Microsporum audouinii (2.7%). Trichophyton mentagrophytes, and Trichophyton violaceum were found with each (1.3%). Parasitism was endothrix-like in 86.7%. Children over 10 years old were more affected (72.9%), OR =2,16, CI (0,48 - 9,69). The rate of positivity was higher in children with small plaques (72.7%). Children with irregular-edged plaques were most affected (76.5%), Prevalence was higher among children who slept at more than 3 per mattress (79.1%), OR=1.82 (95% CI: 1.08 – 3.04). **Conclusion:** These results showed that Tinea capitis are frequent in children living in community. Trichophyton soudanense is the main fungal specie identified. Better knowledge of the epidemiology of these diseases and improved living conditions for children in Koranic schools could help improve patient management.

Keywords: Tinea capitis; Epidemiology; Children; Koranic Schools; Senegal

1. Introduction

Tinea capitis is a superficial fungal infection of the scalp and one of the most commonly seen dermatophyte infections in children under 12 years of age [1,2]. The main determinants of the disease include low socio-economic conditions, high population densities and poor health practices [3]. In addition, the epidemiology is constantly changing all over the world. These changes have been attributed mainly to the movements of population (migration) and changes in the way of life of populations [4,5]. The spectrum of species responsible for scalp ringworms and their frequency vary from country to country. It is caused by anthropophilic, zoophilic or geophilic depending on whether they are transmitted from one infected human to another, acquired through contact with infected animals or contracted from contaminated soil or fomites, respectively [6]. In Sub-Saharan Africa, Microsporum audouinii and Trichophyton soudanense are predominants [7–9]. In Western regions

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of the world, Trichophyton tonsurans has emerged as predominant cause of tinea capitis [10]. Microsporum canis is the most common cause in central and southern Europe [11]. Trichophyton violaceum is the most common cause in North Africa and Asia [12,13]. Changing trends in the epidemiology of this condition and the emergence of antifungal resistance have been documented and recently reviewed elsewhere [14]. Generally, the diagnosis is based on the clinical aspects of the lesions and the treatment is also administrated without mycological confirmation. The identification of the causal agent allows guiding the appropriate antifungal treatment, which is specific and safe in the pediatric population. In Senegal, tinea capitis is endemic and most of the existing data concern adult and come from hospital with prevalence ranging from 25.7% to 71% [15–17]. Date on Tinea capitis among children are scarce. In community area Ndir et al when assessing the epidemiological profile of tinea capitis have noted 3,1% of prevalence in 1994 [19]. The most recent study conducted between 2013 and 2015 found 90% prevalence in 210 children living in koranic school The particularity of Koranic schools where hygiene conditions are precarious and where children often live in promiscuity [20]. Because of the scarcity of data on tinea capitis in children in Senegal, it's become relevant to conduct furthers studies in order to better understand the epidemiology of the diseases in children and the spectrum of pathogens for better case management. It was in this context we conducted this study aiming at assessing the prevalence of tinea capitis and its related factors in children living in koranic school.

2. Materials and Methods

Study design, area and population

A cross sectional survey was performed from February 2019 to March 2020 in koranic school located in Thiès region which is from 70 km to Dakar. Children were recruited from koranic schools located in the same neighborhood in the region. Students who were at the time of the study at one of the targeted schools were included in the study. Two type of students wre recruited: (i) children who are interned in the koranic school (living during all their studies and (ii) children who attend class daily and return to their home after classes.

Data collection

For each child enrolled in the study, a questionary was administered to collect epidemiological, clinical and biological data. The epidemiological data such as age, gender and living conditions were collected. Age was categorized in tree groups (under 5 years, 5 – 10 years and more than 10 years). Clinical examination was performed in order to collect clinical data (presence of plates, type and border of plates, presence of crusts and squama) and the result of WOOD light. Mycological results were also collected using the same questionary.

Sample collection

For each child included in the study, sample were collected in sterile petri dishes. Specimens were collected at the periphery of the lesion. After sample collection, the petri dishes hermetically sealed in order to avoid contamination. All the material used was sterile.

Mycological diagnosis

Laboratory testing was performed at the laboratory of Parasitology – Mycology of Fann teaching hospital. Direct examination with light microscopy was done using a portion of sample. Before examination 30% of hydroxide potassium was added on a slide in order to digest the keratin and for better isolation of fungal agent. The rest of the sample was cultured in two different media (i) Sabouraud dextrose agar plus Chloramphenicol (0,05%) and Sabouraud dextrose agar plus Chloramphenicol (0,05%) plus Cycloheximide (0,05%). Cultures were incubated at 27°C±2 during four weeks. Sample was negative if any growth of pathogen was not noted after four weeks

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incubation. In case of positive sample, the idenfication of fungal specie was based on the growth rate, the macroscopic and microscopic aspects of the colony after staining the slide with lactophenol blue.

Statistical analysis

After data collection, data were entered in Excel software and the analysis was performed using Stata software version MP 16 software. Descriptive analysis was performed. Quantitative variables were described in terms of means, standard deviation. For descriptive data, a description in terms of frequency with 95% confidence interval was used. Risk factors were assessed by multivariate survey logistic regression models Significance level of different tests was set at 5% two sides.

Ethical considerations

This study was conducted according to the declaration of Helsinki and existing national legal and regulatory requirements. The protocol was reviewed and approved by the institutional review board of the Cheikh Anta Diop university. Approval number 0258/2017/CER/UCAD. Informed consent of parent or legal representative was required prior the participation to the study. To respect the confidentiality, an identification code was given to each participant.

3. Results

General characteristic of study participants

A total of 110 participants were included in this study. The mean of the study participant was 9.4 ±3. Study population was mainly represented by children between 5-10 years old (58.18%). Children under 5 years and those aged over represent 8.18% and 33.64% respectively. The sex ratio was 2,7. Bathing was found in all children with a daily frequency in 53.6%. Soap was used in 98.2% of cases. The notion of shaving with a frequency of more than once a month in 74.5%. The children were lying on the mattresses in 77.3% and on the floor in 22.7%. Approximately 50.6% of the children slept with more than 2 persons per mattresses (Table 1).

Table 1. General characteristic of study participants.

Parameters	Number (n)	Percentage (%)	95% CI
Age group			
Under 5 years	9	8.2	3.7 - 15.5
5 - 10 years	64	58.2	44.8 - 74.2
>10 years	37	33.6	23.7 - 46.3
Gender			
Female	4	3.6	0.9 - 9.3
Male	106	96.4	78.9 - 99.9
Bath frequency			
2-3 times/Week	40	36.4	25.6 - 49.5
Daily	59	53.6	40.8 - 69.2
Rarely	11	10	4.9 - 17.9
Use of saop			
No	2	1.8	0.2 - 6.5
Yes	108	98.2	80.5 - 99.9
Shaving frequency			
1 time / month	28	25.5	16.9 - 36.8
> 1/month	82	74.5	59.3 - 92.5
Sleeping			
Mattresses	85	77.3	61.7 - 95.5
Ground	25	22.7	14.7 - 33.5

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Nomber of children/mattress			
1 / mattresses	4	4.7	1.3 - 12
2 / mattresses	38	44.7	31.6 - 61.4
>2 / mattresses	43	50.6	36.6 - 68.1

Clinical aspect of lesions

Clinically, 35.5% of the children had large plaques and 64.5% had small plaques. The borders of the plaques were irregular in 17 children (15.4%) and clear in 7 children (5.5%). The presence of scales and crust was noted in 20.9% and 63.6% respectively.

Wood lamp examination was positive in 78.2% (86/110) (Table 2).

Table 2. Clinical aspect of lesions.

Parameters	Number (n)	Percentage (%)	95% CI
Plate			
Small plate	71	64.5	50.4 - 81.4
Large plate	39	35.5	25.2 - 48.5
Plate border			
No border	87	79.1	63.3 – 97.5
Clean border	6	5.5	0.2 – 11. 8
Irregular border	17	15.4	0.9 – 24.7
Crust			
No	87	79.1	63.3 - 97.5
Yes	23	20.9	13.3 - 31.4
Squama			
No	40	36.4	25.9 - 49.5
Yes	70	63.6	49.6 - 80.4
Crust + Squama			
No	108	98.2	80.5 - 99.9
Yes	2	1.8	0.2 - 6.5
Wood			
Negative	24	21.8	13.9 - 32.5
Positive	86	78.2	62.5 - 96.5

Prevalence of Tinea capitis and identified fungal species

Mycological examination was positive in 75 children given a prevalence of Tinea capitis of 68.2%. The main species found were *Trichophyton soudanense* 93.4% and *Microsporum audouinii* 2.7%. T. *mentagrophytes* and *T. violaceum* and the association *T. soudanense* + *M. audouinii* were noted in one patient respectively. Parasitism was endothirx in 86.7% and endo-ectothrix in 13.3% of cases (Table 3).

Table 3. Prevalence of Tinea capitis and identified fungal species.

Parameters	Number (n)	Percentage (%)	95% CI
Results			
Negative	35	31.8	22.2 - 44.4
Positive	75	68.2	53.6 - 85.5
Fungal species			
T soudanense	70	93.4	72.7 - 99.9
M audouinii	2	2.7	0.3 - 9.6
T mentagrophytes	1	1.3	0.03 - 7.2
T violaceum	1	1.3	0.03 - 7.2

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T soudanense+M audouinii	1	1.3	0.03 - 7.2
Parasitism			
Endothrix	65	86.7	66.8 – 99.9
Endo-ectothirx	10	13.3	6.5 – 24.5

Risk factors associated with the prevalence of tinea capitis

An association between tinea capitis age group, gender and number of children sleeping on mattresses was noted in this study. Children with age over 5 years were more affected. The prevalence increased with age. In the age group 5 - 10 years, the prevalence was 67.2 (OR=1.63, 95% CI [0.38 - 6.74] p=0.49). In children aged more 10 years it was 72.9% (OR=2.16 [0.48 - 9.69] p=0.32). According to gender, prevalence of ringworm of the scalp was higher in male 68.8% (OR=2.21 [0.29 - 16.38] p=0.44) (Table 4).

In children using soap during their bath, scalp tinea prevalence was 67.6% (OR=2.08 (1.39 - 3.12), p= 0.44).

The results from the analysis showed that the frequency of shaving and the type of sleeping and were not correlated with the prevalence of scalp tinea. Prevalence was higher in children who made shaving once a month (71.4%). Regarding the sleeping conditions, prevalence was more important in children sleeping on mattresses (76%) (Table 4).

Table 4. Risk factors (socio-demographic characteristics and living conditions) associated with the prevalence of tinea capitis.

Parameters	Percentage (n/N)	OR (95% CI)	P value
Age group			
Under 5 years	55.6 (5/9)	1	
5 - 10 years	67.2 (43/64)	1.63 (0.38 - 6.74)	0.49
>10 years	72.9 (27/37)	2.16 (0.48 - 9.69)	0.32
Gender			
Female	50 (2/4)	1	
Male	68.8 (73/106)	2.21 (0.29 - 16.38)	0.44
Bath frequency			
2-3 times/Week	80 (32/40)	1	
Daily	61 (36/59)	0.39 (0.15 - 0.99)	0.04
Rarely	63.6 (7/11)	0.44 (0.11 - 1.86)	0.26
Use of saop			
No	100 (2/2)	1	
Yes	67.6 (73/108)	2.08 (1.39 - 3.12)	$<10^{-3}$
Shaving frequency			
1 time / month	71.4 (20/28)	1	
> 1/month	67.1 (55/82)	0.82 (0.32 - 2.08)	0.67
Sleeping			
Mattresses	76 (19/25)	1	
Ground	65.8 (56/85)	0.61 (0.22 - 1.69)	0.43
Nomber of children/mattress			
1 / mattresses	50 (2/4)	1	
2 / mattresses	52.6 (20/38)	1.1 (0.14 - 8.72)	0.92
>2 / mattresses	79.1 (34/43)	3.7 (0.46 - 30.6)	0.21

The type and border of plate were associated with tinea capitis prevalence. In children with large plate, prevalence was 94.8% (OR=16.05 [3.6 - 71.8] p<10-3). Tinea capitis carriage was higher in children with irregular border plate with 76.5% prevalence % (OR=1.5 [0.46 - 5.16] p=0.48). Positive Wood light examination was correlated with the carriage tinea capitis. Prevalence was 76.6% (OR=5.5

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[2.09 - 14.5] p=0.001). The presence of squama and crust was not associated with the prevalence of tinea capitis (Table 5).

Table 5. Risk factors (clinical aspect of the lesions) associated with the prevalence of tinea capitis.

Parameters	Percentage (n/N)	OR (95% CI)	P value
Plate			
Small plate	53.5 (37/71)	1	
Large plate	94.8 (37/39)	16.05 (3.6 - 71.8)	$<10^{-3}$
Plate border			
No border	67.8 (59/87)	1	
Clean border	50 (3/6)	0.47 (0.9 - 2.5)	0.38
Irregular border	76.5 (13/17)	1.5 (0.46 - 5.16)	0.48
Crust			
No	70.1 (61/87)	1	63.3 - 97.5
Yes	60.8 (14/23)	0.66 (0.25 - 1.72)	0.39
Squama			
No	67.5 (27/40)	1	25.9 - 49.5
Yes	68.6 (48/70)	1.05 (0.46 - 2.41)	0.9
Wood			
Negative	37.5 (24/24)	1	
Positive	76.6 (66/86)	5.5 (2.09 - 14.5)	0.001

4. Discussion

Tinea capitis is a common dermatophyte infection of the scalp in the pediatric population. identification of the causal agent allows guiding the appropriate antifungal treatment, which is specific and safe in the pediatric population.

This study was performed to evaluate the prevalence of tinea capitis and its related factors in children living in koranic school in Thiès region in Senegal.

The overall prevalence of tinea capitis was 68.2%. The main species found were Trichophyton soudanense 93.4% and *Microsporum audouinii* 2.7%. *T. mentagrophytes* and *T. violaceum* and the association *T. soudanense* + *M. audouinii* were noted in one patient respectively

The results of our study confirm the endemicity of tinea capitis in children in Senegal which was previously described by others authors.

Badiane et al, when assessing the epidemiological aspects of superficial fungal infection in koranic school have found 90% prevalence of tinea capitis. The most prevalent species were *Trichophyton soudanense* 85.18% and *Microsporum audouinii* 9.25% [19].

NDir et al have noted lower prevalence (3.1%) with *Trichophyton soudanense* 80.8%, *Microsporum audouinii* 18.4% and *Trichophyton violaceum* (0,7%) as main species [18].

When studying the prevalence in school children living in urban and rural area in Mauritania Sy et al have noted 10.5% prevalence of tinea capitis [20].

Coulibaly et al have noted 32% (189/590) prevalence of tinea capitis. *Trichophyton soudanense* and *Microsporum audouinii* were the most fungal identified species with 41.3% and 36.5% [21].

Similar trend was noted in Nigeria with 31.2% prevalence among school children. *Trichophyton soudanense,* 76 (30.6%), followed by *Microsporum ferrugineum,* 19 (7.7%) and *Microsporum audouinii,* 19 (7.7%) were the main fungal species [22].

Trichophyton soudanense has been reported as predominant fungal agent responsible of tinea capitis in Sub-Saharan West Africa. This in line with was noted in our study [9,23,24].

The most frequent species responsible for TC was T. soudanense (93.4%) which is an anthropophilic dermatophyte. Like in others studies performed in Africa T T. soudanense appeared as the most prominent [9,21,25].

Microsporium Audorini var langeronii (21.85%) and *Trichophyton violacum* (3.36%) were also noted. Similar trends were observed in other studies [23,25].

The prevalence of tinea capitis was higher among boys aged over 5 years. These results are in line with were previously reported in early studies [9,23,25,26].

This study found a significant relationship between gender and tinea capitis. Boys were more affected than girls. This was previously described in other surveys [23]. The higher susceptibility of boys may be explained by the fact that boys normally reach puberty later than girls, and sebum acidity may prevent the development of dermatophytes.

The prevalence of tinea capitis was higher among children sleeping on mattress (76%) compared to those sleeping on ground (65.8%). This prevalence increased from 50% for children sleeping on single or two mattresses to 79,1% in children sleeping more than two per mattress. Similar results were noted by Ba et al when assessing the epidemiology of scalp ringworms and superficial fungal infections in schools in Mauritania [27].

5. Conclusions

The present study shows that tinea capitis is endemic among children living in Koranic schools in Thiès, Senegal. The main causative fungal agent is T. Soudanense. The socio-economic conditions such as living conditions could play important role in the transmission. Therefore, further epidemiological studies are needed to better describe the distribution of the disease in urban and rural areas. Molecular identification will allow to better spectrum of pathogens in order to avoid diagnostic errors due to the polymorphism of the colonies of certain species.

Author Contributions: KS: SL conceived and designed the study. ID, SL, supervised the data collection. KS analysed the data. KS wrote the first draft of the manuscript. All authors read and approved the final manuscript.

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Informed Consent Statement: This study was conducted according to the declaration of Helsinki and existing national legal and regulatory requirements. The protocol was reviewed and approved by the institutional review board of the Cheikh Anta Diop university. Approval number 0258/2017/CER/UCAD. Informed consent of parent or legal representative was required prior the participation to the study. To respect the confidentiality, an identification code was given to each participant.

Data Availability Statement: All data generated or analyzed during this study are included in this manuscript and are available from the corresponding author on reasonable request.

Conflicts of Interest: The authors declare that they have no competing interest.

References

1. K. Gupta: R. C. Summerbell, Tinea capitis, *Medical Mycology*, Volume 38, Issue 4, 2000, Pages 255–287, https://doi.org/10.1080/mmy.38.4.255.287
2. Elewski B. Tinea capitis. Dermatol Clin. 1996 Jan;14(1):23-31. doi: 10.1016/s0733-8635(05)70321-1. PMID: 8821154.
3. Hay RJ, Johns NE, Williams HC, et al. The global burden of skin dis- ease in 2010: an analysis of the prevalence and impact of skin condi- tions. *J Invest Dermatol*. 2013;134(6):1-8. https://doi.org/10.1038/ jid.2013.446
4. Borman AM, Campbell CK, Fraser M, Johnson EM. Analysis of the dermatophyte species isolated in the British Isles between 1980 and 2005 and review of worldwide dermatophyte trends over the last three decades. Med Mycol. 2007 Mar;45(2):131-41. doi: 10.1080/13693780601070107. PMID: 17365649.
5. Fuller LC. Changing face of tinea capitis in Europe. Curr Opin Infect Dis. 2009 Apr;22(2):115-8. doi: 10.1097/QCO.0b013e3283293d9b. PMID: 19262376.
6. De Hoog GS, Dukik K, Monod M, et al. Toward a novel multilocus phylogenetic taxonomy for the dermatophytes. *Mycopathologia*. 2017;182(1–2):5-31. https://doi.org/10.1007/s1104 6-016-0073-9
7. Anosike, J. C., Keke, I. R., Uwaezuoke, J. C., Anozie, J. C., Obiukwu, C. E., Nwoke, B. E. B., & Amajuoyi, O. U. (2005). Prevalence and distribution of ringworm infections in Primary school children in parts of Eastern, Nigeria. *Journal of Applied Sciences and environmental management*, *9*(3), 21-26.

8. Cisse M, Diare FS, Kaba A, Magassouba E, Keïta M, Ecra EJ. Les teignes du cuir chevelu dans le service de dermatologie-vénéréologie du C.H.U. de Donka- Conakry, Guinée [Tinea capitis in department of dermatology and venerology in the University hospital of Donka at Conakry, Guinea]. Bull Soc Pathol Exot. 2006 Mar;99(1):32-3. French. doi: 10.3185/pathexo2699. PMID: 16568680
9. Adou-Bryn KD, Assoumou A, Haddad RN, Aka BR, Ouhon J. Epidemiology of tinea capitis in Abidjan, Cote d'Ivoire. Med Trop (Mars). 2004;64(2):171-175
10. Fuller LC. Changing face of tinea capitis in Europe. Curr Opin Infect Dis. 2009 Apr;22(2):115-8. doi: 10.1097/QCO.0b013e3283293d9b. PMID: 19262376.
11. Korstanje MJ, Staats CG. Tinea capitis in Northwestern Europe 1963-1993: etiologic agents and their changing prevalence. Int J Dermatol. 1994 Aug;33(8):548-9. doi: 10.1111/j.1365-4362.1994.tb02892.x. PMID: 7960348
12. Neji S, Makni F, Cheikhrouhou F, Sellami A, Sellami H, Marreckchi S, Turki H, Ayadi A. Epidemiology of dermatophytoses in Sfax, Tunisia. Mycoses. 2009 Nov;52(6):534-8. doi: 10.1111/j.1439-0507.2008.01651.x. Epub 2009 Jan 24. PMID: 19207834.
13. Zaki SM, Ibrahim N, Aoyama K, Shetaia YM, Abdel-Ghany K, Mikami Y. Dermatophyte infections in Cairo, Egypt. Mycopathologia. 2009 Mar;167(3):133-7. doi: 10.1007/s11046-008-9165-5. Epub 2008 Oct 30. PMID: 18972221.
14. Rodríguez-Cerdeira C, Martínez-Herrera E, Szepietowski JC, et al. A systematic review of worldwide data on tinea capitis: analysis of the last 20 years. *J Eur Acad Dermatol Venereol*. 2021;35(4):844- 883. doi:10.1111/jdv.16951
15. Ndiaye M, Diongue K, Seck MC, Badiane AS, Diallo MA, Deme AB, Ndiaye YD, Dieye B, Diallo S, Ndoye NW, Ndir O, Ndiaye D. Profil épidémiologique des teignes du cuir chevelu à Dakar (Sénégal). Bilan d'une étude rétrospective de six ans (2008-2013) [Epidemiological profile of Tinea capitis in Dakar (Senegal). A 6-year retrospective study (2008-2013)]. J Mycol Med. 2015 Jun;25(2):169-76. French. doi: 10.1016/j.mycmed.2015.03.004. Epub 2015 Apr 24. PMID: 25921492.
16. Diop A, Ly F, Diagne F, Ndiaye MT, Seck B, Ndiaye M, Diatta BA, Dieng T, Diallo M, Niang SO, Kane A, Dieng MT. Profil épidémio-clinique et étiologique des teignes du cuir chevelu chez l'adulte à Dakar (Sénégal) [Epidemiological, clinical and etiological profile of tinea capitis in adult patients in Dakar, Senegal]. Ann Dermatol Venereol. 2019 Feb;146(2):100-105. French. doi: 10.1016/j.annder.2018.11.007. Epub 2019 Jan 11. PMID: 30638814.
17. Kane A, Ndiaye D, Niang SO, Ly F, Ndir O, Ndiaye B. Tinea in Senegal: an epidemiologic study. Int J Dermatol. 2005 Oct;44 Suppl 1:24-5. doi: 10.1111/j.1365-4632.2005.02804.x. PMID: 16187953.
18. Dir ON, Gaye O, Faye O, Faye P, Diallo S. Tinea capitis in the Basin of the River Senegal. *J Mycol Med*. 1994;4(4):213-217.
19. Badiane AS, Diongue K, Seck MC, Ndiaye M, Ndiaye D. Epidemiological aspects of superficial fungal infections in Koranic schools in two localities of Senegal (Thies and Touba). Mycoses. 2021 Sep;64(9):1132-1136. doi: 10.1111/myc.13330. Epub 2021 Jun 21. PMID: 34076914
20. Sy O, Diongue K, Ba O, Ahmed CB, Elbechir MA, Abdallahi MSM, Brahim M, Baidy BL, Ndiaye D. Tinea capitis in school children from Mauritania: A comparative study between urban and rural areas. J Mycol Med. 2021 Jun;31(2):101048. doi: 10.1016/j.mycmed.2020.101048. Epub 2020 Oct 13. PMID: 33127320.
21. Coulibaly O, Kone AK, Niaré-Doumbo S, Goïta S, Gaudart J, Djimdé AA, Piarroux R, Doumbo OK, Thera MA, Ranque S. Dermatophytosis among Schoolchildren in Three Eco-climatic Zones of Mali. PLoS Negl Trop Dis. 2016 Apr 28;10(4):e0004675. doi: 10.1371/journal.pntd.0004675. PMID: 27124571; PMCID: PMC4849727.
22. Ayanbimpe GM, Taghir H, Diya A, Wapwera S. Tinea capitis among primary school children in some parts of central Nigeria. Mycoses. 2008 Jul;51(4):336-40. doi: 10.1111/j.1439-0507.2007.01476.x. Epub 2008 Apr 16. PMID: 18422924.
23. Ménan EIH, Zongo-Bonou O, Rouet F, et al. Tinea capitis in schoolchildren from Ivory Coast (western Africa). A 1998–1999 cross-sectional study. Int J Dermatol. 2002;41(4):204-207. PMID: 12031027.
24. Ndiaye D, Ndiaye M, Badiane A, et al. Dermatophyties diagnostiquées au laboratoire de parasitologie et mycologie de l'hôpital Le Dantec de Dakar, entre 2007 et 2011. J Mycol Med. 2013;23:219-224.
25. Hogewoning AA, Adegnika AA, Bouwes Bavinck JN, Yazdanbakhsh M, Kremsner PG, van der Raaij-Helmer EM, Staats CC, Willemze R, Lavrijsen AP. Prevalence and causative fungal species of tinea capitis

among schoolchildren in Gabon. Mycoses. 2011 Sep;54(5):e354-9. doi: 10.1111/j.1439-0507.2010.01923.x. Epub 2010 Jul 19. PMID: 20637052.

26. Emele FE, Oyeka CA. Tinea capitis among primary school children in Anambra state of Nigeria. Mycoses 2008; 51: 536–41.
27. Ba O, Kébé M, Groun SA, Sy O, Sidiya MA, Eibih ABA, Bollahi MA, Ben Abdelaziz A. Epidemiology of scalp ringworms and superficial fungal infections in schools in Mauritania. Tunis Med. 2021 Décembre;99(12):1126-1133. English. PMID: 35288918; PMCID: PMC8974423.