Vol. 14(2), pp. 8-14, July-December 2023
DOI: 10.5897/JYFR2023.0212
Article Number: 55B222571446
ISSN: 2141-2413

http://www.academicjournals.org/JYFR

ACADEMIC JOURNALS
expand your knowledge

Journal of Yeast and Fungal Research

Full Length Research Paper

Epidemiological aspects of tinea capitis among children attending to Koranic schools in Senegal (Thiés)

Khadime Sylla[1]*, Souleye Lelo[1], Ibrahima Diop[1], Cheikh Binetou Fall[1], Issac Akhenaton Manga[1], Magatte Ndiaye[1], Doudou Sow[2], Roger Clement Tine[1] and Babacar Faye[1]

[1]Departement of Parasitology-Mycology, University Cheikh Anta Diop, Dakar, Sénégal.
[2]Service de Parasitologie-Mycologie, Université de Saint Louis, UFR Santé, Sénégal.

Received 7 August, 2023; Accepted 12 October, 2023

Scalp ringworms or tinea capitis are the most common superficial fungal infections of the scalp and hair in the world with high prevalence in pediatric population. This study was to assess the prevalence of tinea capitis and its risk factors among residents of Koranic schools located in the Thiès region of Senegal. A cross-sectional survey was performed from February 2019 to March 2020. Socio-demographic, clinical and biological data were collected using standard questionnaire. Samples collected were examined using direct microscopy and cultured on Sabouraud- Chloramphenicol and Sabouraud-Chloramphenicol-Actidione medium. Risk factors were assessed by multivariate survey logistic regression models. Significance level was 0.05 two-sided. A total of 110 children with mean age of 9 years were included. Study 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)]. Trichophyton soudanense (93.4%) and Microsporum audouinii (2.7%) were main fungal species. Trichophyton mentagrophytes and *Trichophyton violaceum* were found with each (1.3%). Parasitism was endothrix in 86.7%. Prevalence was higher in children aged over 10 years [(72.9%), OR =2.16, CI (0.48 – 9.69)]. Children with irregular-edged plaques were most affected (76.5%). Prevalence was higher among children who slept as more than 3 per mattress (79.1%), OR=1.82 (95% CI: 1.08 - 3.04). These results showed that tinea capitis are frequent in children. *T. soudanense* is the main fungal species. Better knowledge of the epidemiology of these diseases and improved living conditions for children could help improve patient management.

Key words: Tinea capitis, epidemiology, children, Koranic schools, Senegal.

INTRODUCTION

Tinea capitis is the most common dermatophytic infection of the scalp in children under 12 years of age (Bongomin et al., 2021; Coulibaly et al., 2018; Amiri et al., 2020). High prevalence of the disease is related to low socio-economic conditions, high population densities, and poor hygiene practices (Bassyouni et al., 2017). In addition,

*Corresponding author. E-mail: khadimesylla@yahoo.fr. Tel: +221775217644.

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 (Rodriguez-Cerdeira et al., 2021; Charpantidis et al., 2023). The spectrum of species responsible for scalp ringworms and their frequency vary from country to country. Transmission for anthropophilic species occurs through close contact with infected individual. For zoophilic or geophilic dermatophytosis, transmission was acquired through contact with infected animals or contracted from contaminated soil or fomites (Hay, 2017; de Hoog et al., 2017). *Microsporum audouinii* and *Trichophyton soudanense* are predominant species observed in sub-Saharan Africa (Sy et al., 2021; Getso et al., 2021; Coulibaly et al., 2016). *Trichophyton tonsurans* is considered as predominant emerging agent of tinea capitis in occident (Coulibaly et al., 2016). While in North Africa and Asia, *Trichophyton violaceum* is more frequently observed (Rodriguez-Cerdeiraet al., 2021; Dalal et al., 2022). The changing epidemiological profile of fungal agents and the emergence of antifungal resistance are obstacles to the management of scalp ringworm (Rodriguez-Cerdeira et al., 2021). Generally, the diagnosis is based on the clinical aspects of the lesions and the treatment is also administered without mycological confirmation. Clinically, two types of manifestations can be observed: alopecic and inflammatory. Alopecic lesions are usually round-shaped. Microsporic tinea capitis is characterized by the presence of few numbers of lesions which can reach large diameters. Trichophytic lesions are multiple and small. For inflammatory aspects, kerion is characterized by a scaly plaque and intense local inflammatory process with edema, rubor and purulent discharge, evolving many times to cicatricial alopecia. Favus is also an inflammatory lesion characterized by masses resembling yellow, concave crusts (*godet*), with a central hair, with a rat urine smell (Veasey and Muzy, 2018; Gupta et al., 2020).

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 34.51 to 71% (Ndiaye et al., 2015; Diop et al., 2019). The most recent study conducted between 2013 and 2015 found 90% prevalence in 210 children living in Koranic school which are generally characterized by poor hygiene conditions and residents are living in promiscuity (Badiane et al., 2021). Tinea capitis in children in Senegal are frequent but epidemiological data are often scarce. In this context, it becomes relevant to conduct further studies in order to better understand the epidemiology of the diseases in children and the spectrum of pathogens for better case management. The aim of this study was to assess the prevalence of tinea capitis and its related factors in children living in Koranic school.

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 selected from Koranic schools located in the same geographic area. Students who were at the time of the study at one of the targeted schools were included in the study. Two types of students were 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 questionnaire was administered to collect epidemiological, clinical, and biological data. Sociodemographic 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 plaque, type and border of plates, presence of crusts and squama) and the result of WOOD light. Mycological results were also collected using the same questionnaire.

Sample collection

For each child included in the study, samples were collected in sterile Petri dishes. The collection of hairs and scalp scrapings was done from actively growing margins of the lesions using sterile scalpel blades. After sample collection, the Petri dishes were hermetically sealed in order to avoid contamination. All the materials used were 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's dextrose agar supplemented with 0.5 g/L chloramphenicol and (ii) Sabouraud's dextrose agar supplemented with 0.5 g/L chloramphenicol, and 0.4 g/L actidione. Cultures were incubated at 27°C±2 during four weeks. Sample was negative if any growth of pathogen was not noted after four weeks incubation. In case of positive sample, the idenfication of fungal species 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 and 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% for two sides.

Table 1. General characteristic of study participants.

Parameter	Number (n)	Percentage	95% CI
Age group (year)			
Under 5	9	8.2	3.7 - 15.5
5 - 10	64	58.2	44.8 - 74.2
>10	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 soap			
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
Number of children/mattress			
1/mattress	4	4.7	1.3 - 12
2/mattress	38	44.7	31.6 - 61.4
>2/mattress	43	50.6	36.6 - 68.1

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 with 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.

RESULTS

General characteristic of study participants

A total of 110 residents in Koranic school were included. Mean age of participant was 9.4±3 years. Children aged between 5 and 10 years old (58.18%) were more selected. Children under 5 years and those aged over represented 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 was done with a frequency of more than once a month in 74.5%. The children were lying on the mattress in 77.3% and on the floor in 22.7%. Approximately, 50.6% of the children slept with more than 2 persons per mattress (Table 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 (Table 2).

Prevalence of tinea capitis and identified fungal species

Mycological examination was positive in 75 children given a prevalence of tinea capitis of 68.2%. Parasitism was endothrix in 86.7% and endo-ectothrix in 13.3% of cases (Table 3).

The main species found were *T. soudanense* (93.4%)

Table 2. Clinical aspect of lesions.

Parameter	Number (n)	Percentage	95% CI
Plaque			
Small plate	71	64.5	50.4 - 81.4
Large plate	39	35.5	25.2 - 48.5
Plaque 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

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

Parameter	Number (n)	Percentage	95% CI
Results			
Negative	35	31.8	22.2 - 44.4
Positive	75	68.2	53.6 - 85.5
Parasitism			
Endothrix	65	86.7	66.8 – 99.9
Endo-ectothirx	10	13.3	6.5 – 24.5

and *M. audouinii* (2.7%). *T. mentagrophytes* and *T. violaceum* and the association *T. soudanense* + *M. audouinii* were noted in one patient, respectively (Figure 1).

Risk factors associated with the prevalence of tinea capitis

An association between tinea capitis age group, gender and number of children sleeping on mattress was noted. Children aged over 5 years were more affected. The prevalence increased with age. In age group 5 to 10 years, the prevalence was 67.2% (OR=1.63, 95% CI [0.38 - 6.74] p=0.49). In children more than 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 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 in children sleeping on mattresses was 65.8% (Table 4).

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

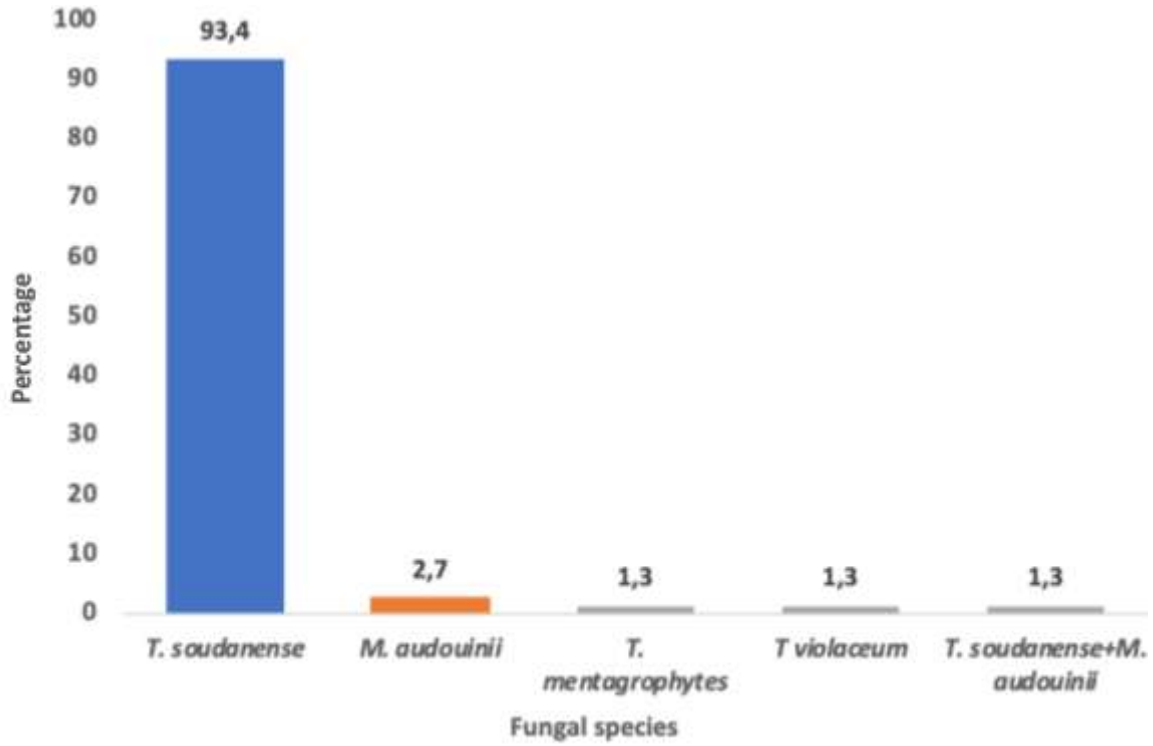

Figure 1. Distribution of differents species.

correlated with the carriage tinea capitis. Prevalence was 76.6% (OR=5.5 [2.09 - 14.5] p=0.001). The presence of squama and crust was not associated with the prevalence of tinea capitis (Table 5).

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 *T. soudanense* 93.4% and *M. audouinii* 2.7%. *Trichophyton mentagrophytes* and *T. violaceum* and the association *T. soudanense* + *M. audouinii* were noted in one patient, respectively.

The results of the present study confirm the endemicity of tinea capitis in children in Senegal which was previously described by other authors. Badiane et al (2021), when assessing the epidemiological aspects of superficial fungal infection in Koranic school found 90% prevalence of tinea capitis. The most prevalent species were *T. soudanense* 85.18% and *M. audouinii* 9.25% (Coulibaly et al., 2016). When studying the prevalence in school children living in urban and rural area in Mauritania, Sy et al (2021) noted 10.5% prevalence of tinea capitis. Coulibaly et al (2016) noted 32% (189/590) prevalence of tinea capitis. *T. soudanense* and *M. audouinii* were the most fungal identified species with 41.3 and 36.5% (Coulibaly et al., 2016).

Ba et al (2021) reported high prevalence of tinea capitis (52.5%) in school children in Mauritania. *T. soudanense* (23.5%), *Trichophyton rubrum* (15.0%), and *Microsporum langeronii* (8.1%) were the main fungal species (Wiegand et al., 2016).

T. soudanense has been reported as predominant fungal agent responsible for tinea capitis in sub-Saharan West Africa. This was noted in our study (Ndiaye et al., 2015; Diop et al., 2019; Badiane et al., 2021; Ba et al., 2021).

M. audouinii var langeronii (21.85%) and *T. violaceum* (3.36%) were also noted. Similar trends were observed in Nigeria (Getso et al., 2021). *T. violaceum* (56.6%) and *M. audouinii* (13%) were noted as the main fungal agents of tinea capitis in Uganda (Wiegand et al., 2016).

The prevalence of tinea capitis was higher among boys aged over 5 years. These results are in line with those previously reported in early studies (Kallel et al., 2017; Adesiji et al., 2019).

This study found a significant relationship between gender and tinea capitis. Boys were more affected than girls. This was previously described in other surveys (Sy et al., 2021; Badiane et al., 2021; Ba et al., 2021). The

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

Parameter	Percentage (n/N)	OR (95% CI)	P value
Age group (years)			
<5	55.6 (5/9)	1	
5 - 10	67.2 (43/64)	1.63 (0.38 - 6.74)	0.49
>10	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			
Ground	76 (19/25)	1	
Mattresses	65.8 (56/85)	0.61 (0.22 - 1.69)	0.43
Nomber of children/mattress			
1/mattress	50 (2/4)	1	
2/mattress	52.6 (20/38)	1.1 (0.14 - 8.72)	0.92
>2/mattress	79.1 (34/43)	3.7 (0.46 - 30.6)	0.21

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 (Mayser et al., 2020; Sardana et al., 2021).

The prevalence of tinea capitis was higher among children sleeping on a mattress (76%) than among those sleeping on the floor (65.8%). This prevalence increased from 50% for children sleeping on one or two mattresses to 79.1% among children sleeping more than two per mattress. Similar results were noted by Ba et al (2021) when assessing the epidemiology of scalp ringworms and superficial fungal infections in schools in Mauritania.

Conclusion

The present study shows that tinea capitis is endemic among children living in Koranic schools in Thiès, Senegal. *T. soudanense* is the predominant species. Living conditions could play important role in the transmission. 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.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENTS

The authors thank the study population and teachers of the Koranic schools. They appreciate the staff of the Laboratory of Parasitology at Fann University Hospital. This study was funded by the Department of Parasitology-Mycology, University Cheikh Anta Diop of Dakar, Senegal.

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

Parameter	Percentage (n/N)	OR (95% CI)	P value
Plaque			
Small plaque	53.5 (37/71)	1	
Large plaque	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

REFERENCES

Adesiji YO, Omolade FB, Aderibigbe IA, Ogungbe O, Adefioye OA, Adedokun SA, Adekanle MA, Ojedele R (2019). Prevalence of Tinea Capitis among Children in Osogbo, Nigeria, and the associated risk factors. Diseases 7(1):13.

Amiri M, Furia FF, Bakari M (2020). Skin disorders among children living in orphanage centres in Dar es Salaam, Tanzania. Tropical Medicine and Health 48:1-7.

Ba O, Kébé M, Groun SA, Sy O, Sidiya MA, Eibih ABA, Bollahi MA, Ben Abdelaziz A (2021). Epidemiology of scalp ringworms and superficial fungal infections in schools in Mauritania. Tunisie Medicale 99(12):1126-1133.

Badiane AS, Diongue K, Seck MC, Ndiaye M, Ndiaye D (2021). Epidemiological aspects of superficial fungal infections in Koranic schools in two localities of Senegal (Thies and Touba). Mycoses 64(9):1132-1136.

Bassyouni RH, El-Sherbiny NA, Abd El Raheem TA, Mohammed BH (2017). Changing in the Epidemiology of tinea capitis among school children in Egypt. Annals of Dermatology 29(1):13-19.

Bongomin F, Olum R, Nsenga L, Namusobya M, Russell L, de Sousa E, Osaigbovo II, Kwizera R, Baluku JB (2021). Estimation of the burden of tinea capitis among children in Africa. Mycoses 64(4):349-363.

Charpantidis S, Siopi M, Pappas G, Theodoridou K, Tsiamis C, Samonis G, Chryssou SE, Gregoriou S, Rigopoulos D, Tsakris A, Vrioni G (2023). Changing Epidemiology of Tinea Capitis in Athens, Greece: The Impact of Immigration and Review of Literature. Journal of Fungi 9(7):703.

Coulibaly O, Kone AK, Niaré-Doumbo S, Goïta S, Gaudart J, Djimdé AA, Piarroux R, Doumbo OK, Thera MA, Ranque S (2016). Dermatophytosis among school children in three eco-climatic zones of Mali. PLoS Neglected Tropical Diseases 28;10(4):e0004675.

Coulibaly O, L'Ollivier C, Piarroux R, Ranque S (2018). Epidemiology of human dermatophytoses in Africa. Medical Mycology 56(2):145-161.

Dalal A, Chawla S, Vohra P, Sangwan J (2022). Clinico-mycological profile and trichoscopic findings among pediatric tinea capitis patients: A cross-sectional study from Northern India (Haryana). Asian Journal of Medical Sciences 13(10):126-132

de Hoog GS, Dukik K, Monod M, Packeu A, Stubbe D, Hendrickx M, Kupsch C, Stielow JB, Freeke J, Göker M, Rezaei-Matehkolaei A, Mirhendi H, Gräser Y (2017). Toward a novel multilocus phylogenetic taxonomy for the dermatophytes. Mycopathologia 182(1-2):5-31.

Diop A, Ly F, Diagne F, Ndiaye MT, Seck B, Ndiaye M, Diatta BA, Dieng T, Diallo M, Niang SO, Kane A, Dieng MT (2019). Epidemiological, clinical and etiological profile of tinea capitis in adult patients in Dakar, Senegal. Annales de Dermatologie et de Vénéréologie 146(2):100-105.

Getso MI, Hashemi SJ, Ghazvini RD, Yusuf SM, Khodavaisy S, Gerami-Shoar M, Kibiya FS, Aliyu UT, Sarvestani HK, Aliyu M (2021). Determination of dermatophytes isolated from tinea capitis using conventional and ITS-based sequencing methods in Kano, Nigeria. Journal of Medical Mycology 31(3):101157.

Gupta AK, Friedlander SF, Simkovich AJ (2022). Tinea capitis: An update. Pediatric Dermatology 39(2):167-172.

Hay RJ (2017). Tinea Capitis: Current Status. Mycopathologia 182(1-2):87-93.

Kallel A, Hdider A, Fakhfakh N, Belhadj S, Belhadj-Salah N, Bada N, Chouchen A, Ennigrou S, Kallel K (2017). Tinea capitis: Main mycosis child. Epidemiological study on 10years. Journal of Medical Mycology 27(3):345-350.

Mayser P, Nenoff P, Reinel D, Abeck D, Brasch J, Daeschlein G, Effendy I, Ginter-Hanselmayer G, Gräser Y, Hipler UC, Höger P, Kolb-Mäurer A, Ott H, Schaller M, Zidane M (2020). S1 guidelines: Tinea capitis. Journal of German Society of Dermatology 18(2):161-179.

Ndiaye M, Diongue K, Seck MC, Badiane AS, Diallo MA, Deme AB, Ndiaye YD, Dieye B, Diallo S, Ndoye NW, Ndir O, Ndiaye D (2015). Epidemiological profile of tinea capitis in Dakar (Senegal). A 6-year retrospective study (2008-2013). Journal de Mycologie Médicale 25(2):169-176.

Rodriguez-Cerdeira C, Martinez-Herrera E, Szepietowski JC, Pinto-Almazan R, Frias-De-Leon MG, Espinosa-Hernandez VM, Chavez-Gutierrez E, Garcia-Salazar E, Vega-Sanchez DC, Arenas R, Hay R, Saunte DM (2021). A systematic review of worldwide data on tinea capitis: analysis of the last 20 years. Journal of the European Academy of Dermatology and Venereology 35(4):844-883.

Sardana K, Gupta A, Mathachan SR (2021). Immunopathogenesis of Dermatophytoses and Factors Leading to Recalcitrant Infections. Indian Dermatology Online Journal 12(3):389-399.

Sy O, Diongue K, Ba O, Ahmed CB, Elbechir MA, Abdallahi MSM, Brahim M, Baidy BL, Ndiaye D (2021). Tinea capitis in school children from Mauritania: a comparative study between urban and rural areas. Journal of Medical Mycology 31(2):101048.

Veasey JV, Muzy GSC (2018). Tinea capitis: correlation of clinical presentations to agents identified in mycological culture. Annal Brazilian of Dermatology 93(3):465-466.

Wiegand C, Mugisha P, Mulyowa GK, Elsner P, Hipler UC, Gräser Y, Uhrlaß S, Nenoff P (2016). Trichophyton violaceum: Main cause of tinea capitis in children at Mbarara Regional Referral Hospital in Uganda. Hautarzt 67(9):712-717.