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Research Article

Prevalence of Tinea Capitis among Children Attending Some Islamiyya Schools in Kaduna Metropolis, Kaduna State, Nigeria

Abdu, M.[1], Musa, F. M.[2]. and Yahya, H.[3]

[1,2]Department of Microbiology, Kaduna State University, Kaduna State, Nigeria
[3]Department of Internal Medicine, College of Medicine, Kaduna State University, Kaduna State, Nigeria
***Corresponding Author's email*: abdumohammed03@gmail.com; Phone: +2347031356035**

ABSTRACT
The Tinea capitis is a mycosis caused by pathogenic fungi known as dermatophytes, which is reported more among children than adults globally. It is also called 'ringworm' not because it is caused by a parasitic worm but due to the appearance of circular form on the infected scalp of an individual. A cross-sectional study was conducted to determine the prevalence, causes and socioeconomic factors related to Tinea capitis among children in some selected Islamiyah schools in Kaduna metropolis, Kaduna State, Nigeria. A total of 400 children were screened for Tinea capitis via culture and microscopy. The overall prevalence of Tinea capitis among the children was 29.3%. *Trichophyton mentagrophytes* was the most prevalent (10.8%), followed by *Microsprorum canis* (5.0%) and *Trichophyton rubrum* (5.0%). Other dematophytes included Trichophyton *tonsurans* (2.5%), *Trichophyton violaceum* (1.8%), *Microsprorum audoinii* (1.8%), but the lowest occurring was *Trichophyton schoenleinii* (1.0%) and *Epidermatophyton floccosum* (0.5%). Antifungal susceptibility was carried out with three (3) antifungal agents, including itraconazole, terbinafine and griseofulvin. All the isolates were sensitive to itraconazole, 22 isolates of *T. Mentagrophytes* were sensitive to terbinafine; while 21 isolates of *T. mentagrophytes* were resistant to terbinafine. Some of the isolates were sensitive to griseofulvin while others were resistant to griseofulvin. Four (4) isolates of *T. rubrum* were resistant to terbinafine; while twenty (20) isolates were sensitive to both itraconazole and griseofulvin, and sixteen (16) isolates were sensitive to terbinafine. This suggests the high propensities of spread of Tinea capitis through human to human and animal contact.

Keywords: Dermatophytosis; Dermatophyte; Characterization; Isolation; Predisposing Factors; Susceptibility

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INTRODUCTION

Ringworm is an infection caused by fungi known as dermatophytes (Zucker *et al*., 2024). It is called ringworm not because it is caused by a parasitic worm but due to the appearance of circular form on the infected person or structure presented on anatomic sites of infected person which is medically known as Tinea (Amiri *et al*., 2022). Tinea capitis is an infection that affects the hair of the scalp. The infection mostly affects the scalps and hair of toddlers and school-aged children. The infection manifests with clinical presentations such as patches on the scalp with swollen edges and redness, itchy scaly skin, dried with rashes and loss of hair (Shaw *et al*., 2022). There are different types of Tinea infections that affect anatomical human body. Tinea pedis (on the foot) affects mostly farmers and children who harboured the pathogen by walking barefooted or by using

contaminated materials such as socks, cover shoes or by swimming in pools used by an infected person (Nenoff *et al*., 2021). Tinea cruris (on the groin area) presents with itchy dry skin, patches on the infected site, inflammation. Other Tinea infections are Tinea capitis (on the scalp), Tinea unguium (most often on toe nail than finger nail) which causes thickening and yellowing of the nail, and Tinea coporis (on the body) with characteristic red, circular lesion and itching at the infected site (Mark *et al.,* 2022). Accurate diagnosis is essential for identifying the aetiological agent and in improving the prescription of therapeutic strategies suitable for each case. This relies on clinical aspects combined with conventional methods, such as culture and microscopy, with the aim of evaluating fungal morphology and physiology.

MATERIALS AND METHODS

Study Population and Area

The study population comprised of children from selected Islamiyyah schools in two Local Government Areas (LGAs) within Kaduna metropolis. The selected schools in Kaduna south LGA were Madrasatul Rafiddin Islamiyyah in Tudun Wada and Mu'azu Bin Jabir in Badikko. In Kaduna North LGA, the selected schools were Amash Islamiyyah in Hayin Banki and Madrasayul Salamatul Littahdil Qur'an Watarbiyatul Aulad in Ungwar Rimi. From Igabi LGA, the selected schools were Uthman Bin Affan Islammiyya in Rigasa and Imamul-Malik Islamiyyay in Hayin Malan Bello; while from Chikun LGA, Mu'azu Bin Abubakar Sadiq Islammiyya in Nasarawa area and Attas-Heel Islamiyya in Millennium City were selected.

Ethical Approval

An ethical approval was obtained from the ethical committee of the Ministry of Health Kaduna State. Approval to perform this study was also obtained from the heads of selected Islamiyyah schools. Letters were sent to parents/guardians of the pupils for permission to enrol them into the study. Only children whose parents/guardians granted informed consents were included in the study and had the right to withdraw their consent at any time.

Inclusion Criteria

Only children whose parents or guardians issued written informed consent were allowed to participate in the study. Only Islamiyyah school children between 3 -14 years old with clinical features of Tinea capitis were included in the study.

Exclusion Criteria

Children <3 years of age and greater than 14 years old were excluded from the study. Also, children on any medication for Tinea capitis in the last 30 days, as well as those using shampoo for hair wash were excluded from the study.

Determination of Sample Size

The sample size was calculated using the formula as described by (Daniel, 1999):

$n = \frac{Z^2 P(1-P)}{d^2}$

where:

n = minimum sample size

P = Prevalence of tinea capitis 45% (0.45) as reported by Dogo (2019).

Z = A statistic corresponding to level of confidence 1.96% at 95%. The result deviated for 5% from the true population,

D = precision (d) would be 0.05 or 5%.

$n = \frac{1.96^2 X 0.45(1-0.45)}{0.05^2}$

n = 380 (rounded up to hundred 400)

Sampling Technique

Random sampling techniques were used to select the Islamiyyah schools in the study areas, using Microsoft excel. The participants for the study were selected by random number sampling from the comprehensive list of children in each Islamiyyah schools. In every selected school the lists of targeted children 3-14 years were collected and automatically arranged in alphabetical order. Code numbers were assigned to the children.

Collection of Samples

Every child was examined in a well-lit room for lesions on the scalp, scaly grey particles and loss of hairs (Akinboro *et al*., 2022). The site of infection was cleared with 70% alcohol, followed by the collection of scalp scrapings from the site of the lesions using sterile scalpel blades (Ayanlowo *et al*., 2022). The samples were transported to the laboratory and temporary placed in a refrigerator at 4-5^0 C. Structured questionnaires were administered to gather socio-demographic data of the children and their exposure to some risk factors of the infection with the help of their parents or guardians.

Isolation of the Dermatophytes

A portion of each sample was placed on a slide and a drop of an aqueous solution of 10% (w/v) potassium hydroxide (KOH) was added. After 5 min, the wet

mount was examined under low (10×) and high (40×) power magnification for the presence of fungal elements such as arthrospores (arthroconidia, macro and/or microconidia and chlamydospores). Each of the samples was cultured on Potato Dextrose Agar (PDA) with 0.05 mg of chloramphenicol and 0.05 mg of cycloheximide. The PDA was prepared by dissolving 65 g in one liter of distilled water. The resulting medium was autoclaved at 95 C for 15 min and then allowed to cool to a temperature of 43°C. Thereafter, 15–20 mL of the molten agar medium was poured into each sterilized Petri dish and allowed to solidify. The agar was inoculated by transferring some of the hair scales to the surface of the medium using a sterile wire loop and forceps. The plates were labeled and then incubated for three weeks at 27–30 °C, aerobically, for at least 3 weeks before being discarded as a negative result. Further identification after the growth of the dermatophytes was established; the sub-culture was also made on Potato Dextrose agar. The mycelium and spore characteristics were noted. The identification of the dermatophytes from the positive cultures was based on the colonial characteristics in pure culture and the microscopic morphology of fungi using lactophenol blue, which includes the presence of conidia (macro and micro) and the microscopic appearance of the conidia.

Antifungal susceptibility Test

Susceptibility testing to antifungal drugs were carried out using itraconazole (10µg), terbinafine (2µg), and griseofulvin (25µg), were diluted with distilled water and prepared inoculum for susceptibility testing were obtained by using Kirby-bauer well dilution method from the Potato dextrose agar plate, dermatophytes fungal density of $3x10^6$ organisms per millimetre were obtained as determined by McFarland standard scale number 1. The inocula were aseptically streaked on PDA with sterile wire loop and 0.5ml of antifungal drugs were inserted in to the well. The plates were incubated at 30^{oc} for 3 days but every day, the plates were checked for observation, the culture plates were examined for the evidence of inhibition concentration zone. A ruler meter was used to take the zones inhibition growth Clinical Laboratory Science Institute (CLSI, 2008). The probable isolates were recorded as Sensitive (S), Resistant (R), and Intermediate (I) to antifungal drugs, by compared with the standard value was recommended according to by Clinical Laboratory Science Institute (CLSI).

Data Analysis

Data obtained from this study were analyzed using SPSS Inc. (IBM version 23) (IBM Corp, Armonk, NY, USA). Significant differences between variables were determined using chi-square and p- value

RESULTS

Table 1 presents the socio-demographic characteristics of Islamiyya pupils. Two-fifth of the pupils (44.3%) were within the age group of 6-10 years. Majorities were in the class 1-6 (77.7%). Mother's highest level of education was Islamiyya/ Qur'anic school (26.0%) and the father's highest level of education was tertiary school (40.3%). Female pupils had higher proportion (51.0%) than the male (49.0%). Subjects from families with 1-10 children had higher infection (87.0%) than those over 10 children (12.5%).

Regarding the result of Table 2 present study showed that less than half of the Islamiyya pupils (31.7%) had their bath more than once daily, while 60.5% shared combs with other peoples. Majority of the Islamiyya pupils used soap for bath. Most of the male performed hair cut at home/ wanzami (63.7%), while 36.3% of them shaved at barbing saloon. About 74.7%shared bed with other peoples, while 40.7% shared caps/ hijab with other peoples. About 42.7% shared clothes/towels with other people, while 51.5% changed uniform daily and 18.7% changed uniform more than twice weekly.20.5% of the pupils who played with animal had Tinea capitis compared to 44.5% of those who do not (P=0.001), while 79.4?% of those that played with sand had tinea capitis compared to 55.5% of those that do not played with sand (P=0.001).

Table 1: Socio-demographic Characteristics of Islamiyya Pupils

Variable	Frequency (n=400)	Percentage (%)	p-value
Age Group			
3 -5 years	84	21.0	
6 - 10 years	177	44.3	0.014*
11 - 14 years	139	34.7	
Gender			
Male	196	49.0	
Female	204	51.0	0.883
Mother's level of education			
Raudh	89	22.3	
1 – 6	311	77.7	0.993
Number of children in the house			
1 -10	350	87.5	
Above 10	50	12.5	0.040*
Father's level of education			
Islamiyya/Qur'anic	74	18.5	
Primary	66	16.5	0.001*
Secondary	99	24.7	
Tertiary	161	40.3	
Mother's level of education			
Islamiyya /Qur'anic	104	26.0	
Primary	78	19.5	
Secondary	143	25.8	0.015*
Tertiary	75	18.8	

Keys: n = Number, *Significantly different

Table 2: Socio-demographic Data and other Predisposing Factors in Relation to Tinea Capitis in Kaduna Metropolis, Kaduna state, Nigeria

Variable (n = 400)	Number examined	Percentage (%)	p-value
Place for haircut			
Home/Wanzami	255	63.7	
Barbing saloon	145	36.3	0.581
Sharing of bed			
Yes	299	74.7	
No	101	25.3	0.016*
Sharing of combs			
Yes	242	60.5	
No	158	39.5	0.785
Sharing of caps/hijabs			
Yes	163	40.7	
No	237	59.3	0.603
Sharing of clothes/towels			
Yes	171	42.7	
No	229	57.3	0.008*
Frequency of bathe			
Daily	273	68.3	
More than once	127	3.1.7	0.86
Use of soap to bath			
Yes	348	87.0	
No	52	13.0	0.04*
Frequency of changing school uniform			
Daily	206	51.5	
Once every week	56	14.0	
Twice every week	63	15.8	0.001*
More than twice weekly	75	18.7	
Frequent play item			
Animal	24	20.5	
Sand	93	79.5	0.001*

*Significantly different

Table 3 presents the prevalence and distribution of Tinea capitis among Islamiyya pupils. The infection occurred highest among children at Uthman bin Affan (17.9%), followed by those from Madrasatul Faffidin Islamiyya (16.0%), Amas Islamiyya school (15.4%), Imamul malik (14.0%), Mu'azu bin Abubakar Sadiq

(11.1%) and Mu'azu bin Jabir (10.3%), while the least infection was among children from Attas-heel Islamiyya (6.8%).

Table 4 presents the prevalence of the dfferent dermatophytes among the children with Tinea capitis. *Trichophyton mentagrophytes* was the most prevalent dermatophyte (10.8 %), followed by 5.0% each for *Microsporum canis* and *Trichophyton rubrum*. Other dermatophyes isolated were *Trichophyton tonsurans* (2.5 %), *Microsporum audouinii* (1.8 %), *Trichophyton violaceum* (1.8 %); while the lowest was *Epidermatophyton foccosum* (0.5 %).

Table 5 presents the antifungal susceptibility of the dermatophytes isolated from the children with Tinea capitis to the three antifungal agents. All the isolates were sensitive to itraconazole, 22 species of *T. mentagrophytes* were sensitive to terbinafine; while 21 isolates of *T. mentagrophytes* were resistant to terbinafine. Some of the isolates were sensitive to griseofulvin, while others were resistant to griseofulvin. Four (4) isolates of *T. rubrum* were resistant to terbinafine, while twenty (20) isolates were sensitive to both itraconazole and griseofulvin. sixteen (16) isolates were sensitive to terbinafine. Six (6) isolates of *T. tonsurans* were sensitive to itraconazole, 5 isolates were sensitive to terbinafine, 8 isolates were sensitive to griseofulvin. However, some of the dermatophye isolates were resistant to terbinafina, itraconazole and griseofulvin. All the isolates of *T. violaceum* were sensitive to itraconazole, terbinafine and griseofulvin. The most common antifungal therapy used in this study to achieve "clearance" or "cure" was itraconazole, followed by terbinafine and the least was griseofulvin.

Table 3: Distribution of Tinea capitis among the pupils based on their schools in Kaduna Metropolis

LGAs	Islamiyya Schools Pupils	No. Screened	No. infected with Tinea capitis (%)
KS	MRI	50	19(38.0)
	MBJ	50	12(24.0)
KN	MSQ	50	10(20.0)
	AIS	50	18(36.0)
CH	ATI	50	08(1.60)
	MAS	50	13(26.0)
IG	UBI	50	21(42.0)
	IMM	50	16(32.0)
Total		**400**	**177**
Prevalence			**29.3**

Keys: No. = Number; KS = Kaduna South; MRI = Madrasatul Rafidin Islamiyya; KN = Kaduna North, MBJ = Mu'azu bin Jabir**;** CH = Chikun; MSQ = Madrasatul Salamatu littabdil Qur'an IG = Igabi; AIS = Amas Islamiyya; ATI = Attas-heel Islamiyya; MAS = Mu'azu bin Abubakar Sadiq; UBI = Uthman Bin Affan Islamiyya; IMM = Imamu Malik Islamiyya.

Table 4: Prevalence of dermatophytes among the children with Tinea capitis

Dermatophyte (n = 400)	Frequency	Prevalence (%)
Epidermatophyton floccosum	2	0.5
Microsporum audounii	7	1.8
Microsprorum canis	20	5.0
Microsporum ferrugineum	4	1.0
Trichophyton mentagraphtes	43	10.8
Trichophyton rubrum	20	5.0
Trichophyton schoelumi	4	1.0
Trichophyton tonsurans	10	2.5
Trichophyton violaceum	7	1.8

Table 5: Antifungal susceptibility of dermatophytes isolated from children with Tinea capitis

Dermatophytes	ITR			TER			GRI		
	S	I	R	S	I	R	S	I	R
E. floccosum	2	0	0	2	0	0	2	0	0
IZD (mm)	23	20	14	28	21	19	32	26	18
M. audoinii	7	0	0	7	0	0	7	0	0
IZD (mm)	25	17	14	27	21	17	33	23	14
M. canis	20	0	0	20	0	0	20	0	0
IZD (mm)	30	18	6	31	21	7	30	24	10
M. ferrugineum	0	0	4	4	0	0	4	0	0
IZD (mm)	20	17	6	28	24	6	33	25.5	6
T. meutagrophytes	43	0	0	22	0	21	40	0	3
IZD (mm)	25	17	6	28	22	18	34	24	6
T. rub rum	20	0	0	16	0	4	20	0	0
IZD (mm)	26	20.5	6	28	19.5	11	33	20	6
T. schoenleinii	0	0	4	0	0	4	4	0	0
IZD (mm)	20	18	6	23	20.4	8	33	25	16
T. tonsurans	6	1	3	5	0	5	8	0	2
IZD (mm)	25	17	10	28	19.2	6	33	20	27
T. violaceum	7	0	0	7	0	0	7	0	0
IZD (mm)	30	15.5	10	28	20	18	35	25	6

Keys: S = Number of sensitive isolates, R = Number of resistant, I = Number of inter mediate, ITR= Itraconazole (10 µg), TER= Terbinafine (2µg), GRI = Griseofulvin (25 µg), IZD = inhibition zone diameter, MM = millimeter, µg = microgram

ITR (S = ≥ 22, I = 21-15, & R = ≤15)

TER (S = ≥ 26, I = 26-20 & R = ≤20)

GRI (S = ≥ 31, I = 26-31& R = ≤ 26)

(CLSI, 2008; European Committee on Antimicrobial Susceptibility, EUCAST (2024)

DISCUSSION

Tinea capitis has shown to be a major public health challenge among children in Nigeria and worldwide and this has again been demonstrated in this study were the prevalence of Tinea capitis among Islamiyya school pupils is 29.3%. This was found to be higher when compared to a similar study done in an urban community of Ile-ife Osun State (Nweze, 2022) with the prevalence of 21.7%, which might be suggestive of an increase in the prevalence of the disease over the years. It is also higher compared to studies done in Ile-ife (Ajao *et al*., 2020) with a prevalence of 14.0% and in eastern Nigeria who found a prevalence of 9.4% (Enendu *et al*., 2023), which could probably be due to difference in geographical location for the study. However, the prevalence of this study was higher than those obtained in other studies: 9.5% for study carried out on 2150 Qur'anic scholars in Kano State (Nweze, 2022), 15.4% for a study on 604 children in a rural settlement in southwestern Nigeria (Ayanlowo *et al*., 2022), and 9.4% for a study in Anambra State involving 47723 children (Emele *et al*., 2020). The prevalence of Tinea capitis from our study was found to be lower than that by Dogo *et al*. (2019) in the community of a Nok, Kaduna State among school children 5 to 15 years with a reported prevalence at 45%.

The present study assessed Islamiyya school children who were within the age 3 to 14 with the most being between 4–7 years old which is the range purported to have the highest prevalence as reported by Nweze (2022).

Dermatophytes were isolated and identified as the cause of Tinea capitis amongst the children attending Islamiyya schools in Kaduna Metropolis, Kaduna State, Nigeria. The infection was most prevalent among children aged 3–14 years. The dermatophytes that were isolated, in the order most prevalent, were *T. mentagrophyte, M. canis, T. rubrum, T. tonsurans, M. audouinii, T. violaceum, T. schoeileinii, M. ferrugineum and E. flocussum*. The most prevalent dermatophytes causing Tinea capitis in this study were slightly different from those found in other studies that were also conducted in Kaduna Metropolis, Kaduna State, Nigeria. A particular study in Nok community, Kaduna State, Nigeria, a town in the same state where our study was carried out, isolated *Trichophyton rubrum* as the most prevalent

organism among pupils (Dogo *et al.*, 2019). Similarly, this study isolated *Trichophyton rubrum* among the most prevalent dermatophytes. However, the most occurring dermatophyte in our study, *T. mentagrophytes*, has also been the most isolated organism among children with Tinea capitis infection in certain parts of Northern Nigeria, following a study among school children in Anambra State, Nigeria. Another peculiar finding in this study is the isolation of *T. violaceum* which we found in seven of the pupils. This particular dermatophyte has been said to be rarely isolated in Africa ((AL-Janabi *et al.*, 2023), although another study has shown that this fungus has been isolated in another region in Nigeria (Nweze, 2022). This shows that *T. violaceum* may be an emerging cause of dermatophyte infections in regions of the world where it was thought to be rare (AL-Janabi *et al.*, 2023). Tinea capitis was more prevalent in children between the ages of 6 and 10 years. This is similar to findings by other studies, such as the study by (George *et al*., 2022), which reported that most of the infected children were below the age of ten years (George *et al*., 2022). These results support the suggestions that dermatophytosis, especially Tinea capitis, is predominantly a pre-pubertal disease.

Regarding gender distribution, the infection was found to be more prevalent among female pupils. A plausible explanation could be that male pupils and their parents/guardians were more conscious of their appearance than the female, as suggested in some previous studies (Yazdanfar, 2020). Our study showed a significant association between the infection and factors such as bathing with soap, irregular changing of uniform, playing with animals and sand, and the sharing of combs, caps and headscarves.

In the second phase of this study, *in vitro* antifungal susceptibility tests revealed variable patterns. Griseofulvin was the most effective antifungal against all fungal species. Due to the limited availability of antifungal susceptibility tests in many laboratories, dermatophytic infections are often treated without antifungal susceptibility tests. However, studies have demonstrated an increasing antifungal resistance among dermatophytes over time (Arendrup, *et al*., 2021).

CONCLUSION

The overall prevalence of Tinea capitis among the children in this study was 29.3%. *Trichophyton mentagrophytes*, *Trichophyton rubrum* and *Microsprorum canis* were the most prevalent dermatophytes. Age, school class, level of education of parents, infrequent bath, sharing of beds, and sharing of clothes were significantly associated with Tinea capitis among the children ($P<0.05$). The dermatophyte isolates were most susceptible to itraconazole with variable susceptibilities to terbinafine and griseofulvin.

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