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Prevalence of *Tinea capitis* among Primary School Children of a Rural Community in Gombe, Nigeria, and Associated Predisposing Factors

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Abstract

Tinea capitis, an infection of the scalp and hair shaft, is increasingly prevalent worldwide among children aged between six months and pre-pubertal age. This descriptive cross-sectional study aimed to assess the prevalence, identify causative agents, and the predisposing factors for Tinea capitis infection among primary school children of a rural community in Gombe, Nigeria. Scalp and hair scrapings were collected from school children with a clinical diagnosis of T. capitis for microscopic examination and fungal culture. Relevant information for investigating predisposing factors was collected using a well-structured questionnaire. Out of the 60 samples collected, the mycological analysis of 58 samples revealed dermatophyte presence, while 2 samples were contaminated with Aspergillus niger. The prevalent fungi included Trichophyton mentagrophyte (25%), Microsporum canis (20%), Trichophyton rubrum (13.3%), Microsporum gypseum (11.6%), Trichophyton schoenleinii (10%), Trichophyton verrucusum (8.3%), Trichophyton tonsurans (8.3%) and Aspergillus niger (3%). Common predisposing factors identified were sharing combs, towels, bed sheets and close contact with household pets. Additionally, low socioeconomic status, overcrowding in mud houses, and poor hygiene practices emerged as determinants of Tinea capitis transmission among children. In light of these findings, the study underscores the need for comprehensive health promotion and educational interventions, emphasizing personal hygiene and the importance of proper living conditions.

Keywords: Prevalence, Tinea capitis, Primary School, Predisposing factors

INTRODUCTION

Tinea capitis is a superficial mycosis characterized by fungal infection affecting the skin of the scalp, eyebrows, and eyelashes, particularly targeting hair shafts and follicles. Dermatophytes belonging to *Trichophyton* and *Microsporum* genera primarily cause *T. capitis* and are transmitted through direct contact with organisms from anthropophilic (Humans), zoophilic (Animals), geophilic (Soil), or indirectly through fomites: hats, hairbrushes (Ahmad and Crane 2023). Global evidence highlights a substantial burden of serious fungal infections, particularly affecting school-age children in Africa, with reported prevalence ranging from 10-30% (Ayodele *et al.*, 2021). Studies in Nigeria's northern states also showed *Tinea capitis*'s prevalence in primary schools (Muhammad et al., 2021). Some contributing factors to the high prevalence of tinea capitis among children in developing nations encompass inadequacies in social, economic, healthcare, and hygiene practices. These include suboptimal living conditions, interaction patterns, poor sanitation, overcrowding, limited water supply, and the use of contaminated personal items. Susceptibility is heightened among children with pets, wet skin conditions, skin injuries, and those utilizing public showers, being barefoot, or sharing personal items (Ndako *et al.*, 2012). Notably, the prevalence is elevated among pre-pubertal children, particularly in the age group of 5 to 10 years, and is more pronounced in economically challenged families with multiple children (Hay, 2017; Vishnu-Sharma *et al.*, 2015).

The clinical manifestations of *T. capitis* vary based on factors such as the infecting organism, host inflammatory response, and the type of hair infection. Zoophilic infections, in particular, present distinctive patterns, including non-inflammatory seborrheic dermatitis and the inflammatory type known as kerion celsi (Bennassar and Grimalt 2010).

The consequences of *Tinea capitis* extend beyond the physical, impacting students' psychological well-being due to disfigurement, social stigma, and distraction during lessons.

Furthermore, the contagious nature of the disease can result in mental stress and anxiety among affected individuals, with the epidemic potential to spread if conducive environmental and human factors prevail.

In light of these considerations, this study aimed to investigate the prevalence, causative agents, and predisposing factors of *Tinea capitis* among primary school students in Gombe State, North-East Nigeria.

MATERIALS AND METHODS

The research was carried out in Balanga Local Government Area (LGA), Gombe State, in the Northeastern region of Nigeria, specifically targeting primary school children from Pilot Primary School and Kwasi Primary School (the First one a private school and the second public school). A total of 60 primary school children were recruited to participate in the study following human ethics approval (MOH/ADM/621/V.1/447). The selection process involved identifying children exhibiting physical manifestations of Tinea infections, including erythema, alopecia, scaling, crusting, circinate lesions, follicular inflammation, or pruritus. The inclusion criteria ensured that selected participants were not older than 14 years. Exclusion criteria were applied to pupils without signs of Tinea infections, non-primary school children, and those undergoing either orthodox or traditional antifungal treatment within two weeks of the sample collection period. Prior to their recruitment in the study, informed consent was obtained from guardians of all participating pupils, emphasizing the maintenance of participant anonymity and adherence to good laboratory practices/quality control measures. The selection process was conducted in accordance with a code of ethical conduct obtained from relevant authorities, with a commitment to treating every finding with the utmost confidentiality and exclusively for the purpose of the study. The descriptive cross-sectional statistical method was used in this study.

Sample Collection and Questionnaires Administration

Scalp hair of sixty (60) school children with suspected *T. capitis* lesions was obtained using new surgical blades, each designated for an individual to scrape affected areas onto clean sheets of sterile paper. It was then emptied into labelled sterile containers (Forbes *et al.*, 2007). A study proforma (Questionnaires) was used to obtain information on Socio-demographic characteristics, information on the sharing of fomites, Clinical profile, distribution of clinical features, associated risk factors, and socioeconomic classification

Socioeconomic index scores were awarded to the occupations and educational attainments of the participants' parents or caregivers using the socioeconomic classification scheme by Oyedeji (2021). The mean of four scores (two for the father and two for the mother) approximated to the nearest whole number was the social class assigned to the child. For example, if the mother is a junior school teacher (score=3), the father a senior teacher (score=2) and the educational attainment of the mother is primary six (score=4), and the father is a school certificate holder (score=2), the socioeconomic index score for this child will be; 3+2+4+2/4=2.75 to the nearest whole number gives 3. Socioeconomic classes I and II are the high socioeconomic class, class III is the middle class while socio economic classes IV and V are the low socioeconomic class.

Microscopic Examination of Scalp Scrapping

For each scalp scraping specimen, a wet mount was prepared using a sterile pair of forceps to place scrapings on a grease-free microscope slide with a few drops of 20% KOH solution. A 22 by 22 mm cover slip was applied, and the slide was gently warmed over a low Bunsen burner flame for a few seconds to digest the keratin and release fungal elements. Subsequently, the slide was left to stand for five minutes. Examination under low (10x) and high (40x) objectives followed to assess the presence of spores, their distribution pattern in hairs (ectothrix, endothrix, or favic type), and hyphae in scalp scrapings (Ayodele *et al.*, 2021).

Isolation of Tinea capitis

The scalp hair on MycoselR agar were sub-cultured on Sabouraud's Dextrose Agar (SDA) with 0.05 mg of chloramphenicol. The SDA 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, 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 in duplicate. The plates were labeled and then incubated for three weeks at room temperature (26°C ± 4°C), and the other at 35-37°C.

Examination of the culture plates occurred every other day to monitor evidence of growth, with cultures considered negative for growth only after four weeks of incubation. The mycelium and spore characteristics were noted and recorded.

Identification of Fungi isolates

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 20% KOH solution, which includes the presence of spores, their distribution pattern in hairs (ectothrix, endothrix, or favic type), and hyphae in scalp scrapings. Colonies appearing cottony, wooly, powdery or fluffy on SDA are suggestive of the growth of a dermatophyte.

RESULTS

Sixty (60) school children presenting with scalp lesions and associated symptoms were enrolled and a notable gender imbalance emerged, with a majority of affected individuals being males (70%), while females constituted the minority (30%). An in-depth exploration of age distribution revealed that children aged 8-12 bore the highest prevalence of scalp lesions, making up 60% of the cases. The subsequent age group of 11-14 accounted for 25% of the affected individuals, while the age range of 5-7 exhibited the lowest prevalence at 15%. Pupils were sourced from two primary schools, with the majority (66.67%) from Pilot Primary School and the remaining 33.3% from Kwasi Primary School, as delineated in Table 1.

Distribution across different primary classes indicated that the highest percentage of affected pupils congregated in primary 5 (25%), closely followed by primary 4 (21.67%). Primary 3 and 1 demonstrated parallel rates of occurrence at 13.3%, while primary 2 pupils showcased the lowest prevalence at 6.67% as seen in Table 1.

Table 1: Distribution of gender and socio-demographic characteristics

Variables	Parameter	Frequency (n=60)	Percent (%)
Gender	Male	42	70.0%
	Female	18	30.0%
Age group	5-7	11	15.0%
	8-12	35	60.0%
	11-14	14	25.0%
Primary School Residence	Pilot Primary School	40	66.7%
	Kwasi Primary School	20	33.3%
Primary school classes	1	8	13.3%
	2	4	6.67%
	3	8	13.3%
	4	13	21.67%
	5	15	25.0%
	6	7	11.66%

The current study demonstrated that the majority of pupils with scalp lesions exhibited associated clinical symptoms, including itching and scaling (25%), small black dots (26%), bald areas due to hair loss (16%), pus-filled sores (8.3%), among others (Table 2). Risk factors associated with the occurrence of *Tinea capitis* were observed among the participants; overcrowding (83.3%), sharing of items such as combs and bed sheets (70.0%), close association with household pets (31.7%), residing in mud houses (93.3%), use of soap (53.3%), and living with an infected person at home leading to reinfection (25.0%), among other factors. Parents or sponsors from the lower socioeconomic class were higher (93.3%) than those in the low socioeconomic class (6.7%) as shown in Table 2.

Out of the 60 children diagnosed with *Tinea capitis*, microscopic and cultural analysis revealed *Trichophyton mentagrophyte* (25%), *Microsporum canis* (20%), *Trichophyton rubrum* (13.3%), *Microsporum gypseum* (11.6%), *Trichophyton schoenleinii* (10%), *Trichophyton verrucusum* (8.3%), and *Trichophyton tonsurans* (8.3%), as detailed in Table 3. The mycological analysis of 58 samples revealed dermatophyte presence, while 2 (3%) samples were contaminated with *Aspergillus niger*.

Table 2: Distribution of clinical features, associated risk factors and socioeconomic classification

Variables	Parameter	Frequency (n=60)	Percent (%)
Clinical features	Itching and Scaling	15	25%
	Bald areas due to hair loss	10	16%
	Small black dots	26	43%
	Pus-filled sores	5	8.3%
	Others	4	6.7%
Risk factors	Over crowding	50	83.3%
	Sharing bed sheet/combs	42	70.0%
	Pet at home	19	31.7%
	Infected person at home	15	25.0%
	Use of soap	32	53.3%
	Living in mud houses	56	93.3%
	Family size		
	< 5	13	21.7%
	>5	47	78.3%
Socioeconomic class	High	4	6.7%
	Low	56	93.3%

Table 3: Fungal isolate from *Tinea capitis* infection among participant

Type of Fungai	Frequency (n=60)	Percentage (%)
Trichophyton mentagrophyte	15	25.0%
Mricrosporum canis	12	20.0%
Trichophyton rubrum	8	13.3%
Microsporum gypseum	7	11.6%
Trichophyton schoenleinii	6	10.0%
Trichophyton verrucusum	5	8.3%
Trichophyton tonsurans	5	8.3%
Total	**58**	**96.3%**

DISCUSSION

Tinea capitis, also known as scalp ringworm, is a fungal infection that affects children's scalp and hair. It is caused primarily by the dermatophyte species *Microsporum* and *Trichophyton*. In this study, dermatophytes that caused tinea capitis were isolated and identified amongst children attending two selected primary schools in Gombe State, North-East Nigeria. Higher susceptibility of *Tinea capitis* was observed among children aged 5-14 years. This aligns with previous studies indicating a higher incidence of *Tinea capitis* among pre-pubertal children, attributed to lower fungistatic properties of sebum fatty acids (Afolabi *et al.*, 2018) with a higher prevalence of the infection among males (70%) as compared to females (30%). The predominant causative agent is *Trichophyton mentagrophyte* (25%), *Microsporum canis* (20%), *Trichophyton rubrum* (13.3%), *Microsporum gypseum* (11.6%), *Trichophyton schoenleinii* (10%), *Trichophyton verrucusum* (8.3%), and *Trichophyton tonsurans* (8.3%), in the prevalent order. Dermatophytes obtained from this work are similar to other studies in Nigeria (Adesiji *et al.*, 2019) but in different distributions. For example, *Trichophyton mentagrophyte*, is the most common dermatophyte found in this study, which is the most common in Nigeria compared to other dermatophytes (Adesiji *et al.*, 2019).

he high prevalence has been attributed to the perforating organ the organism possesses. This facilitates the mechanical destruction of keratin and allows mycelia's faster growth, which explains this dermatophyte species's dominance (AL-Janabi et al., 2016). *T. mentagrophte* has been the most isolated organism among children with tinea capitis infection in the Oke-Oyi community of Kwara state (Adefemi *et al.*, 2011), school children in Abia state, Southeastern Nigeria (Adesiji *et al.*, 2019), as well as Cross-River state, Nigeria (Ezeronye, 2017). *Microsporum canis*, the second most common dermatophyte in this study, was also common among school children at the public primary schools in Osogbo, Southwest Nigeria (Adesiji *et al.*, 2019) and the Nok community of Kaduna State, Nigeria (Dogo *et al.*, 2016).

Although research has indicated that *Microsporum gypseum* has been isolated in different regions of Nigeria (Nweze, 2010) and in public primary schools in Oshogo (Adesiji et al., 2019), it is believed to be a rare isolate in Africa (AL-Janabi et al., 2016).

This indicates that M. gypseum is starting to emerge as a source of dermatophyte infections in some rare regions. The most isolated dermatophyte among children with tinea capitis infection in regions of Northern Nigeria Schools (Dogo et al., 2016) and children in Osogbo, Southwest Nigeria (Adesiji et al., 2019) is *Trichophyton rubrum*, was also identified in our investigation. In this study, anthropophilic dermatophytes (*Trichophyton mentagrophyte and Trichophyton rubrum)* dominated, suggesting person-to-person and animal-to-human transmission. Sharing personal items and close interaction with infected individuals contributed to the spread, which conforms to the findings of Ayodele *et al*. (2021). The variations in prevalence could also be due to the sampling methods used and could be a reflection of people's habits, climatic conditions, standards of hygiene, and levels of education, all of which can influence predisposition to *Tinea capitis* (Fathi and Samarai, 2000).

A higher proportion of children whose parents or sponsors belonged to the lower socioeconomic class were predominantly affected (93.3%), in contrast to children whose parents were in the high socioeconomic class (6.7%). This trend indicates the correlation between *Tinea capitis* prevalence and factors such as low standard of living, poor hygiene, low parental education levels, and overcrowding, commonly observed in rural areas.

The concentration of cases within particular demographics prompts further exploration into potential risk factors or susceptibility within these subgroups, necessitating an investigation into the underlying determinants of scalp lesions in the primary school population. Risk factors included large family size, with children from larger families three times more likely to have *Tinea capitis*. Overcrowding and limited income in large families facilitated the sharing personal items, promoting fungal transmission. Living in proximity to pets increases susceptibility to zoophilic dermatophytes. These findings emphasize the significance of personal hygiene and improved living conditions in preventing *Tinea capitis*.

The study's rural setting in Balanga LGA, where 93.3% of children belonged to a low socioeconomic class, further highlighted the association between socioeconomic status and *Tinea capitis*. Low-income households, often with poor hygiene conditions, correlated with a higher prevalence of dermatophytosis.

CONCLUSION

In conclusion, *Tinea capitis* emerged as the most prevalent fungal infection among primary school pupils in the study area. The observations underscored the influence of age, sex, socioeconomic status, and environmental factors on infection prevalence. Continuous monitoring, treatment, and health education are recommended to curb the spread of *Tinea capitis*. Discouraging sharing personal items, promoting good hygiene practices, and creating awareness about fungal infections are crucial preventive measures. Government intervention in providing adequate school infrastructure is also advocated. The collaborative efforts of students, teachers, parents, and government agencies are essential to effectively address *Tinea capitis* in the community.

Limitation

However, it is acknowledged that this study has limitations, including the need for extended epidemiological investigations over a more extended period to confirm trends and determine the true incidence of dermatophytes in the region. The study's sample size might not fully represent the total population of children aged 5-14 in Balanga LGA, Gombe state.

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