Original Research

Epidemiology and pattern of superficial fungal infections among primary school children in Enugu, south-east Nigeria

N.E. Ezomike[1], A.N. Ikefuna[1], C.L. Onyekonwu[2], A.C. Ubesie[1], U.R. Ojinmah[2], B.C. Ibe[1]

1. Department of Paediatrics, University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu, Nigeria
2. Sub-Department of Dermatology, University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu, Nigeria

Correspondence: Nkeiruka Elsie Ezomike (nkeirukaezomike@gmail.com)

Abstract

Background

Superficial fungal infections (SFIs) are prevalent among schoolchildren and result in significant morbidities that may lead to school absenteeism or school drop-out and hence setback in the education of the child. Differences exist in the epidemiology and pattern of SFIs among children in various geographical locations. Community-based studies on diseases are a true reflection of their pattern in that locality. There are no recent studies on this regard in south-east Nigeria despite the high prevalence reported in the country.

Aim

This study aimed to determine the epidemiology and pattern of SFIs among children in rural and urban communities in Enugu, south-east Nigeria, for evidence-based effective interventions in this region.

Methods

A comparative and descriptive cross-sectional study of primary school children from three randomly selected urban communities and three randomly selected rural communities was conducted. The sample size was determined with use of the formula for comparison of two proportions. A total of 1662 pupils were recruited through a multistage sampling method, with 831 from urban primary school populations and 831 from rural primary school populations. Data were analysed with IBM SPSS Statistics version 24.

Results

Of the 1662 children recruited, 748 had SFIs, with 502 (60.4%) seen in urban communities and 246 (29.6%) seen in rural communities. Tinea capitis was the most prevalent SFI (73.7%), and there was a statistically significant difference between urban (40.3%) and rural (26.1%) communities ($P<0.001$). The prevalence of SFIs was higher among urban female and rural male pupils. Children aged 9–12 years and 5–8 years were most commonly affected in the urban and rural communities, respectively. The personal hygiene of the children was poor in both communities.

Conclusion

Emphasis on health education for SFIs and good personal hygiene will reduce the incidence of SFIs in the communities, especially among urban dwellers, which will encourage school attendance, concentration in class and child education.

Key Words; Prevalence, mycoses, tinea capitis, schools, child

Introduction

Superficial fungal infections (SFIs) are common cutaneous infections worldwide, affecting about 20% to 25% of the world's population, with an estimated lifetime risk of 10% to 20%[1,2]. Dermatophytes are fungal organisms that infect keratinized superficial layers of the skin (stratum corneum) and use keratin as a source of nutrients. This allows them to colonize the keratinized tissues of the skin and its appendages[3]. Dermatophyte infections include several distinct clinical entities, depending on the part of the body affected and the etiological agents involved[3]. These clinical entities include tinea capitis (scalp), tinea corporis (body), tinea cruris (groin), tinea pedis (foot), tinea unguium (nail), tinea manuum (hand) and tinea faciei (face)[3]. Dermatophytes consist of three genera: *Trichophyton*, *Microsporum* and *Epidermophyton*[4]. Non-dermatophytes are fungal organisms that affect the stratum corneum but do not depend on keratin for survival[5]. They include *Malassezia furfur* and *Candida* species, which cause pityriasis versicolor and cutaneous candidiasis, respectively[4,5].

The commonest SFI, tinea capitis, is more prevalent among children aged 12 years or younger[3]. In developing countries in Africa, skin infections affect 21% to 87% of children[4]. The prevalence in Nigeria ranges from 3.4% to 55.1%[5,6] and differs according to age, sex, geographical location and hygiene conditions[1,7]. It constitutes a major public health challenge among school children in the country[1,8]. In addition, the epidemiology has changed due to human migration patterns, drug therapy, lifestyle and socioeconomic status[8].

These infections affect the health and well-being of primary schoolchildren around the globe, especially in resource-poor countries such as Nigeria, where children constitute 44% of the population[1,7,10]. Southern Nigeria has the highest prevalence of SFIs in the country[11]. Although rarely life-threatening, SFIs can lead to morbidity, including itch, pain, fever, hair loss, scarring, and cosmetic disfigurement[12].

Community-based studies, accurately reflect the true prevalence of SFIs in that locality[13]. SFIs are commoner in rural communities than in urban communities, especially where hygiene may be poor, with overcrowding of school and home environments providing increased opportunities for frequent skin-to-skin contact and spread of SFIs[13,15,17]. Although a high prevalence of SFIs is reported in

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Nigeria, there are no community-based studies on the prevalence among primary schoolchildren in Enugu State, which is located in south-east Nigeria. The few published studies on SFIs in Enugu State are all hospital-based studies[19,20]. Therefore, there is a need to provide up-to-date information on this skin disease for evidence-based effective interventions, such as planning a school health programme, thereby improving dermatology care. The aim of this study is to determine the prevalence and descriptive epidemiology of SFIs among primary schoolchildren in rural and urban communities in Enugu State.

Methods

Study design and study area

The study was a comparative and descriptive cross-sectional analysis performed from February to April 2018 in Awgu local government area (LGA) and from January to March 2019 in Enugu North LGA involving primary school children in rural communities (Awgu LGA) and urban communities (Enugu North LGA) in Enugu State. Enugu State has a population of 3,267,837[18]. The majority of the residents are of the Igbo ethnic group. The inhabitants are people with different educational backgrounds and religious beliefs. The working-class population consists of individuals in various occupations, mostly subsistence farming, palm wine tapping, livestock rearing in Awgu LGA, and mainly trading and the civil service in Enugu North LGA.

Study population and sampling

Awgu and Enugu North LGAs represent rural and urban areas, respectively, and were selected by simple random sampling. A multistage sampling method was used for the selection of communities, schools and classes, while proportionate allocation of pupils was done from selected class strata.

The sample size (N) was calculated with use of the formula for sample size determination for comparison of two proportions: $N = \{(z^{a} + z1\text{-}\beta)^2 \times [p1(1 - p1) + p2(1 - p2)]\}/(p1 - p2)^2$, where N is the minimum sample size for each group (double for total sample size), z^{a} is 1.96 for the 95% confidence level, $z1\text{-}\beta = 0.84$ for the power of the test set at 80%, p1 is the first proportion (42% or 0.42; prevalence of SFIs among primary school children in a rural area in Ghana), and p2 is the second proportion (35% or 0.35; prevalence of SFIs among primary school children in an urban area in Ile-Ife, Osun State). We obtain

$N = \{(1.96 + 0.84)^2 \times [0.42 \times (1 - 0.42) + 0.35 \times (1 - 0.35)]\}/(0.42 - 0.35)^2 = 755.$

To account for attrition, 10% of the sample size was added.

A total of 1662 pupils, 831 from rural communities and 831 from urban communities, were recruited. Twenty-one schools were selected from urban communities and 16 schools were selected from rural communities.

In Enugu North LGA, there are 214 registered primary schools, comprising 54 public and 160 private schools. The ratio of public to private schools in the study area is therefore 1:3. The total number of primary schools selected was obtained with a proportionate sampling outcome of 10%. Since there are 214 primary schools in Enugu North LGA, 10% of 214 is approximately 21. Therefore, 21 primary schools were selected. Because the ratio of public to private schools is 1:3, of the 21 primary schools selected, 5 primary schools were chosen from the public schools and 16 were chosen from the private schools. These 5 public and 16 private schools were selected by a simple random sampling method. A multistage sampling method was used to select the study participants:

Stage 1. The number of participants to be selected from each school was determined with the proportionate sampling method formula as follows:

no = $n/N \times$ nh,

where no is the sample size for the target school, n is the total population of the target school and nh is the population of the target class. For each school, the sample size allocated is given as follows: total population of the index school/sum of the population of the 21 schools (N) × total sample size.

Stage 2. For each of the 21 schools selected, the proportional allocation formula was applied to obtain the sample size for each class:

n1 = no /n × nh,

where n1 is the sample size for each class in the school,

In each class, the serial number in the register was used to select the pupils randomly with the aid of a computer-generated table of random numbers.

The same sampling method was applied in the selection of participants from primary schools in Awgu LGA, with a total of 148 primary schools comprising 75 private and 73 public schools. In Awgu LGA, equal numbers of private and public schools were selected, 8 of each type.

To obtain consent, three visits were made to each of the selected schools; the first was to introduce the researcher, the study objectives and the study design as well as to obtain approval from school authorities. The second and third visits were used to explain briefly the basis of the study to the children, parents, class and head teachers, and to select participants. Parents who could not read or write were interviewed orally by the researcher. The selected participants (irrespective of age) were given written informed consent forms with the Igbo translated version and proforma sections consisting of the demographic data and clinical history to take home for their parents/guardians to complete.

The written informed consent forms were completed and signed or thumb printed by the parents/guardians and assent was obtained from study participants aged 7 years or older before the study commenced.

Data and sample collection

Only pupils whose parents/guardians gave informed consent were enrolled in the study. Information on the sociodemographic characteristics of the parents or guardians, such as educational status and occupation, was obtained by means of a structured questionnaire designed for this study. Physical examination was conducted by the researcher under natural light in a room provided by the head teacher on the school premises for proper identification of SFIs. Diagnosis of infection was clinically ascertained from participants with suspected skin fungal infections. The affected skin, hair and surface of the disease nail plates were scraped (the nail clippings) with the blunt edge of a scalpel after the affected areas had been cleaned with 70% alcohol. Scales were collected with disposable brushes. A Wood lamp was used to further examine lesions of the scalp and body where the definitive clinical diagnoses of tinea capitis and pityriasis versicolor were inconclusive.

The samples were collected in clean envelopes, labelled,

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Table 1. Age group and sex distribution of study participants in urban and rural communities; *N*=1662

Age group (years)	Urban			Rural			Test statistics	
	Male	Female	Total	Male	Female	Total	χ^2	P
							103.578	<0.001
5–8	72 (18.5%)	113 (25.6%)	185 (22.3%)	205 (40.1%)	144 (45.0%)	349 (42.0%)		
9–12	243 (62.5%)	277 (62.7%)	520 (62.6%)	277 (54.2%)	167 (52.2%)	444 (53.4%)		
13–15	74 (19.0%)	52 (11.8%)	126 (15.1%)	29 (5.7%)	9 (2.8%)	38 (4.6%)		
Total	389 (100%)	442 (100%)	861 (100%)	511 (100%)	320 (100%)	861 (100%)		

Table 2. Relationship between demographic characteristics and superficial fungal infections (SFIs); N=1662

Variable	SFIs Present (n=748)	Absent (n=914)	P	Test statistics	95% CI
Age group (years)					
5–8					
9–12	206 (27.5%)	328 (35.9%)			
13–15	454 (60.7%)	510 (55.8%)	<0.001		
	88 (11.8%)	76 (8.3%)			
Sex					
Male					
Female	378 (50.5%)	522 (57.1%)			
	370 (49.5%)	392 (42.9%)	0.007	OR 1.3	1.1–1.6
School location					
				χ^2=159.317	
Urban	502(60.4)	329(39.6)	<0.001		
				OR 3.6	
Rural	246(29.6)	585(70.4)			2.9–4.4

and transported to the laboratory for direct microscopy and culture. The scrapings, including the nail clippings, were handled individually to ensure there was no mix-up. In the laboratory, one or two drops of 20% potassium hydroxide (KOH) was added to each slide containing small samples of skin, nail and hair. Coverslips were placed over the slides and heated over a flame. Each heated slide was viewed under low-power (×10) and high-power (×40) objectives to better visualize the hyphae and spores.

Samples that were positive on KOH tests were subjected to standard fungal culture techniques for isolation of dermatophytes and non-dermatophytes. The dermatophytes were isolated by inoculation of samples onto Sabouraud dextrose agar with chloramphenicol and actidione. To isolate non-dermatophytes, another sample was inoculated onto Sabouraud dextrose agar with cycloheximide (0.5 mg/ml) to prevent the growth of saprophytic fungi and yeast and supplemented with chloramphenicol (0.05 mg/ml to kill bacterial contaminants).

All the inoculated samples were incubated at 28°C for 21 days. During this period, the cultures were examined daily in the first week, twice in the second week and once in the third week. Their hygiene status was objectively assessed with use of hygiene assessment tools for skin, hair, fingernails and the clothing[20].

Table 3. Age group distribution of superficial fungal infections (SFIs) by type of community; *N*=1662

Variable	Presence of SFIs		Statistics		
	Urban (n=502)	Rural (n=246)	χ^2	df	P
Age group (years)					
5–8	77 (15.3%)	129 (52.4%)	122.721	2	<0.001
9–12	344 (68.5%)	110 (44.7%)			
13–15	81 (16.2%)	7 (2.9%)			
Total	502 (100%)	246 (100%)			
Sex					
Male	235 (46.8%)	143 (58.1%)			
Female	267 (53.2%)	103 (41.9%)	8.459	1	<0.001
Total	502 (100%)	246 (100%)			

Table 4. Frequency of superficial fungal infections (SFIs) among pupils in rural and urban communities; N=1662

SFI	Urban (n=831)	Rural (n=831)	χ^2	df	P
Tinea capitis					
Present	335 (40.3%)	217 (26.1%)	37.769	1	<0.001
Absent	496 (59.7%)	614 (73.9%)			
Tinea corporis			90.447	1	<0.001
Present	115 (13.8%)	12 (1.4%)			
Absent	716 (86.2%)	819 (98.6%)			
Tinea unguium					<0.001*
Present	38 (4.6%)	3 (0.4%)			
Absent	793 (95.4%)	828 (99.6%)			
Tinea pedis			2.022		0.155
Present	12 (1.4%)	6 (0.7%)			
Absent	819 (95.4%)	825 (99.3%)			
Pityriasis versicolor				1	<0.001*
Present	149 (17.9%)	5 (0.6%)			
Absent	682 (82.1%)	826 (99.4%)			
Tinea manuum					
Present	61 (7.3%)	1 (0.1%)		1	<0.001*
Absent	770 (92.7%)	83 (99.9%)			

Table 5. Relationship between personal hygiene and the presence of superficial fungal infections (SFIs) among pupils in rural and urban communities

School location	Personal hygiene			Total	χ^2	df	P
	Good	Fair	Poor				
Urban	51 (45.1%)	279 (64.7%)	172(84.3%)	502	53.186	2	<0.001
Rural	62 (54.9%)	152 (35.3%)	32 (15.7%)	246			
Total	113 (100%)	431 (100%)	204 (100%)	748			

Data analysis

Outcomes were analysed with IBM SPSS Statistics version 24. Descriptive statistics were used for proportions and percentages. The results are presented as percentages or the mean and the standard deviation. The chi-square test was used as a test of association to compare the prevalence of SFIs among primary schoolchildren in rural and urban communities in Enugu State as well as to compare the clinical patterns of SFIs between the two types of communities. Comparison of means was done by the *t* test.

Logistic regression analysis was used to determine the relationship between sociodemographic factors such as age, sex, socioeconomic status and SFIs. The reason for this is because the dependent variable (SFIs) appeared dichotomous (either present or absent). Only the variables that were significant in the bivariate analysis (chi-square test) were put in the logistic regression model to estimate odds ratios with a 95% confidence interval. A *P* value less than 0.05 was regarded as statistically significant.

Ethical approval

Ethical approval was obtained from the University of Nigeria Teaching Hospital Health Research Ethics Committee, Enugu State, Nigeria. Permission was obtained from Enugu State Universal Basic Education Board.

Results

A total of 1662 participants were recruited for this study, with an equal number of participants from rural and urban communities. Of the 831 pupils recruited from urban communities, there were 389 boys (46.8%) and 442 girls (53.2%). Of the 831 pupils recruited from rural communities, 511 (61.5%) were boys and 320 (38.5%) were girls. The mean age of the urban participants was 10.46 years (standard deviation 2.33 years) compared with 9.03 years (standard deviation 2.10 years) among pupils in the rural schools. Most of the study participants were from the lower socioeconomic class. The demographic characteristics of the study participants are shown in Table 1.

Of the 1662 primary school children recruited, 748 were found to have SFIs, with an overall prevalence of 45%. The prevalence of SFIs was significantly higher in urban communities (60.4%) than in rural communities (29.6%), $P<0.001$.

The mean age of the participants with SFIs was 10.04 years (standard deviation 2.33 years), and this was significantly different from that of the participants without SFIs ($P<0.001$). The presence of SFIs was significantly related to sex and age ($P<0.05$). The odds of a child in an urban school having an SFI is 3.4 times greater than that of a child from a rural school, as shown in Table 2.

The highest prevalence of SFIs was observed among the 9–12-year age group in urban communities and the 5–8-year age group in rural communities. Girls were more affected (53.2%) in the urban communities, while 58.1% of the pupils affected in the rural communities were boys, and this was statistically significant (Table 3).

Table 4 illustrates that the SFI types observed were more frequent among urban pupils than rural pupils. Tinea capitis was the commonest SFI observed. Tinea manuum and tinea unguium were the SFIs least frequently observed in rural communities. Cutaneous candidiasis and tinea cruris were not seen.

Table 5 shows that there is a significant association between the presence of SFIs and personal hygiene among pupils in rural and urban communities ($P<0.001$). Among children with poor personal hygiene, the majority (80.2%) had SFIs, with a greater proportion (67.7%) from urban communities than from rural communities (15.7%).

Discussion

The results of our study have established that SFIs are common among primary schoolchildren as found in other studies in Nigeria and the world as a whole[4,6,12,16,22]. In this study, the prevalence of SFIs among primary schoolchildren was found to be higher in urban communities than in rural communities. Although this may not be an expected finding, it may be because cities around the world can be very heterogeneous and the local diseases and health challenges can differ greatly[23]. The challenges for one city can be completely different from another city[23]. Therefore, urban health may actually be worse than health in certain rural environments[24]. In addition, the density of inhabitants and the close contact between people in urban areas are potential reasons for rapid spread of infections such as SFIs[22,24]. Furthermore, schools in urban communities are overpopulated and overcrowded due to migration of people from rural to urban settings because of economic push and pull factors. This resulted in a large number of children per classroom and an increased number of schools located in the same compound. These factors predispose children to frequent close person-to-person contact in classrooms and playgrounds, leading to easy spread of SFIs. The finding of higher prevalence of SFIs in urban communities than in rural communities corroborates the findings of earlier studies. Figueroa et al.[25] in Ethiopia ascribed a similar finding to school overcrowding. Poluri et al.[26] in India attributed this to the inclusion of patients who attended the outpatient department of a tertiary hospital in their study. Finally, Chepchirchir et al.[27] in Nairobi concluded that the frequent shaving of hair at barber shops contributed to the high prevalence of SFIs in urban settings.

Similarly, Nigerian studies by Aaron[28] in Rivers State and Anosike et al.[29] in Ebonyi State reported a low prevalence in rural communities. In contrast, studies conducted in Mali[30], as well as in Osun State[31] and Ogun State[32] in south-west Nigeria noted low prevalence of SFIs in urban communities and high prevalence in rural communities. The

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authors attributed their findings to the preponderance of unsatisfactory hygiene status of the rural pupils[22,29].

The common SFIs identified in both types of communities include tinea capitis, tinea corporis, tinea unguium and pityriasis versicolor, although the clinical patterns of these SFIs were different in rural and urban communities. Tinea capitis was the commonest SFI in both types of communities but more so in the urban communities compared with the rural communities. The fact that tinea capitis was the most prevalent SFI can be explained by high hygiene scores (pointer to poor personal hygiene) noted more among the children in the urban communities, which enhances scalp tinea infection or transfer through close head contact due to congestion in classrooms or at home, sharing of combs and poor hair grooming practices. This was in keeping with findings from previous Nigerian studies[14,16] that also documented tinea capitis as the commonest clinical type of SFIs among primary schoolchildren. Likewise, reports from studies in Egypt[32] and Ethiopia[33] support our findings.

Pityriasis versicolor and tinea corporis were the next types of SFI observed more frequently among primary schoolchildren in urban communities than among their rural counterparts. In addition, the least prevalent SFIs noted among the primary schoolchildren in rural and urban communities were tinea manuum and tinea pedis, respectively. The findings in the rural communities are similar to those of earlier Nigerian studies by Ogbu et al.[16] and Oke et al.[4], who documented the prevalence of tinea capitis (most prevalent SFI), tinea manuum and tinea pedis (least prevalent SFI). The low prevalence of tinea manuum seen in the rural communities may be due to less frequent exposure of the study population to factors that encourage the spread of the infection, such as close contact with children with tinea pedis, since the schools in these communities may not be overcrowded.

The age group was significantly associated with the presence of SFIs, such that children aged between 5 and 8 years were found to have more SFIs in rural communities and those aged between 9 and 12 years in urban communities had more SFIs. Similar findings were observed in previous studies[21,23,35]. A plausible reason for this that most children aged 5–8 years have frequent contacts with playmates in schools and are left to care for themselves at home, especially in rural communities[14]. However, in the urban communities, these children are usually cared for at home by older members of the family, unlike the 9–12-year-olds, who have to care for themselves but maybe ignorant of methods to prevent SFIs[14]. Also, Ayorinde et al.[31] and Amoran et al.[36] noted high prevalence of SFIs among children aged 5–7 years, which they attributed to the poor personal hygiene of these children[4].

There was a relationship between sex and the presence of SFIs. Among all the children with SFIs, the proportion of boys was greater than that of girls. This is expected as females in our environment do more domestic work, such as the washing of plates and clothing and other hygiene practices, such as hand washing. In addition, females are more concerned about hygiene and personal grooming, which includes weaving of their hair, which reduces the risk of spread of infection[4], unlike males, who are more involved in outdoor activities such as farming and sports, which encourage close personal contact with soil. Furthermore, males usually cut their hair short, and make frequent visits to the local barber shops, where the instruments for cutting hair may not be disinfected regularly, especially in rural communities, where the barbers are less likely to procure the disinfectants regularly due to ignorance. Although there was male dominance of SFIs in rural communities and female dominance in urban communities, the observed differences were not significant. This finding was similar to that of Figueroa et al.[25]. In contrast, several other authors in Mali[29] and Nigeria[2,13] reported higher prevalence of SFIs among male pupils in urban communities.

Personal hygiene was associated with the presence of SFIs. The proportion of children with poor personal hygiene who had SFIs was greater than that of children who had good and fair personal hygiene. This was in keeping with findings from previous studies[5,8,13,22]. This finding may be explained by the presence of dirty skin, with unkempt nails, hair and clothes, which makes the environment conducive for the growth of dermatophytes and non-dermatophytes.

Conclusions/Recommendations

SFIs are common among school children with varied epidemiology and clinical patterns. They were more prevalent in urban communities than in rural communities, with grey patch tinea capitis as the predominant clinical pattern. Poor personal hygiene of the children was significantly associated with the presence of SFIs. Emphasis on health education for SFIs and good personal hygiene will reduce the incidence of SFIs in the communities, especially among the urban dwellers, which will encourage school attendance, concentration in class and child education.

It is recommended that the school health programme should include regular health inspection of the personal hygiene of pupils by teachers, and dermatological services by a dermatologist for early identification, prompt diagnosis and treatment of SFIs. This will curtail spread especially in urban communities, where SFIs are more prevalent. Health education of mothers, teachers and children on the need to maintain good personal hygiene, which is essential for the control of SFIs among children, should also be incorporated into school health intervention.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

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