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Ringworm Infections in Anambra State of Nigeria: Epidemiologic Features and Antifungal Potentials of Local Plant Remedies

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Abstract

Ringworm infection remains an important public health problem in Nigeria, as in other parts of the world where poor living conditions prevail. The epidemiologic pattern of the disease has not been well defined in Anambra State of Nigeria, hence the need for this study. A total of 51,092 individuals (48,084 children and 3,008 adults) were surveyed for ringworm lesions. The population constituted of primary school children and their contacts. Results showed that of the 51,092 individuals, 5,127 (or 10.04%) had ringworm lesions on their body. Scalp ringworm was more common in children than adults (X^2=9.8482; P<0.05). Younger children were more frequently affected than older children, who, in turn, were more affected than adults. Although scalp infection was significantly more common in children, ringworm of other body parts did not show significant age (X^2=0.0297; P>0.05) or gender-related (X^2=0.0057; P>0.05) pattern. Contact tracing showed that chances of transmitting ringworm infection from a case were higher in the family (38%) than in the school classroom (1.3%), which was higher than in the neighbourhood (0.8%). Transmission within the household was mainly horizontal among children, and occasionally from child to adults. Close and prolonged contacts with ringworm–afflicted individual appeared to enhance transmission. Of plant materials locally used to treat ringworm infections, the inhibitory concentrations against locally isolated dermatophyte fungi were as follows: leaves of *Vanda roxburgii* (MIC_{range}=1.56-25.00 mg/ml; MIC_{90}=25.00 mg/ml), *Parkia biglobosa* seeds (MIC_{range}=3.13-12.50 mg/ml; MIC_{90}=12.50 mg/ml), leaves of *Sena alata* (MIC_{range}=3.13-12.50 mg/ml; MIC_{90}=12.50 mg/ml), leaves of *Mitracarpus villosus* (MIC_{range}=3.13-25.00 mg/ml; MIC_{90}=25.00 mg/ml) and *Gmelina arborea* fruits (MIC_{range}=6.25-100 mg/ml; MIC_{90}=50.00 mg/ml). It could be concluded that tropical plants hold great promise as potential source of antifungal agents and are therefore, recommendable as possible option in the search for newer anti-fungal agents.

Keywords: Ringworm; Epidemiologic features; Plant remedies; Nigeria

Introduction

Ringworm continues to be a world-wide problem, particularly in developing countries, where level of medical awareness, hygiene, and social enlightenment tends to be very low and preventive measures not readily enforced. Epidemiologic information from different parts of the world [1] suggest that dermatophytic infections are usually acquired by direct or indirect contacts with hair or desquamated epidermal material from a ringworm lesion; the shedded arthroconidia and hyphae may remain viable and infective in the environment, or formite, for months or years. Ringworm infection affects people of all age groups, but most causative agents circulate among children, from where compromised adults might acquire them [1,2]. Transmission in a household can be by direct person to person contact, or indirectly by sharing of contaminated materials [3,4].

Due to widespread poverty and low level of enlightenment, most infected individuals in this part of the world often resort to self-medication, usually with medicinal plant remedies or conventional antifungals [5]. The local remedies include *Gmelina arborea* fruits, *Sena alata* leaves, *Mitracarpus villosus* leaves, seeds of *Parkia biglobosa*, among others, while the most commonly used conventional antifungal is ketoconazole (personal communication).

No work, to our knowledge, has determined if there is scientific basis for the application of these plant materials in the treatment of ringworm infections in this locality. Also, no work has clearly defined the factors that are responsible for transmission and distribution of ringworm infections in this locality. We, therefore, saw the need for this work.

Materials and Methods

Anambra State is located East of lower Niger river, in the rain forest region of Eastern Nigeria, between 5° 43′ N 6° 38′ E and 6° 46′ N 7° 23′ E [6]. The mean annual temperature is 30°C, with annual rainfall of 152 cm-203 cm and relative humidity of 60-80% [6]. The state has a population of about 3 Million people (according to 1991 Nigerian National census figures) and covers an area of 4,416 sq Km.

The study population consisted of pupils attending public primary schools in the state and their household and other contacts. The body of every pupil and staff in 115 randomly selected schools was examined for ringworm lesions. Interviewer administered, semi-structured, pre-tested questionnaires were served to the afflicted pupils as well as staff of the schools; the questions included duration of lesion, current treatment, size of family, number of family members with ringworm lesion, sharing of beds and formites, suspected source of infection, socio-economic background of family, duration of lesion, among others. Household, school, and community contacts of seven selected

cases (one adult with skin lesion and six children with scalp infections) were screened for ringworm, as part of contact-tracing efforts; the seven index cases whose contacts were traced were individuals from whom well identified dermatophyte isolates had been recovered, as follows: *Microsporum audouinii*-three persons, *Microsporum ferrugineum*-two persons, and *Trichophyton mentagrophytes*-two persons. Samples were collected from lesions of the case contacts and examined mycologically [7-9] for the case's strain. Questionnaires were also used to obtain relevant information on household, school, and community contacts of the selected cases-questions such as number of individuals that sleep with the index case, number of family members with ringworm, shared formites and type of treatment, among others. On the whole, a total of 51,092 individuals (48,084 children and 3,008 adults) were screened between 2002 and 2010. Recruitment into the study was by informed consent and permission from parents/guardians and school authorities.

Crude ethanolic extracts of each of 5 locally used antifungal plant remedies were non-sequentially extracted as earlier described [10]; this was tested for activity against dermatophyte isolates, as follows: stock solution of the crude extract was made in 1:9 dilution of dimethyl sulphoxide (DMSO) in water; this was serially diluted in distilled water [11]. Dilutions of ketoconazole were similarly made. Susceptibility of the isolates to the medicinal preparations was determined by agar dilution method, using Sabouraud's dextrose agar, and results interpreted by standard criteria [12-14]; the minimal inhibitory concentration (MIC) was the highest dilution of the preparations that showed total inhibition of growth after incubation [15]. The Plant materials evaluated included leaves of *Vanda roxburgii*, *Mitracarpus villosus*, *Sena alata*, seeds of *Parkia biglobosa*, and fruits of *Gmelina arborea*. The plants were collected from their wild sources and their identity duly authenticated by experts.

Results

Of the 51,092 individuals screened, 5,127 (10.04%) had ringworm lesion. The prevalence of ringworm was higher in children than adults (X^2=9.8482; P<0.05) (Table 1).

Although male children tended to be more afflicted with scalp infection (11.64%) than their female counterparts (7.30%), lesions other than those on the scalp did not show any age (X^2=0.0297; P>0.05) or gender-related (X^2=0.0057; P>0.05) pattern, although females of all age groups were slightly more afflicted than males in body parts other than scalp (Table 2).

Age (year)	No. (%) occurrence of lesion on body site		
	Scalp	Other Body sites	Total
≤ 9 year (n=27,703)	3394 (12.25)	187 (0.68)	3581 (12.93)
10-14 year (n=20,381)	1157 (5.68)	327 (1.60)	1484 (7.28)
>15 year (n=3,008)	1 (0.03)	61 (2.02)	62 (2.06)

Table 1: Prevalence of ringworm lesions on the body of individuals of different age groups in Anambra State, Nigeria. Scalp: Children (1-15 year) *vs.* Adults (>15 years); (X^2=9.8482; P<0.05).

Gender	No. (% occurrence) of lesion on body location		
	Scalp	Other body sites	Total
Male children (n=23,989)	2,791 (11.64)	244 (1.02)	3,035 (12.7)
Female children (n=24,095)	1,759 (7.30)	271 (1.13)	2,030 (8.43)
Adult male (n=999)	0 (0.00)	13 (1.30)	13 (1.30)
Adult female (n=2,009)	1 (0.05)	48 (2.39)	49 (2.44)

Table 2: Distribution of ringworm on the body of individuals of different gender groups in Anambra State of Nigeria.

Setting of contact	No. of index Cases	Index Cases Contacts			No. sleeping with index cases and having index cases' strains			No. Sleeping with index cases and not having index cases' strains			No. not sleeping with index case but having index cases' strains			Acquisition rate through Shared bed with case	Over-all rate of acquisition of ringworm		
		A	C	T	A	C	T	A	C	T	A	C	T		A	C	T
Household (n=7)	7	18	21	39	2	10	12	2	2	4	0	3	3	12/16 (75%)	2/18 (11%)	13/21 (61%)	15/39 (38%)
School class rooms (n=6)	6	6	148	154	NA	NA	NA	NA	NA	NA	0	2	2	NA	0/6 (0%)	2/148 (1.4%)	2/154 (1.3%)
Neighbour-hood (n=7)	7	86	170	256	NA	NA	NA	NA	NA	NA	0	2	2	NA	0/86 (0%)	2/170 (1.2%)	2/256 (0.8%)

Table 3: Pattern of Transmission of Ringworm from Infected individuals to case contacts in different settings in Anambra State, Nigeria ["A" means Adult (>15 years of age); "C "means Children (≤ 15 years of age); "T" means Total].

The over-all transmission risk of ringworm infection in the household of an infected individual was 38%, which was higher than the school contact of the case (1.3%) and the neighbourhood (0.8%). This risk in the household was higher in children (61%) than adults (11%) (X^2=54.2534; P<0.05), as shown in Table 3. Table 3 also showed that 75% of those who shared sleeping bed with a case acquired the case's strain (Table 3). The most frequently shared formites were towel (52%) and bathing sponge (40%). Figure 1 highlights the suspected sources of infection by the respondents.

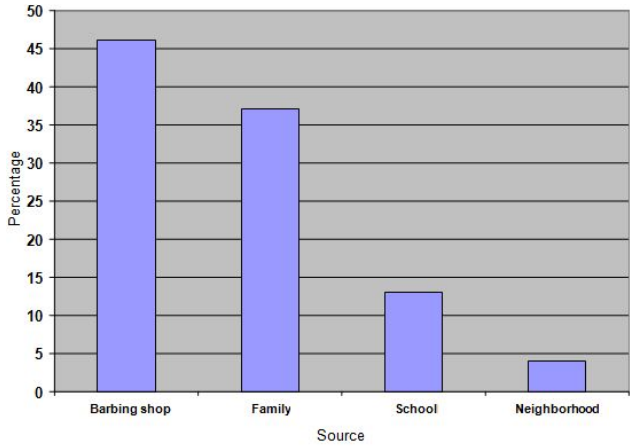

Figure 1: Plot showing presumed sources of acquisition of ring worm infection by children in Anambra State of Nigeria.

Infection apparently acquired after wearing second-hand clothes purchased at the local market was encountered (Figure 2).

Figure 2: Picture showing ringworm infection apparently acquired from wearing of second-hand clothing material.

Of the medicinal plants screened for antifungal activity, *Vanda roxburgii* had the lowest 'MIC' value (1.56 mg/ml) against test isolates, while fruits of *Gmelina arborea* recorded the highest 'MIC' value (100 mg/ml), as shown in Table 4.

Plant part	MIC range and MIC_{90} (mg/ml) against:			
	M. *audouinii* (n=7)		T. *mentagrophytes* (n=3)	
	[M. *ferrugineum* (n=3)		[Other Trichophyton spp. (n=3)]	
	Range	MIC90	Range	MIC90
Leaves of *Sena alata*	3.13-12.50 [NT]	12.50 [NT]	3.13-12.50 [NT]	12.50 [NT]
Leaves of *Vanda roxburgii* leaves	1.56-25.00 [6.25-12.50]	25.00 [12.50]	1.56-25.00 [6.25-12.50]	25.00 [12.50]
Leaves of *Mitracarpus villosus*	3.13-25.00 [3.13-12.50]	25.00 [12.50]	3.13-25.00 [3.13-12.50]	25.00 [12.50]
Seed of *Parkia biglobosa*	3.13-12.50 [NT]	12.50 [NT]	3.13-12.50 [NT]	12.50 [NT]
Fruit of *Gmelina arborea*	6.25-50.0 [6.25-100.00]	50.00 [100.00]	6.25-12.50 [6.25-25.00]	12.50 [25.00]
Ketoconazole	0.004-2.00* [0.13-4.00*]	2.00* [4.00*]	0.004-4.00* [0.25-4.00*]	4.00* [4.00*]

Table 4: Minimal inhibitory concentration (MIC) of ethanolic extracts of plant parts against local isolates of dermatophytic fungi in Anambra state, Nigeria. [*µg/ml; NT=not tested]

Discussion

Scalp ringworm was the commonest form of the disease encountered in children, which is in agreement with reports from other parts of the world [16]. This is probably because infancy and childhood predispose to this form of mycoses, as adult sebum is believed to contain certain fungistatic fatty acids [17]. The result also showed that younger children suffered more from scalp infection than older children, who in turn were more afflicted than adults. This suggests that the fungistatic fatty acid associated with adulthood builds up with age until puberty is attained, as earlier observed [5].

Contact tracing showed that chances of transmitting a ringworm infection from a case were higher in the family (38%) than in the school (1.3%), which was higher than in the neighbourhood (0.8%). This tends to suggest that closeness of contact with a case enhances transmission of the case's strain-sleeping together in the same bed with a case tended to represent the closest contact. This view is strengthened by an observation made in the course of screening the household contacts of a particular boy who had *Trichophyton mentagrophytes* infection involving the entire head, upper trunk of the body and finger nails. His strain was not recovered from the lesions of members of his immediate family (with 3 children) nor from any in his compound or immediate community, but his friend (a boy from a neighbouring compound, who used to sleep in the same bed with him every night) harboured the organism in his scalp lesion. Such close contacts probably enhanced the chances of coming into contact with fallen hairs and desquamated epithelium from the afflicted individual.

Surprisingly, infected adults did not transmit their infections to their spouses-even though they shared the same bed, and involved in intimate affairs (such as coital activity) that could maximize body contacts. This tends to agree with the views expressed by previous authors [1] that dermatophyte infections, especially those by zoophilic and geophilic species, are hardly transmitted to one's spouse. We observed that transmission within the household was enhanced by condition of over-crowding and poor conditions of living; sharing of sponge, towels and other formites appeared to have contributed to the transmission.

Based on our findings, it would appear that transmission in the household is mainly horizontal among young children, and occasionally from children to adults (often parents). We found out that transmission to adults is not gender-related, and tended to occur frequently on the skin rather than scalp. It could not be established whether or not closeness of a pupils' seat (in a classroom) to that of an index case could enhance acquisition of the case's infection.

In many occasions, lesions on the body of siblings in a household, which appeared similar, and were assumed to have been transmitted from the same source, turned out to be of different dermatophytic etiology-suggesting acquisition from different sources. Based on this observation, it could be concluded that the only definitive proof of epidemiologic relationship between lesions is the isolation of same strain of a fungus, that are possibly of the same clone; in this study, transmission lines were established by cultural isolation of same strains; clonal analysis could not be carried out due to technical limitations.

We encountered two adult cases who claimed to have acquired their infections (tinea corporis) after wearing second-hand clothing materials (a brazier and dress, respectively) purchased at the local market. It should be pointed out that mycological examination of the cloths at the time the case was reported was more likely to yield organisms transferred from the patient's lesion to the fabrics, rather than confirm the cloth as source of the infection- hence we saw no benefit in doing so. However, the possibility of transmission of ringworm through clothes has been reported before [18]. Acquisition of ringworm from second-hand clothes is of dire implications in this part of the world, since majority of Nigerians, even those at the upper socio-economic stratum of the society, have significant taste for second-hand wears. This risk could be reduced by ensuring proper treatment of second-hand clothes with fungicidal disinfectants before displaying them for sale to the public.

We observed that ringworm-afflicted individuals in this locality readily engaged in self-medication with either medicinal plants or other unorthodox preparations (74%) or conventional antifungal drugs, most commonly ketoconazole (26%); other local formulations used for self-medication included sooth from chimney (delivered with palm oil), car hydraulic fluid, among others. The recourse to self-medication could be attributed to wide spread poverty among the population, coupled with sky-rocketing hospital bills, which makes it difficult for the poor to patronize the hospitals. We, therefore, suggest that public health authorities should mount continual enlightenment campaigns to highlight the dangers associated with self-medication, and that special medical subsidies be worked out for those at the lower economic bracket.

Antifungal susceptibility results showed that the medicinal plants evaluated in this study were active against a wide spectrum of dermatophytic fungi, corresponding to their uses against ringworm infections in folk medicine; anti-dermatophytic activity of plants has been observed in other parts of the world [19]. The antifungal efficacy of the plant materials tends to establish a scientific basis for their application in folk medicine and appears to suggest that these plant materials hold a great promise as potential sources of antifungal agents.

It is, therefore, suggested that further works be carried out, so as to isolate the active principles (some of which might prove to be novel chemical compounds), test them pharmacologically and toxicologically, and possibly, formulate them into drugs. When properly purified, these principles might be active at much lower concentrations-making them good candidate antifungal drugs. Fortunately, the plant materials evaluated were quite inexpensive and readily available and hence could serve as potential sources of cheap and available antifungal drugs.

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