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Research Article

Cutaneous Mycoses among Rice Farmers in Anambra State, Nigeria

Chito Clare Ekwealor and Christie Amechi Oyeka

Department of Applied Microbiology and Brewing, Faculty of Biosciences, Nnamdi Azikiwe University Awka, Anambra State, Nigeria

Correspondence should be addressed to Chito Clare Ekwealor; chitoekwealor@yahoo.co.uk

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Rice grain is one of the world's most important food crops, and its cultivation is a major occupation in Anambra State, Nigeria. These rice farmers are exposed to various agents that predispose them to cutaneous mycoses. The aim of this work was to screen rice farmers for lesions suggestive of cutaneous mycoses and to isolate and identify fungal agents associated with the infection. This survey was carried out between November 2009 and June 2011 in Anambra State, Nigeria. Clinical samples collected from 201 farmers with lesions suggestive of cutaneous mycoses were processed and the organisms identified. Questionnaires were used to obtain other necessary data and were statistically analyzed. Of the 2,580 rice farmers screened, 201 (7.79%) showed positive lesions. Organisms recovered included *Microsporum audouinii, Microsporum ferrugineum, Trichophyton megnini, Trichophyton tonsurans, Trichophyton rubrum, Aspergillus terrus, Aspergillus candidus, Aspergillus scleriotorum, Aspergillus niger, Aspergillus flavus, Scopulariopsis* sp., *Chrysosporium* sp., *Eupenicillium javanicum*, *Fusarium* sp., *Penicillium aculeatum*, and *Penicillium pinophilum*. At the end of this work, onychomycosis was observed to be the most prevalent with nondermatophyte molds now becoming very important agents of cutaneous mycoses among rice farmer.

1. Introduction

Rice farming is one of the major occupations in northern part of Anambra State, Nigeria. This grain which is one of the worlds' most important food crops is cultivated either in marshy low land areas with plenty of water or in a plateau or hilly regions where natural rainfall provides adequate amount of water [1]. The preparation of the land, plowing the field, using manure, fertilizers, pesticides, and herbicides, sowing of rice seeds, transplanting of rice seedlings, and harvesting are done manually by these farmers which predispose them to cutaneous mycoses.

Cutaneous mycoses are pathogenic fungal infections that affect the keratinized layers of the skin and its appendages (nail, hair). It does not affect the living tissues. These infections are mainly caused by dermatophytes and yeasts. In addition to the accepted pathogens, nondermatophyte molds are now becoming significant in cutaneous mycoses [2, 3].

There have been reports of frightening increase in the incidence of fungal infections in the recent times. These have been linked by Terrell [4], Meis and Verweij [5], and Rolston [6] to medical treatments, immune-compromised conditions, malnutrition, certain surgeries, and heavy metals like mercury. Other factors that can predispose one to fungal infections according to Gugnani [7], Shenoi et al. [8], and Oyeka and Eze [9] include personal hygiene, crowded living and poor sanitary condition, size of family, age, warm humid climate, socioeconomic status, and international travels. Farm workers that are exposed to various irritant agents, namely, mud, cow dung, or other types of manure, fertilizers, herbicides, pesticides, dust, and soil (which is regarded as reservoir of most pathogenic organisms including dermatophyte and nondermatophyte fungi) are also predisposed to fungal infection [10–12].

Fungal infections caused by dermatophyte and nondermatophyte molds had been extensively reported to be a public health problem in Nigeria and all over the world [13–15]. This, however, cannot still be overemphasized as the contagious nature among animal communities; high cost of treatment, difficulty of control, and the public health consequences

explain their great importance [16]. Hence this study was designed to report the dermatophyte and nondermatophyte molds associated with cutaneous mycoses among rice farmers in Anambra State, Nigeria.

2. Materials and Method

Two thousand, five hundred and eighty (2,580) rice farmers including adults and children were screened for lesions suggestive of cutaneous mycoses. The lesions were evaluated for itching, scaling, fissuring, redness of skin, and dystrophy of the nails. Questionnaires were used to obtain information on gender, age, location of lesion, educational level, size of family, nature of families' living accommodation, presence of pets/domestic animals in the house, and duration of lesion, if the farmer uses manure, fertilizer, herbicides, or pesticides.

2.1. Collection of Clinical Specimen. The lesions were cleaned with 70% alcohol, and scrapings aseptically collected from near the advancing edges of these lesions with sterile scalpel. Finger and toe nail samples were collected using nail clips after the nails had been cleansed with 70% alcohol. Samples were collected in sampling pockets, transferred to microbiology laboratory, Nnamdi Azikiwe University, Awka, Nigeria, and processed within 2 h. Swabs were also collected from toe/finger web after cleaning with 70% alcohol using sterile swab stick.

2.2. Processing of Specimen. Direct microscopy slides were prepared with 20% KOH for some portions of skin scrapings and nail clippings. The remaining portions and toe/finger web swabs were inoculated into duplicate plates containing Sabouraud Dextrose Agar (SDA) (Biotech) supplemented with 0.05 mg/mL chloramphenicol and 0.5 mg/mL cycloheximide. Another duplicate plate with 0.05 mg/mL chloramphenicol alone was also inoculated with the sample. The plates were incubated at 27°C for 4 weeks. Positive plates with fungal growth were purified by subculturing the different colonies into fresh SDA slants without antibiotics.

2.3. Identification of Isolates. Isolates were identified on the basis of a detailed study of their gross and microscopic morphologies and compared with the standard description given by Campbell and Stewart [17], Guy St-Germain and Richard [18], and De Hoog et al. [19]. Ten of the isolates were identified using sequencing of the internal transcribed spacer region of the ribosomal DNA of the isolate at Nationales Konsiliarlabor für Dermatophyten, Institut für Mikrobiologie und Hygiene, Charité-Universitatmedizin, Berlin, Germany.

2.4. Statistical Analysis. The results and data obtained from the questionnaire distributed to the affected rice farmers were statistically analyzed using chi-square, Kruskal-Wallis, and Mann-Whitney tests. The results were tested for significant level of 0.05.

3. Results

Out of a total of 2,580 farmers screened for cutaneous infections, 201 (7.79%) persons were found to have lesions suggestive of fungal infection. The samples collected were positive by KOH and culture. The KOH mount showed fragments of septate hyphae in some samples and nonseptate in others. Among the study population with skin infection, 78 (38.81%) were males, while 123 (61.19%) were females. Ninety (44.78%) out of the 201 samples were from finger nail infection, 45 (22.39%) from toe nail, 27 (13.43%) from glabrous skin infection, 20 (9.95%) from feet infection, 12 (5.97%) from finger/toe web infection, and 7 (3.48%) from scalp infection. Table 1 shows the distribution of cutaneous mycoses according to site of infection, sex, and age of rice farmers. Analysis of cases of infection according to age of the rice farmers showed that infection was statistically significant with age ($P = 0.023$) and was recorded more in age group 16–30 years (47.76%), followed by age group 31–45 years (35.82%) (Table 1). Infection was also reported more among families living in crowded accommodation ($P = 0.0028$), farmers that shared facilities ($P = 0.000$) and those that kept pets/domestic animals ($P = 0.001$).

A total of 225 fungal isolates, comprising of 48 (21.33%) dermatophytes (Table 2) and 177 (78.67%) nondermatophyte molds (Table 3) were recovered from the samples. *T. rubrum* (11.11%) and *A. candidus* (16.44%) were the most frequently isolated dermatophyte and nondermatophyte molds, respectively. The isolates identified at Nationales Konsiliarlabor für Dermatophyten, Institut für Mikrobiologie und Hygiene, Charité-Universitatmedizin, Berlin, Germany, belonged to *Aspergillus scleriotorum*, *Aspergillus flavus*, *Aspergillus terrus*, *Eupenicillium javanicum*, *Penicillium aculeatum*, *Penicillium pinophilum*, and *Fusarium* species.

4. Discussion

The present study serves to emphasize the public health importance of fungal infection among rice farmers in Anambra State, Nigeria. Infection of the finger and toe nail was more than that of other parts of the body and more prevalent in females. The higher prevalence of this infection among females can be attributed to the fact that females use more of their fingers in rice cultivation and harvesting than males. This agrees with the reports of El Sayed et al., [20] and Souza et al. [21]. Souza et al. [21] reported that 72.25% of cases of onychomycosis from their study in Japan were among females, while Kazemi [22] and Charles [23] reported higher prevalence of this infection among males, even though their studies were not among rice farmers. This is also supported by the findings of Blank et al. [24] and Shenoi et al. [8] who reported a high rate of nail infection among paddy field workers in India.

Scalp infection was seen only in children and probably might have been transmitted through the infected hands of their mothers and other relations. Males (71.43%) had more of the infection than the females (28.57%). Oyeka [25] made the same observation and linked it to low personal hygiene of males compared to their female counterparts.

Table 1: Distribution of cutaneous mycoses according to site of infection, sex, and age of rice farmers.

Site of infection	Number of samples collected	Sex		Age			
		Males	Females	<15	16–30	31–45	>45
Finger nails	90 (44.78%)	19	71	1	48	32	9
Toe nails	45 (22.39%)	20	25	—	23	16	6
Glabrous skin	27 (13.43%)	10	17	—	15	8	4
Foot	20 (9.95%)	16	4	—	6	10	4
Finger/toe web	12 (5.97%)	8	4	—	4	6	2
Scalp	7 (3.48%)	5	2	7	—	—	—
Total (no)	201	78	123	8	96	72	25
Total (%)	100	38.81	61.19	3.98	47.76	35.82	12.44

Table 2: Species of dermatophyte molds isolated and their percentage occurrence.

Species of dermatophytes	Number of isolates	Percentage occurrence (%)
Microsporum audouinii	5	2.22
Microsporum ferrugineum	2	0.89
Trichophyton megnini	6	2.67
Trichophyton tonsurans	10	4.44
Trichophyton rubrum	25	11.11
Total	48	21.33

Table 3: Species of nondermatophyte molds isolated and their percentage occurrence.

Species of nondermatophytes	Number of isolates	Percentage occurrence (%)
Aspergillus terrus	24	10.67
Aspergillus candidus	37	16.44
Aspergillus scleriotorum	26	11.56
Aspergillus niger	11	4.89
Aspergillus flavus	26	11.56
Scopulariopsis sp.	18	8
Chrysosporium sp.	12	5.33
Eupenicillium javanicum	2	0.89
Fusarium sp.	11	4.89
Penicillium aculeatum	4	1.77
Penicillium pinophilum	6	2.67
Total	177	78.67

Farmers in age range 16–30 years recorded more infection than other age groups and could be explained by the fact that this age group is more actively involved in rice farming than the younger and older age groups and tend to sweat more.

Transmissibility of fungal infections among family members has extensively been reported in Nigeria [7, 13] and supports the findings of this study where higher rate of infection was reported among families living in crowded accommodation ($P = 0.0028$), those that shared facilities ($P = 0.000$) and those that kept pets/domestic animals ($P = 0.001$). These facilities and animals can act as reservoir of fungi/spores through which infection can easily be transferred to farmers.

An important observation made during this study was that rice farmers neither used boots nor hand gloves during their farm work, as the boots sink to the mud and reduce their speed of work according to these farmers. Nonuse of protective foot and hand wears exposes these farmers to agents of infections. Similar observation was made by Shenoi et al. [8]. Also observed was poor personal hygiene among these farmers which is a factor known to predispose persons to all kinds of infections including fungal infections [7, 26].

Trichophyton rubrum was the most frequently recovered dermatophyte (11.11%) in this study. It was the only fungal organism recovered from all the body sites except from finger/toe web. This agrees with the work of other researchers who reported *T. rubrum* as the commonest etiologic agent of dermatophytoses of different parts of the body [9, 27, 28]. This study also demonstrated that in addition to the cutaneous fungal infection causing dermatophytes, nondermatophyte molds are becoming very important etiologic agents of skin infection. Nondermatophyte molds were found to be more frequently isolated (78.67%) in this study than the usual dermatophytes (31.33%) especially in onychomycosis. Though some workers [22, 29] had reported dermatophytes to account for the majority of onychomycosis cases, epidemiological studies had also shown that *Aspergillus* sp. are emerging fungal agents of toe nail onychomycosis. It is now ranked second to *Scopulariopsis* sp. and then *Fusarium solani* in nondermatophyte onychomycosis [30–32]. *Aspergillus* sp. was the most predominantly isolated nondermatophyte molds in this study, followed by *Scopulariopsis* sp. and then *Chrysosporium* sp.; *Penicillium pinophilum*, *Penicillium aculeatum*, and *Eupenicillium javanicum* which were isolated in this work had not according to the literature been involved in skin infection. They had been reported to be frequently isolated from soil and are involved in the production and saccharification of different industrial enzymes like B-D-mannase, endoglucanase, β-glucosidase, and pectinase and in saccharification of polysaccharides of barley, oat and wheat straw, and Solka-Floc [33–36]. The ability of these organisms to produce the abovementioned enzymes could explain their ability to also degrade the keratinized areas of the skin. The high frequency in isolation of nondermatophyte molds as

observed in this study could be attributed to their regular isolation from water, air, soil, and vegetation as recorded by Oyeka and Okoli [11] and Cribier and Bakshi [29]. This makes their chances of getting in contact with the human skin high, giving rise to opportunistic infection.

5. Conclusion

At the end of this study, it was observed that cutaneous fungal infection of the nails was the most prevalent. Care therefore must be taken to control the spread of this infection since these farmers share public utilities with the masses. It was also noted that in addition to dermatophytes, nondermatophyte molds are now very important etiologic agents of skin infection especially in onychomycosis. Further test will be carried out to determine the pathogenicity of *Penicillium pinophilum*, *Penicillium aculeatum*, and *Eupenicillium javanicum* recovered in this work.

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