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Prevalence of Fungi Skin Infections Among Individuals with Skin Lessions in Enugu East Community

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ABSTRACT

Superficial and cutaneous skin infections constitutes a major public health challenge globally. These fungal skin infections normally cause dis-figuration of skin, finger and toe nails. The goal of this study was to determine the occurrence and risk factors among children, adolescents and adults in rural dwellers of Enugu East local government Area , Enugu Nigeria. This was a cross-sectional study that enrolled individuals with skin lesions in any part of the body. The pupils and adolescents were recruited from primary and secondary schools while the adults were recruited from churches and primary health care clinics. Skin scrapping were collected from the various part of the body, head, finger and toe nails and affected hair strands. The samples were analysed mycologically using sabouraud dextrose agar and corn meal agar with actidione. A total of 211 persons with skin lesions were analysed. They comprised of 42.7% (90/211) pupils; 33.2% (70/211) adolescents and 24.1% (51/211) adults. The mean age of the pupils, adolescents and adults were 6.9 ± 1.68, 12.29 ± 2.3 and 29.53 ± 8.6 year olds respectively. The prevalence rate of fungal isolates from pupils, adolescents and adults were 36.97%, 30.8% and 21.8% respectively. Among the pupils and adolescents, *tinea capitis* and *tinea corporis* at a frequency of 13.2% and 7.9%, were prevalent, while *tinea unguium* 6.3% was more among the adults. The fungal agents isolated comprised majorly of 19.0% *Trichophyton soudanense,* 11.4% *Trichophyton rubrum, 10.9% Microsporum audounii and 6.6% Trichophyton mentagrophytes.* Both *Aspergillus fumigatus, Aspergillus flavus* and *Malasessia furfur were* obtained at prevalence rate of 6.6%, 5.7% and 1.4%. The high occurrence of fungal skin infections among the different age groups remains public health problem. This is because these fungal agents may penetrate dermis and induce systemic infections, and / or cause dis-figuration of the skin. It is hereby suggested that health workers of the primary health centers be empowered to routinely educate the populace on good hygiene practices.

INTRODUCTION

Background of the study

Fungal infection of the skin is a common public health problem globally with associated morbidity among affected individuals (Olaide *et al*., 2014). Children are the epicentre of fungal skin infection due to associated favourable predisposing factor predominant among them such as overcrowding, poor environmental and personal hygiene. pre-pubertal factors, the on-set and late reporting to healthcare center, immigration, culture and socioeconomic dispositions have great implication for the proliferation of dermatophytosis. (Olaide *et al*., 2014, Ndako *et al.*, 2012). Fungi skin infections can be classified into two broad categories namely*; Superficial skin infection* (Superficial mycoses) *and Cutaneous skin infections* (Cutaneous mycoses) .

Pityriasis versicolor is a chronic superficial infection of the stratum corneum caused by Malassezia globosa, Malassezia restricta, and other members of the Malassezia furfur complex (Thomas Mitchell, 2013). Although the lipophilic yeast Malassezia is part of the normal cutaneous microflora of the skin in most warm blooded vertebrate, they may become occasional pathogen when there is alteration in the skin microclimate architecture or host defense occurs (Narain Gupta., 2016) The invasion of the cornified layers of skin illicit mild host immune

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response producing a discrete, serpentine, hyper-, or hypopigmented maculae on the skin, predominantly onthe chest, upper back, arms, or abdomen (Thomas Mitchell,. 2013, Gemmer *et al.,* 2002, Shokohi T, *et al.,* 2009). Pityriasis versicolor produces chronic lesions which occur as macular patches of discoloured skin that may enlarge and coalesce, with moderate inflammation, irritation and scaling (Thomas and Mitchell, 2013, Enemuo and Amedu., 2009) Malassezia species are lipophilic or lipid-dependent yeasts, and at least some belong to the normal cutaneous microflora (Thomas Mitchell, 2013, Gemmer *et al*., 2002) and thus require lipid in the medium for growth. Although for decades the genus Malassezia remained limited to two species; the lipid dependent Malassezia furfur and the lipophilic M. pachydermatis. Whereas their contribution to skin diseases is under investigation (Shokohi, *et al.,* 2009., Sugita., 2004), the diagnosis is by direct microscopic examination of scrapings of infected skin, treated with 10–20% potassium hydroxide (KOH) or stained with calcofluor white. Short unbranched hyphae and spherical cells observed in the preparation indicate its confirmation. The lesions also fluoresce under Wood's lamp. Pityriasis versicolor is treated with daily applications of selenium sulfide. Topical or oral azoles are also effective (Thomas Mitchell, 2013). Other minor superficial mycoses are Tinea nigra, white piedra and black piedra (Enemuo and Amedu., 2009).

The fungi infections of the skin (Cutaneous) are majorly dermatophyte infections of the superficial layer of the skin as dermatophytes invade and propagate in the keratinized tissues of the body such as the skin, hair and nails (Oumar *et al.,* 2018). Dermatophytes infects various parts of the body and propagate in outward pattern on the skin; producing a ring-like lesion; hence the name "Ring worm" (Oumar *et al.,* 2018). Lesions are clinically classified according to anatomical locations: tinea capitis- on the scalp, tinea pedis- on the foot, tinea corporis- on the body, tinea cruris- on the groin, tinea manuum- hand, tinea unguim- nails, tinea barbae- on the beard areas of the body.

Superficial mycoses involve only the outer most layer of skin hair or nails usually non- inflammatory eg are pityriasis versicolor caused by malassezia furfur, Other minor superficial mycoses are Tinea nigra, white piedra and black piedra (Enemuo and Amedu., 2009).

Dermatophytes requires keratin for growth and propagation, and are therefore restricted to the hair, nails and superficial layer of the skin. They do not propagate or infect mucosal surfaces (Barry, 2003). Less frequently fungi skin infection is caused by some non-dermatophytes yeast such as Candida species (Rai and Wankhade., 2009). Dermatophytes which are the etiological agent for dermatophytosis of the skin are grouped into three distinct genera namely; . *Epidermophyton*, . *Microsporum*, . *Trichophyton* (Nweze& Eke., 2018). Though dermatophytosis is worldwide in distribution, predominant risk factors vary from one region to the other, with higher prevalence in developing countries (Nweze., 2010, Nweze & Eke., 2016). Poor hygiene, overcrowding, low economic status, age and sex, remains the major risk factors for fungi skin infections (Moto *et al*., 2015). Fungi skin infections are transmited through skin contacty from infected humams ; anthropophilic, animals; zoophilic and contaminated soil ; geophilic route (mark and marianthe 2008).

Justification

The burden of tinea infections among-st the populace remains a significant public health concern, with potential long-term consequences, due to dissemination to the dermis and inducing systemic fungal infections. In rural and sub-urban settlements, in Nigeria,fungal skin infection is poorly understood. It is characterized by lack of adequate data on the distribution of species, prevalence, and risk factors, which hinders the effective control / prevention strategies and development of targeted public health interventions.

The goal of this study was to determine the prevalence of fungal skin infections among different age groups in Enugu, Nigeria. The study assessed the risk factors affecting the such infections within the populace.

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MATERIAL AND METHOD

Study Area

The study area was semi-urban and rural settlements of Enugu East Local Government Area of Enugu State., within the out skirts of Enugu metropolis with an area of 383KM^2 and has a population of about 397,700 people according to 2022 census projection. The study was carried out between April 2022 to December 2023 .

The study involved children, adolescents and adults in rural community and semi urban area of Enugu East LGA. The majority of the residents are of Igbo ethnic group, the inhabitants are people with different educational background and religious beliefs. The working class population consists of individuals in various occupations, mostly subsistence farming, palm wine tapping, livestock rearing, trading and the civil service in some semi urban part of the LGA. The population of the area range between 2- 3 million people (NPC 2006 and 2022).

Study Design

The study adopted cross-sectional method which involved humans with skin rashes/ringworm lesions. The study subjects consisted of three groups which included ,pupils (children), adolescents and adults recruited from their schools, churches and health care centers. These different categories of subjects were enrolled to check the spread of fungal agents within the communities. The subjects with skin, finger nail, hairs, toe nail that voluntarily agreed to participate were enrolled.

The subjects were administered with a different structured questionnaire to obtain information on demographic characteristics and risk factors. The parent or the guardian of the children helped to complete the questionnaire for the children, while the adolescents and adults completed the questionnaire with little or no assistance.

Collection of skin scrapping: The collection of skin scrapping samples was based on consecutive sampling technique. This involved the sampling of all participants with any skin lesion that agreed to participate in the study. Scalped blades were used to collect skin scrapping from those with skin lesions.This was placed in dry wide mount containers and transported to the laboratory for analysis.

Fungal Culture: The skin scrapping were processed mycologically. Briefly, the scrapping were inoculated unto sabouraud dextrose agar supplemented with actidion and / or chloramphenicol antibiotics. These were incubated at 35^{o}c and observed daily for fungal growth for 21days. Those without growth were discarded while those with fungal growth were identified using mycological methods.

Fungal Identification: The fungal isolates were identified using lactophenol cotton blue mount, while those with yeast - like colonies were gram - stained and those that showed budding cells were identified by germ tube test.

Ethical Consideration

Ethical approval was obtained from Enugu state Research Ethics committee with reference number MH/MSD/REC21/633. Ministry of Health Nigeria

Statistical Analysis:

The fungal isolates were matched with the questionnaires in accordance with the age groups. descriptive statistics were employed to obtain the mean and standard deviation of the variables, and percentages. chi-square statistic was used to compare the variables and significance value taken at $p \leq 0.05$.

RESULTS

Characteristics of The Study Subjects

A total of 211 individuals with skin lesions were enrolled for this study, distributed as follows, pupils 42.7% (90/211), adolescents 33.2% (70/211) and adults 24.1% (51/211)..

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In General, they comprised of 50.7%(107/211) males and 49.3% (104/211) females. The mean age of the pupils, adolescence and adults were 6.9± 1.68 (range 3-9 years old) 12.29± 2.3 (range 10-17 year old) and 29.53± 8.6 (range 18-58 year-old) respectively. Majority of the pupil were of the age group of 6-8 constituting 27.5% (58/211) while the adolescents were more in age group 10-13 with 24.2% (51/211) and in adults the age group of 18-27 years old constituted 10.9% (23/211). (Table 1)

Table 1: Characteristics of the Study Subjects

Variables (n-211)	**Frequency**	**Percent**
Sex		
Male	107	50.7
Female	104	49.3
Category of subject		
Pupils	90	42.7
Adolescents	70	33.2
Adults	51	24.1
Age categories (in years)		
Pupils		
3-5	20	9.5
6-8	58	27.5
9	12	5.7
Adolescents		
10-13	51	24.2
14-17	19	9.1
Adults		
18-27	23	10.9
28-37	21	9.9
≥38	7	3.3

Frequency of Risk Factor for Tinea Infections

The risk factors peculiar to each of the study subjects were assessed among the pupils, the number of household members indicated that majority were 4-6 persons per household and they accounted for 67.8% (61/90), while adolescent and adults, they agreed that having 4-6 persons per house constituting 60% (42/70) and 54.9% (28/51) respectively. Majority of the subjects agreed to having contacts with pet animals such as dog and cats accounted for 47.9% (42/211). The source of water is very important and among all groups the source of water were mainly well water and River. The river especially is shared with animals as source of water for domestic use Personal

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hygiene indicated that majority had their bath 2 times per day, and many had previous history of ringworm constituting 61.1% (55/90) and 90.0% (81/70) respectively (Table 2).

Table 2: Frequency of Risk Factors for Tinea Infections

Variables	Pupils (n=90)	Adolescent(n=70)	Adults(n=51)	Total (n=211)
Number in household				
1-3	11(12.2%)	4(5.7%)	4(7.8%)	19(9.0%)
4-6	61(67.8%)	42(60.0%)	28(54.9%)	131(62.1%)
≥7	18(20.0%)	24(43.3%)	19(37.3%)	61(28.9%)
Domestic animal at home				
Yes	42(46.7%)	38(54.3%)	40(78.4%)	120(56.9%)
No	48(53.3%)	32(45.7%)	11(21.6%)	91(43.1%)
Contact with pets (animals)				
Yes	42(47.9%)	42(60.0%)	41(80.4%)	126(59.7%)
No	48(52.2)	28(40.0%)	10(19.6%)	85(40.3%)
Sources of water use				
Well water				
Yes	46(51.1%)	49(70.0%)	22(43.1%)	128(60.7%)
No	44(48.9%)	21(30.0%)	29(56.9%)	83(39.3%)
Rivers/Stream				
Yes	19(21.1%)	17(24.3%)	22(43.1%)	58(72.5%)
No	71(78.9%)	53(75.7%)	29(56.9%)	153(72.5%)
Tap water				
Yes	5(5.6%)	0(0.0%)	2(3.9%)	7(3.3%)
No	85(94%)	70(100.0)	49(96.1%)	204(96.7%)
Tanker water				
Yes	25(27.8%)	10(14.3%)	12(23.5%)	47(22.3%)
No	65(72.2%)	60(85.7%)	39(76.5%)	164(77.7%)
Sharing water source with animals(River/stream)				

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Yes	27(30.0%)	14(20.0%)	12(23.5%)	53(25.1%)
No	63(70.0%)	56(80.0%)	39(76.5%)	158(74.9%)
Number of baths per day				
Once	30(33.3%)	32(45.7%)	18(35.3%)	80(37.9%)
Twice	55(61.1%)	36(51.4%)	30(58.8%)	121(57.4%)
Thrice	5(5.6%)	2(2.9%)	3(5.9%)	10(4.7%)
History of Ringworm				
Yes	81(90.0%)	62(88.6%)	40(78.4%)	178(84.4%)
No	9(10.0%)	8(11.4%)	11(21.6%)	33(15.6%)

Summary of Fungal Isolates from Respondents:

A total of 211 skin scrapping were collected from the subjects and subjected to mycological studies. Of the skin scrappings 89.6% (189/211) had fungal growths while 9.0% (19/211) had no fungal growth. The prevalence of fungal growth among the pupils, adolescents and adults were 36.97% (78/211), 30.8% (65/211) and 21.8% (46/211) respectively. It was observed that there was no mixed fungal growth in Sabourand dextrose Agar cultures. The fungal isolates obtained were *Aspergillus* species, molds and dermatophytes. Among the *Aspergillus* speices, *Aspergillus Niger* and *Aspergillus flavus* was obtained from pupils at a prevalence rate of 0.9% and 4.7% respectibely.

Aurobasidium pullulans was obtained from the adolescents at prevalence rate of 0.9%, and adults at 0.5%, while cladosporium spp was obtained at 0.5%. Among the pupils, adolescents and adults, ***penicillum species*** were obtained at frequency of 1.4% 1.9% and 0.5% respectively. *Malassezia furfur* was obtained from adolescents and adults at 0.5% and 0.9% respectively. while *sporothrix schenckii, mucor spp* and *fusarium spp* was obtained from adults only at frequency of 1.4%, 0.5%, and 1.4% .

The *yeast, Candida albicans* was isolated at frequency of 0.9%, 3.8% and 0.5 from pupil's adolescents and adults respectively. *Trichophyton soudenecese* was obtained at a frequency of 8.1%, 5.2% and 5.7% amongst the pupils, adolescents and adults respectively.

Microsporum audounii was obtained from the pupils, adolescents and adults at frequency rate of 6.6%, 2.6%, and 1.4% respectively. Other dermatophytes isolated were *Trichophyton mentagrophytes, Trichoplyton tonsurans* which was obtained from the pupils a prevalence rate of 4.3%, 3.3%, 0.5% and 0.5% respectively, whereas *Trichoplyton rubrum, Trichoplyton schoenlenii, Trichophyton tonsurans* was obtained from adolescent at frequency of 4.7%, 1.9% and 0.5%. *Trichoplyton interdigitales* occurred in an adolescents and adults at frequency rate of 1.4% and 3.8% respectively. (Table 3).

Table 3: Summary Of Fungal Isolates From The Subjects **(n=211)**

Fungal Isolate	**Pupils n=90(%)**	**Adolescents n=70 (%)**	**Adults n=51(%)**	**Total %**
Aspergillus Niger	2 (0.9)	-	-	2 (0.9)
Aspergillus flavus	10 (4.7)	2 (0.9)	-	12 (5.7)
Aspergillus, fumigatus	10 (4.7)	3 (1.4)	1 (0.5)	14 (6.6)

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AspergillusTerrus	1 (0.5)	1 (0.3)	-	2 (0.9)
Aureobasidium Pllutans	-	2 (0.9)	1 (0.5)	3 (1.4)
Candida albicans	2 (0.9)	8 (3.8)	1 (0.5)	11 (5.2)
Microsporum audounii	14 (6.6)	6 (2.8)	3 (1.4)	23 (10.9)
Cladosporum spp	1 (0.5)	3 (1.4)		4 (1.9)
Penicillium notatum	3 (1.4)	4 (1.9)	1 (0.5)	8 (3.8)
Trichophyton mntagrophytes	9 (4.3)	4 (1.9)	1 (0.5)	14 (6.6)
Trichophyton interdigitales	-	3 (1.4)	8 (3.8)	11 (5.2)
Trichophyton rubrum	7 (3.3)	10 (4.7)	7 (3.3)	24 (11.4)
Trichophyton schoenlenii	1 (0.3)	4 (1.9)	-	5 (2.4)
Trichophyton tonsurans	1 (0.3)	1 (0.5)	1 (0.5)	3 (1.4)
Trichophyton soudenecese	17 (8.1)	11 (5.2)	12 (5.7)	40 (19.0)
Fusarum	-	-	3 (1.4)	3 (1.4)
Malassezie furfur	-	1 (0.5)	2 (0.9(	3 (1.4)
Sporothrix schenckii	-	-	3 (1.4)	3 (1.4)
Trichophyton verrucosum	-	2 (0.9)	1 (0.5)	3. (1.4)
Mucor		-	1 (0.5)	1 (0.5)
No Growth	12 (5.7)	5 (2.4)	2 (0.9)	19 (9.0)
Total isolates	78 (36.97)	65 (30.8)	46 (21.8)	211 (100%)

Distribution of Fungal Isolates According to Body Sites in Pupils

The distribution of fungal isolates among the pupils indicated that majority *of Aspergillus* species were from the head, and the body/stomach. *Aspergillus flavus*, *Aspergillus fumigatus* and *Aspergillus terrus were* obtained from the head lesions at frequence of 5.1% (4/78) 7.6% (6/78) and 1.3% (1/78) while *Aspergillus niger*, *Aspergillus flavus* and *Aspergillus fumigatus* were obtained from stomach skin scrapping at frequence of 2.6% 7.6% and 5.1% respectively. The *yeast candida albicans* was isolated from the stomach lesion at frequence of 2.6%. Penicillum *spp* was only isolated from the head of the pupils. A total of 21.8%, 17.3% 11.5% and 9.0% of *Trichophyton soudeneces*, *Microsporum audounii*, *Trichophyton mentagrophyte* were respectively obtained from the various lesions of pupils. (Table 4)

Table 4 Distribution of **F**ungal Isolates According to Body Sites in Pupils

Fungal Isolates n = 78	**Head**	**Stomach**	**Chest**	**Toe**	**Total**
Aspergillus niger	-	2 (2.6)			2 (2.6)
A flavus	4 (5.1)	6 (7.6)			10 (12.5)

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A fumigatus	6 (7.6)	4 (5.1)			10 (12.5)
A Terrus	1 (1.3)				1 (0.5)
Candida albicans	-	2 (2.6)			
Penicillium notatum	3 (3.8)				3 (3.8)
Microsporum audounii	14 (17.9)				14 (17.9)
Cladosporum spp		1 (1.3)			1 (1.3)
T. Mentagorphyes	3 (3.8)	3 (3.8)	1 (1.3)	2 (2.6)	9 (11.5)
T. Rubrum	2 (2.6)	5 (6.4)			7 (9)
T. Schonilenii				1 (1.3)	1 (1.3)
T. Tonsurans				1 (1.3)	1 (1.3)
T. Soudenesce	6 (7.6)	7 (9)	4 (5.1)		17 (21.8)
Total Isolates	**39**	**30**	**5**	**4**	**78**

Distribution of Fungal Isolates According to Body Site in Adolescents:

A total of 23.1% , 36.9% , 9.2% , 23.1 and 9.6% fungal isolates were obtained from the head, stomach, chest, toe nails and finger nails respectively. The prominent dermatophytes isolated was *Trichophyton soudenecese*, which was isolated from all parts of the body except the finger nails. *Trichophyton rubrum* was obtained from the head, stomach, toe and finger nails, but not in the chest lesions. The least fungal isolates were *Aureobasidium pullulans*. *Trichophyton tonsurans* and *Malassisia furfur* at a frequency of 1.5% each. (Table 5)

Table 5: Distribution of Fungal Isolates According to Body Site Fungal in Adolescents

Variable	**n**	**Head (%)**	**Stomach**	**Chest**	**Toe**	**Finger**	**Total**
Aspergillus flavus	2		2(3.1)	-	-	-	2 (3.1)
Aspergillus fumigatus	3		3(4.6)	-	-	-	3(4.6)
Aspergillus terrus	1	1(1.5)	-	-	-	-	1(1.5)
Aureobasidium	2		2(3.1)	-	-	-	2(3.1)
Candida. Albicans	8				5(7.6)	3(4.6)	8(2.8)
Microsporum audounii	6	4(6.2)	2(3.1)	-	-	-	6(9.2)
Cladosporum	3	-	3(4.6)	-	-	-	3(4.6)
Penicillium	4	1(1.5)	3(4.6)	-	-	-	3(4.6)

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T. Mentagorphytes	4	1(1.5)	2(3.1)		1(1.5)		4(6.2)
es	3	-	-	-	3(4.6)		3(4.6)
phyton rubrum	10	4(6.2)	3(4.6)		2(3.1)	1(1.5)	10 (15.4)
Trichophyton. scholenii	4	2(3.1)	1(1.5)	-	1(1.5)	-	4(6.2)
Trichophyto ntonsuran	1	1(1.5)	-	-	-	-	1(1.5)
T.Soudeneceses	11	1(1.5)	1(1.5)	6(9.2)	3(4.6)	-	11(16.9)
Malassia furfur	1(1.5)	-	1(1.5)	-	-	-	1(1.5)
Trichophyton.Verrucosum	2	-	1(1.5)	-	-	1(1.5)	2(3.1)
Total	**65**	**15(23. 1)**	**24(36.9)**	**6(9.2)**	**15(23.1)**	**5(7.6)**	**65**

Fungal Isolates from the Adults:

The adults with fungal skin infections had majority of the isolates from the finger nails at prevalence rate of 38.8% (16/46), this was followed by infections in the chest and stomach region at frequency of 19.6% (9/46) and 17.4 (8/46) respectively. The toe nails and scalp had fungal isolates of 19.6% (9/46) and 8.7% (4/46). The prominent fungi obtained was *Trichophyton soudenesces* at rate of 26.1% (12/45) (Table 6).

Table 6: Distribution of Fungal Isolates According the Body Site in Adults

Fungal Isolate	n	Head	Body/stomach	Chest	Toe	Finger	Total
A fumigatus	1		-	-	-	1(2.2)	1(2.2)
Aerobasidium	1		1(2.2)	-	-	-	1(2.2)
Candida albicaus	1		1(2.2)	-	-		1(2.2)
MicrosporumAudounii	3		-	-	1(2.2)	2	3(4.5)
Penicillium	1		1(2.2)	-	-		1(2.2)
T. Mentagorphyte	1		-	-	-	1(2.2)	1(2.2)
T. Interdigitalis	8		-	-	4(8.6)	4(8.6)	8(17.4)
Trichophyton. rubrum	7	3(4.5)	-	4(8.6)	-	-	7(15.2)
Trichophyton. Tonsuran	1	1(2.2)	-	-	-	-	1(2.2)
s	12		1(2.2)	3(6.5)	3(6.5)	5	12(26.1)
um	3		3(4.6)	-	-	-	3(6.5)
Malasiza fur fur	2		-	2(4.3)	-	-	2(4.3)

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Sporothirx.schenkii	3		1(2.2)	-	1(2.2)	1(2.2)	3(6.5)	
T.Verrucosum	1		-	-	-	1(2.2)	1(2.2)	
Mucor	1		-	-	-	1(2.2)	1(2.2)	
Total	**46**	**4(8.7)**	**8(17.4)**	**9(19.6)**	**9(1.6)**	**16(38.8)**		**46**

Distribution of *Tinea* Infections Among the Subjects:

Categorization of Tinea Infections indicated that dermatophytes, opportunistic molds and yeast were isolated from the skin lesion collected from the subjects. *Tinea capitis* was isolated from 13.2% (25/189), 7.9% (15/189) and 2.1% (2/189) from the pupil's adolescents and adults respectively. The presence of *Tinea ungium* was observed in 1.1% (2/189) adolescents and 6.3% (12/189) adults where as *Tinea corporis* was obtained from 10.6% (20/189) 7.4% (14/189) and 5.8% (11/189) among the pupils, adolescent and adults respectively.

Tinea pedis was obtained at a prevalence rate of 2.1% (4/189), 5.2% (10/189) and 3.7% (7/189) respectively. The opportunistic fungal agent *Aspergillu*s species was observed in 12.2% (23/189), 3.2%) (6/189 (0.5% (1/189) among the pupils, adolescents and adults respectively. The molds groups of fungal and the yeast were isolated at overall frequency of 12.7% (24/189) and 5.8% (11/189) (Table 7).

Table 7: Distribution of Tinea Infection Among the Subjects

Tinea infection	**Pupils (%)**	**Adolescents (%)**	**Adults**	**Total**
Tineacapitis	25 (13.2)	15 (7.9)	4 (21)	44(23.3)
Tinea unguim	0	2 (1.1)	12 (6.3)	14(7.4)
Tinea corporis	20 (10.6)	14 (7.4)	11 (5.8)	45(23.8)
Tinea pedis	4 (2.1)	10 (5.3)	7 (3.7)	21(11.1)
Opportunistic Fungal				
Aspergillus species	23 (12.2)	6 (3.2)	1 (0.5)	30(15.9)
Molds	4 (2.1)	10 (5.3)	10 (5.3)	24(12.7)
Yeast	2 (1.1)	8 (4.2)	1 (0.5)	11(5.8)
Total	**78 (41.3)**	**65(34.4)**	**46 (24.3)**	**189**

Association Between Fungal Isolates Among the Pupils and Demographics

Among the pupils the females had more fungi infections than the males at frequency of 19.4% and 17.5% respectively though not statistically significantly. The age group of 3-5, 6-8, and ≥ 9 year old had prevalence rate of 7.1%, 23.7% and 6.1% respectively. The presence of domestic animals at home indicated that subjects that agreed to having pet animals had fungal infection of 18.0%, while those that agreed to sharing the same stream with animals had fungal infections of 12.8%. The individuals with 4-6 persons in the household had the highest yield of fungi with 24.6%, while those that bath two times per day had the highest fungal isolates of 21.8%, those with previous ringworm infection had the highest number of fungal isolate at frequency rate of 33.2% (Table8).

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Table 8: Association between fungal isolates among the Pupils and Their social demographic

Variables	No. of fungal isolates (%)		P-value
Sex			
Male	37	17.5	0.968
Female	41	19.4	
Age group (in years)			
3-5	15	7.1	
6-8	50	23.7	0.166
9	13	6.1	6.1
Number in household			
1-3	10	4.7	0.905
4-6	52	24.6	
7-9	16	7.6	
Domestic animal at home			
Yes	38	18.0	0.214
No	40	18.9	
Contact with domestic animal			
Yes	36	17.0	0.579
No	42	19.9	
Source of water			
Well water	39	18.5	0.964
Rivers/stream	17	8.0	
Tap	5	2.4	
Tanker	17	8.0	
Animals using the river/stream			
Yes	27	12.8	0.098
No	51	24.1	
Number of baths per day			
Once	28	13.3	0.105

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Twice	46	21.8	
Thrice	41	1.8	
History of ring worm			
Yes	70	33.2	0.613
No	8	3.7	
Presence of crack in the classroom			
Yes	66	31.3	0.419
No	12	5.6	
Sitting on the floor			
Yes	22	10.	0.214
No	56	26.5	
Sandy play ground			
Yes	69	32.7	1.000
No	9	4.2	
Presence of sand on pupil's head			
Yes	77	36.5	<0.001
No	1	0.4	

Association of Fungal Isolates Among Adolescents

In adolescents the males had more fungal isolates than the female accounting 17.5% and 13.5% respectively. The age group of 10-13, 14-17 year old had a frequency of 21.8% and 9.0%. Those that had contact with domestic animals had 18.0%. the number of persons per household showed that these between 4-6 and 7-9 had a yield of fungal isolate at a frequency of 18.5% and 10.4% respectively (Table9). All the risk factors were not statistically significant.

Table 9. Association Between Fungal Isolates Among Adolescents and Social Demographic

Variables	**No. of fungal isolates (%)**		**P-value**
Sex			
Male	37	17.5	1.000
Female	28	13.3	
Age group (in years)			
10-13	46	21.8	0.313

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14-17	19	9.0	
Number in household			
1-3	4	1.9	1.000
4-6	39	18.5	
7-9	22	10.4	
Domestic animal at home			
Yes	34	16.1	0.641
No	31	14.7	
Contact with domestic animal			
Yes	38	18.0	
No	27	12.8	
Sources of water			
Well water	40	18.9	1.000
Rivers/stream	16	7.6	
Tap	9	4.3	
Tanker			
Animals using the river/stream			
Yes	13	6.2	1.000
No	52	24.6	
Number of baths per day			
Once	30	14.2	1.000
Twice	33	15.6	
Thrice	2	1.0	
History of ringworm			
Yes	57	27.0	1.000
No	8	3.8	

Relationship between the Socio-Demographic Characteristic and fungal isolates among adults

In adults, the females had predominance of fungal isolates at a frequency of 12.3% against the males with 9.4%. The age group of 18-24 and 28-37 had a yield of 10.0% as against those of 38-47 and 48+ with 1.4% and 0.4% respectively. The individual that agreed to having 4-6 and 7-9 persons per household had a frequency of fungal

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isolates at 11.4%, 8.5% respectively as against those with 1-3 persons per household with a yield of 1.9%. A fungal yield of 16.6% was obtained from the adults that harbor domestic animal at their homes while those that had direct contact with the animal had 17.5% of the total fungal isolates. (Table10)

Table 10: Relationship Between the Socio-demographic Characteristics and the Number of Fungal Isolates Among Adult Respondents

Variables	**No. of fungal isolates (%)**		**P-value**
Sex			
Male	20	9.4	0.235
Female	26	12.3	
Age group (in years)			
18-27	21	10.0	0.621
28-37	21	10.0	
38-47			
≥48			
Number in household			
1-3	4	1.9	1.000
4-6	24	11.4	
7-9	18	8.5	
Domestic animal at home			
Yes	35	16.6	1.000
No	11	5.2	
Contact with domestic animal			
Yes	37	17.5	0.357
No	9	4.3	
Sources of water			
Well water	15	4.7	1.000
Rivers/stream	18	8.5	
Tap	1	0.5	
Tanker	12	5.7	
Animals using the river/stream			

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Yes	11	5.2	0.419
No	35	16.0	
Number of baths per day			
Once	17	8.0	1.000
Twice	27	12.8	
Thrice	2	1.0	
History of ringworm			
Yes	35	16.6	1.000
No	11	5.2	

DISCUSSION

The skin protects the human body against pathogenic superficial fungal infections thereby maintaining good skin architecture. In some circumstances individuals may lose the integrity of the skin due to certain environmental factors such as knife cut or poor hygiene. Children, adolescents and adults may not be exempted from such skin infections due to contact with soil, barbing saloons and domestic animals. The individuals infected with such fungal infections may carry it for longer period of time due to poor treatment options available to them.

Thus, the goal of this study was to determine the superficial skin infections among-st primary school children (pupils), adolescents and adults in Enugu East L.G.A. The prevalence rate of fungi superficial skin infections among the pupils, adolescents and adults was 36.9%, 30.8% and 21.8% respectively. These indicated that superficial skin infection is prevalent among the populace. Similarly, in primary school pupils, Anosike *et al* (2005) obtained 21.1% of ringworm infections in parts of Eastern Nigeria. In a similar study among school children Oke *et al* (2014) reported 35% of ringworm infections in Ile-ife while higher prevalence of 58.2% was reported among school children in Kano by Nduako *et al* (2012). These results showed that ringworm infection among school children is common in most parts of Nigeria.

In this study the prevalence rate of ringworm infection among adolescents, aged 10-17 was 30.8 %. Among these age groups Ezomuike *et al* (2021) reported 60.7% ringworm infections. The implications of these group being infected with ringworm is of public Health concern. This is because these group can care for themselves and their little ones in primary school, therefore they may constitute source of transmission route to their younger ones. The adult had the less prevalence rate of 21.8%, this was in contrast to the report of Joseph *et al* (2024) that reported prevalence of 20.1% ringworm infection among adults in Akwa Ibom Nigeria. It is rear for adults to harbor ringworm infection because they are expected to practice good hygiene and take good care of their body; the occurrence of 21.8% of fungal infection among the adults is of concern especially the within a rural populace. To maintain good personal hygiene among the adult calls for advocacy programs by primary health care clinics on the need for personal hygiene and notification of such infections and the need for proper health care.

In this study, Tinea capitis ranked highest among the pupils and adolescents while in adults' tinea unguium was most prominent.

Tinea Corporis was observed in pupil's, adolescents and adults. Tinea pedis was also recorded among all the groups, pupils, adolescents and adults. Dermatophyte infections of the scalp, (*Tinea capitis*) remain the major health concern among the populace.

In this study 13.2%, 7.9% and 2.1% of Tinea capitis was obtained from the pupil's adolescents and adults respectively. This indicated an increasing phenomenon of tinea capitis from the pupils than adults. The reasons

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for this was that pupils are more prone to dermatophyte infections due to constant playing with soil which is the reservoir for the dermatophytes. The occurrence of Tinea capitis in adults is a chance occurrence, It may be as result of contact with an infected child or obtained from the saloon equipment's while modeling their hairs. Bonigumin *et al* (2017) estimated that Nigeria ranked highest in the world with 76.1% of Tinea capitis occurrence. Thus it is not surprising that both children, adolescents and adult were affected by Tinea capitis. The implication of this is that such affected individuals may have scaling of the scalp, subcutaneous and cutaneous spread of these agents may occur.

The most occurring dermatophytes were *Microsporum audounii, Trichophyton Mentagrophytes, Trichophyton rubrum, T. tonsarans* and *T. sondanencesces*, all these fungal have the capacity to induce scalp scaling and inflammatory lesions that can lead to subcutaneous and cutaneous infections. Thus the occurrence of onchomycosis among the adults is of natural infection, not influenced by any co-infections. For instance, Idris *et al (2024) reported a prevalence rate of 63.3%* Tinea unguim (*onchomycosis*) among daibetic patients. Thus, *Tinea unguim* in adults especially in rural areas may result from non- proper washing of hands after farming activities.

Dermatophyte infection of the body, tinea corporis was obtained at a frequency of 10.6%, 7.4% and 5.8% among the pupil's, adolescents and adults respectively. Personal hygiene like cleanliness of clothes plays an important role in dermatophyte infection of the body. The dermatophytes implicated in this Tinea corporis were *Microsporum audounii*, *Tnchophyton rubrum*, *Trichophyton soudanenceses* and *T. Verrucosum*. The implication of this was the scaling of skin and itchings, and body odour. Akabas *et al (2016)* reported 26% of Tinea corporis in adolescents. this indicated that tinea corporis affects all ages and presents as body nuisance.

Tinea pedis and athletes foot are vital dermatophyte infections that can lead to the removal of the toe nails and ulceration of in between the toe nails. In both pupil's adolescents and adults, dermatophytes infections were obtained at prevalence rate of 2.1%, 5.3% and 3.7% respectively. The 5.3% Tinea pedis en-counted among the adolescents, was an indication that the group are more affected with ringworm of the toe webs. In a similar study, it was established that tinea pedis occurs in adolescents more than any other group. In Turkey the range of Tinea pedis between adolescents was 2.6% and 4.6% (Dura et al., 2011; Kava *et al*, 2011).

Duro, N.W (2003) reported 16.5% of ringworm of toe web infections in Jos Nigeria. The infection of the toe web and the nails is of importance because it can spread at home through desquamatoed scales adhering to moist surfaces such as bathrooms or changing room floor. It can be spread through sharing of shoes and foot wears.

The opportunistic fungal infections are non- dermatophytes that can colonize any part of the body system without being detected or from dermatological hospital units, this fungus included the Aspergillus spieces, mold and yeasts. There can co-infect with dermatophytes on the inflammatory lesion created by the invading dermaphytes fungi.

There are differences among the *Aspergillus* infections for instance, *Aspergillus flavus* was obtained from the scalp and body region of the pupils while it was only obtained from the stomach region of the adolescents along with *Aspergillus fumigatus*, only *Aspergillus fumigatus* was obtained from the finger nails of the adults. Of importance was *Candida albicans spp* that was obtained from body/chest region of adolescents and adults. This indicated that *Aspergillus* spp and *Candida albicans* may induce scaling of the body system along with the dermatophytes. In a study in lran it was observed that *Candida albicans* is implicated as opportunistic fungal infection, followed by *Trichophyton interdigitals* and *Aspergillus flavus*. The authors suggested that a regional factor can affect the prevalence of this type of infection (Havlickova, *et al,* 2014).

The mold *Auerobasidium pullulan* and *fursarium* spp are known for their cutaneous infections with advantages of causing *invivo*- infections such as pneumonia, meningitis and scleras infections Fleche *et al* ,2000, Gupta *et al*.,2017). It can lead to allergic reactions including sneezling itching and watery eyes. Untreated tinea corporis, caused by *Auerobasidum spp* and *fusarum spp* infections may lead to advanced systemic infection by passing through the dermis. The fungi isolated differ greatly among the pupils, adolescents and adults, it was observed that these fungal agents were more among the pupils and gradually decreasing from adolescents to adults. It has been extrapolated that the keratin in children is more susceptible to fungal infection than adults as the age

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advances, the proteinase contents of the keratin reduces, thereby giving rise to low colonization of dermatophytes and opportunistic fungal infections. As the age increases the skin keratin becomes more brittle and delay the structural protein. Earler study Ogbonna *et al* (1982) showed that children usually playing with flood water could contract fungal infections easily and serves as source of fungal spread. The highest dermatophyte isolated was *T. Soudenenseces* in both the pupils, adolescents and adults. These was followed by *Trichophyton rubrum* and *Microsporum* audounii. The occurance of these dermatophytes was associated with the presences of oil in the scalp and hair root. George and Altraide (2008) reported a high prevalence of 83.7% dermatophytes in children below 10years. In this study there is gradually decrease of dermatophyte infections as the age increases hence the high prevalence of dermatophyty infection among the pupils more than the adolescents and adults. Of important is the occurrence of *Malassezia furfur*, *Trichophyton verrucosum* in adolescents and adults and also the *Fusarium* species occurred in only adults, these agents found in only adults indicated specificity of certain fungal agents infecting humans. For instance, Malassisia *furfur* is an agent of eczema and body color change which can disfigure the skin of the affected individuals and may induce subcutenaous and cutaneouos infections. Fungal infection in humans are linked with several behavioural characteristic that exposes them to skin infections, this behavioral changes differs among the different age groups. In this study the risk factor for acquisition of fungal skin infections indicated that only pupils that played in the soil with remainat of sands on their head where statistical significant for tinea capitis among the pupils. There is high contact with domestic animals which yielded 17.0% of fungal agents while personal hygiene like frequent bathing in the morning and returning back from school did not make any difference in fungal infections. This aspect are synonymous with high fungal infections because this children may have been exposed with animals with skin infections coupled with lack of consistent bathing that allows the accumulation of this agents on their body. The high occurrence of fungal agents among the household with 4-6 persons per home is of concern, this group accounted for 24.6% of fungal skin infection among the pupils. The indication of this, is that this fungal agent due spread among the family's hence the high number. Ndako *et al., (*2012) in their report agrees that overcrowding and poor nature of the school infrastructures and amenities are sources of fungal acquisition by pupils. For instance, in this study the crack on the floor of class room where observed from the school and majority of pupil's due sit on the floor of the cracked floors to study. This cracked floors helps in disseminating of these fungi.

Among the adolescents and adults, the major risk factor was previous history of ringworm. It was observed that individuals that had suffered from ringworm for the pass due have frequency rate of 27.0% and 16.0% of current ringworm infection respectively, this outcome was not statistically significant but very important in the monitoring of previous ringworm infections, it may be that this infection was not properly treated that results in reinfection of poor personal hygiene practices may have allowed to persistent of ringworm infection or dermatophyte colonization of the body. Also the source of water in the families of adolescents and adults indicated that majority get their water from well water sources and thus individuals had fungal infections of frequency rate of 18.9% and 71% respectively. Also among the adults the use of stream either for washing of cloth or bathing affect the outcome of fungal infection this adults accounts for 8.5% of fungal agent isolated. The use of both of water form the well and stream for bathing and washing of cloths may be the source of this fungal infection for instance during the raining season. The flood that carried the rain water along with decayed plants, feathers and hairs that may contain most of this fungal agent like fusarium and clodosporum to the body of water and the soil, this streams acts as a conveyor of fungal agents. This was supported by early study of Ogbonna and Pugh (1982) that isolated dermatophytes including *Microsproum canis,* and *Trichophyton* agents from the soil, since this fungal is common in the soil and children adolescents and adults uses the water to bath. This could be one source of fungal infection since all groups uses stream and well water.

In this study the risk factor for acquiring fungal infection were diverse ranging from overcrowding in homes, being in constant touch with the pet animals due to lack of persistent personal hygiene, thus most of this factors were not statistically significant but they are still important in the person to person transmission and may be very common within the study population. Secondly the lack of monitoring of fungal skin infections within the public health domain makes this infection to be ignored as an important skin disfiguring disease in human.

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