

**ASSESSMENT OF TINEA INFECTIONS AMONG PRIMARY
SCHOOL CHILDREN IN ANINRI LOCAL GOVERNMENT
AREA OF ENUGU STATE, NIGERIA**

BY

**IKPENWA, CHIDIMMA MAUREEN
PG/M.Sc/12/63317**

**DEPARTMENT OF MEDICAL LABORATORY SCIENCES
FACULTY OF HEALTH SCIENCE AND TECHNOLOGY
COLLEGE OF MEDICINE
UNIVERSITY OF NIGERIA
ENUGU CAMPUS**

SEPTEMBER, 2015

TITLE PAGE

**ASSESSMENT OF TINEA INFECTIONS AMONG PRIMARY SCHOOL
CHILDREN IN ANINRI LOCAL GOVERNMENT AREA OF ENUGU
STATE, NIGERIA**

BY

**IKPENWA, CHIDIMMA MAUREEN
PG/M.Sc/12/63317**

**A THESIS SUBMITTED
IN PARTIAL FULFILLMENT OF THE AWARD OF MASTER OF
SCIENCE (M.Sc) DEGREE IN MEDICAL LABORATORY SCIENCES**

**DEPARTMENT OF MEDICAL LABORATORY SCIENCES
FACULTY OF HEALTH SCIENCE AND TECHNOLOGY
COLLEGE OF MEDICINE
UNIVERSITY OF NIGERIA
ENUGU CAMPUS**

AREA OF MAJOR SPECIALTY:

MEDICAL MYCOLOGY

SUPERVISOR:

DR. T.K.C UDEANI

SEPTEMBER, 2015

DEPARTMENT OF MEDICAL LABORATORY SCIENCES
COLLEGE OF MEDICINE
UNIVERSITY OF NIGERIA

Telegramms NIGERSITY, ENUGU

HEAD OF DEPARTMENT

OUR RUN/CM/MLS/B2.....

YOUR REF:.....



ENUGU CAMPUS
NIGERIA

Tel:

Ext.

14th March, 2016

DATE:.....

CERTIFICATION

Mr. /Mrs./Miss **IKPENWA CHIDIMMA MAUREEN.** (PG/M.Sc/12/63317 a post graduate student of the Department of Medical Laboratory Sciences, Faculty of Health Sciences & Technology, College of Medicine, University of Nigeria, Enugu Campus majoring in **MYCOLOGY** has completed the requirements for the research work.

The results embodied in the work have not been submitted in partial or full to any Diploma or Degree of this or any other University.

Supervisor's Name: **DR.T. K.C. UDEANI**

Signature:

DEDICATION

This work is dedicated to God Almighty, the Alpha and Omega who alone made everything about me possible.

And to my husband, Mr. Benjamin Chukwueze for his unconditional love and support.

And to my parents, Barr.& Dr. (Mrs.) Ikpenwa for their guidance through the years.

ACKNOWLEDGEMENT

It is with deepest sense of responsibility, respect, and utmost honesty that I owe my unalloyed gratitude, first to the greatest lover of mankind- The Almighty God- without whom this work and indeed, my humble existence would not have been.

My unqualified and inestimable gratitude goes to all my lecturers in the Department of Medical Laboratory Sciences, Faculty of Health Sciences and Technology, University of Nigeria, Enugu Campus (UNEC).Of particular mention is my project Supervisor, Dr, Udeani, T.K.C who has been so patient with me, he tolerated my inadequacies in the course of production of this work, displaying his invaluable commitment, hard work and complete dedication through his guidance, analytical review and expertise.

Also worthy of mention are my dearest husband, wonderful parents, adorable kids for their unparalleled love, patience, moral and financial assistance and sustained daily prayers which were inevitable to the success of this programme. I equally appreciate my siblings, friends, even the typist for his dedication. These people and several others not mentioned due to limited space have remained second only to God in this struggle.

TABLE OF CONTENTS

Title Page-	-	-	-	-	-	-	-	-	-	-	i
Certification-	-	-	-	-	-	-	-	-	-	-	ii
Dedication-	-	-	-	-	-	-	-	-	-	-	iii
Acknowledgement-	-	-	-	-	-	-	-	-	-	-	iv
Table of Contents-	-	-	-	-	-	-	-	-	-	-	v
List of Tables--	-	-	-	-	-	-	-	-	-	-	viii
List of Figures-	-	-	-	-	-	-	-	-	-	-	ix
Abstract-	-	-	-	-	-	-	-	-	-	-	x

CHAPTER ONE: INTRODUCTION

1.1	Statement of Problem-	-	-	-	-	-	-	-	-	3
1.2	Justification-	-	-	-	-	-	-	-	-	4
1.3	Aims and Objectives-	-	-	-	-	-	-	-	-	4
1.3.1	General Objective-	-	-	-	-	-	-	-	-	4
1.3.2	Specific Objectives-	-	-	-	-	-	-	-	-	4

CHAPTER TWO: LITERATURE REVIEW

2.1	Classification of Tinea Infections-	-	-	-	-	-	-	-	5
2.1.1	Tinea Capitis--	-	-	-	-	-	-	-	5
2.1.2	Tinea Corporis-	-	-	-	-	-	-	-	6
2.1.3	Tinea imbricata-	-	-	-	-	-	-	-	7

2.1.4	Tinea faciei	-	-	-	-	-	-	-	-	8
2.1.5	Tinea pedis	-	-	-	-	-	-	-	-	8
2.1.6	Onychomycosis-	-	-	-	-	-	-	-	-	9
2.1.7	Tinea Manuum	-	-	-	-	-	-	-	-	11
2.1.8	Tinea Barbae	-	--	-	-	-	-	-	-	11
2.1.9	Tinea Cruris-	-	-	-	-	-	-	-	-	11
2.2	Ecological Groups of Dermatophytes-	-	-	-	-	-	-	-	-	12
2.2.1	Anthropophilic dermatophytes-	-	-	-	-	-	-	-	-	12
2.2.2	Zoophilic dermatophytes-	-	-	-	-	-	-	-	-	12
2.2.3	Geophilic dermatophytes-	-	-	-	-	-	-	-	-	12
2.3	Groups of Dermatophytes	-	-	-	-	-	-	-	-	12
2.3.1	<i>Microsporum</i> species	-	-	-	-	-	-	-	-	12
2.3.2	<i>Epidermophyton</i> species	-	-	-	-	-	-	-	-	13
2.3.3	<i>Trichophyton</i> species	-	-	-	-	-	-	-	-	13
2.4	Epidemiology of Tinea Infections	-	-	-	-	-	-	-	-	14

CHAPTER THREE: MATERIALS AND METHODS

3.1	Study Area-	-	-	-	-	-	-	-	-	19
3.2	Study Design-	-	-	-	-	--	-	-	-	19
3.2.1	Study Population-	-	-	-	-	-	-	-	-	19

3.2.2	Sample Size-	-	-	-	-	-	-	-	-	19
3.2.3	Inclusion Criteria-	-	-	-	-	-	-	-	-	20
3.2.4	Exclusion Criteria-	-	-	-	-	-	-	-	-	20
3.2.5	Ethical Issues--	-	-	-	-	-	-	-	-	20
3.2.6	Sampling Method/ Techniques-	-	--	-	-	-	-	-	-	20
3.2.7	Selection of Pupils-	-	-	-	-	-	-	-	-	21
3.2.8	Sample Collection-	-	-	-	-	-	-	-	-	23
3.3	Mycological Procedure-	-	-	-	-	-	-	-	-	23
3.3.1	Direct Microscopic Examination-	-	-	-	-	-	-	-	-	23
3.3.2	Fungal Culture-	-	-	-	-	-	-	-	-	24
3.3.3	Identification of Isolates-	-	-	-	-	-	-	-	-	25
3.3.4	Data Analysis--	-	-	--	-	-	-	-	-	25

CHAPTER FOUR: RESULTS

4.1	Results-	-	-	-	-	-	-	-	-	26
-----	----------	---	---	---	---	---	---	---	---	----

CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1	Discussion-	-	-	-	-	-	-	-	-	33
5.2	Conclusion and Recommendation-	-	-	-	-	-	-	-	-	39
5.3	Limitations	-	-	-	-	-	-	-	-	39

References

Appendices

LIST OF TABLES

TABLE	TITLE	PAGE
1:	Distribution of pupils according to schools - - - -	22
2:	Distribution of the various fungal isolates- - - -	28
3:	Distribution of dermatophytes according to sites- - - -	29
4:	Relationship between the demography and risk factors in acquiring tinea infections- - - - -	30
5:	Different schools in relation to their nature and hygienic characteristics- - - - -	31
6:	Multiple dermatophyte infections- - - - -	32

LIST OF FIGURES

FIGURE	TITLE						PAGE
1	Tinea mannum-	-	-	-	-	-	40
2	Tinea corporis -	-	-	-	-	-	40
3	Tinea capitis -	-	-	-	-	-	41
4	Tinea corporis-	-	-	-	-	-	41
5	Tinea capitis- -	-	-	-	-	-	42
6	Tinea unguim (Onychomycosis)	-	-	-	-	-	42
7	Tinea capitis- -	-	-	-	-	-	43

Abstract

Tinea infection is a common fungal infection that affects the superficial keratinized tissues of the body (skin, hair and nails). This study assessed tinea infections among primary school children in Aninri Local Government Area of Enugu State, Nigeria. Seven primary schools were selected for the study. Ethical approval was obtained from the Education and Health Departments of Aninri Local Government and informed consent also obtained from the parents of the pupils. A researcher-developed questionnaire was used to obtain information on demography, hygienic practices and clinical picture. The pupils were randomly selected based on those with tinea (ringworm) lesions. Samples of nail clippings, hair and skin scrapings were collected from the affected sites after sterilizing with 70% ethanol into sterile wide containers and transported to the Medical laboratory at the Department of Medical Laboratory Sciences, University of Nigeria, Enugu Campus. The samples were analyzed by microscopy using 10% KOH followed by mycological cultures using Sabourand dextrose agar, Potatoe dextrose agar and Corn meal agar. The isolates were identified based on their colonial morphology using lactophenol cotton blue stain. Statistical analysis was by Chi-square and student's t-test. Of the 1544 pupils examined, 186 had various tinea infections; Tinea capitis was the commonest infection with a prevalence of 72.5%. Tinea corporis, Tinea unguis and Tinea manuum had a prevalence of 16.18%, 3.8% and 2.2% respectively. The males had higher isolates of dermatophytes (55.1%) than the females (44.9%). The age group of 6 to 10 years had the highest fungal isolates of 55.4% with the least isolates seen in those below 6 years; 11.8%. The mean age for the pupils was 8.70 ± 2.66 . There was no significant difference ($p > 0.05$) between the age groups. *Trichophyton mentagrophytes* was the leading dermatophyte isolated; 56.1% and the least was *Trichophyton soudanense* with a yield of 0.5%. The non dermatophyte species isolated were *Aspergillus flavus* (0.5%) and *Candida albicans* (1.6%). Risk factors assessed such as poor personal hygiene, overcrowding, intimate association with household pets among the children and poor infrastructure play roles in the dissemination of tinea infection among these children. Consequently, proper health education, personal and environmental sanitation, provision of infrastructure, primary health care and regular clinical studies are recommended for these primary school pupils.

CHAPTER ONE

INTRODUCTION

Tinea infections (otherwise known as Dermatophyte infections or Dermatophytosis) cause a wide range of diseases in humans and are worldwide in distribution but more prevalent in tropical countries, where temperature and humidity are more favorable for their act and persistence (Verenkar *et al.*, 1991). The term tinea originally indicated larvae of insects that fed on clothes and books. Subsequently, it meant parasitic infestation of the skin. By the mid 16th century, the term was used to describe diseases of the hairy scalp. The term ringworm referred to skin diseases that assumed a ring form, including tinea. The causative agents of tinea infections of the beard and scalp were described first by Remak and Schonlein, then by Gruby, during the 1830s. Approximately 50 years later, in Sabouraud's dissertation, the endothrix type of tinea capitis infection was demonstrated, and it was known that multiple species of fungi cause the disease (Seebacher *et al.*, 2008).

Tinea infections are fungal infections caused by dermatophytes, a unique group of fungi that invade and grow on dead keratin. Superficial mycoses are among the most frequent forms of human infections, being estimated to affect about 15% of the world's population, and their incidence is constantly increasing (Havlickova *et al.*, 2008). Dermatophytes represent the prevailing type of fungi that cause these infections of the hair, skin and nails (Havlickova *et al.*, 2008). Three types of dermatophytes account for the majority of infections: *Epidermophyton*, *Trichophyton*, and *Microsporum* (Bolognia *et al.*, 2007). They were separated by Emmons in 1934 on the basis of differences in the macroconidia (Ajello, 1968). Tinea infections have varied presentations, are named by location, and have similar treatments (Noble *et al.*, 1998).

Dermatophytes have acquired in the evolutionary process the ability to metabolize and subsist upon keratin (they require keratin for nutrition), a protein resistant to most other organisms. They produce keratinase which enables them to use keratin as a nutrient source. The fungi attack hair, skin and nails, where keratin is the major structural protein; leading to a wide range of disease states (Bolognia *et al.*, 2007). Infection is limited to the dead layers of the skin but encouraged by a damp and warm local environment. They tend to grow outwards on skin, producing a ring-like pattern hence the term "ringworm" (Achtermann and White, 2012). Ringworm infection is not a reportable disease but is a cause for concern because of its contagious nature.

The major types of dermatophyte infections include: involvement of the scalp (tinea capitis), feet (tinea pedis), groin (tinea cruris) and other body surfaces (tinea corporis). These are typically superficial, involving the epidermis. Tinea infections routinely affect individuals who are otherwise healthy, but people with compromised immune systems are particularly susceptible (Crissey *et al.*, 1995). Tinea is spread from person to person by direct contact, commonly in such places as contaminated public showers, locker rooms, work-out mats, and gym equipment. It can also be spread from cats, dogs and domesticated animals to humans.

The signs and symptoms of tinea infections include itching and stinging, red scaly rash that is shaped like a ring, cracking - splitting - peeling on toes, blisters, yellow or white discoloration on the finger or toe nails, spots with no hair on scalp which occurs with tinea capitis. Pruritis is the most common symptom in humans. Tinea infections can be unsightly or disfiguring causing varying symptoms depending on the part of the human skin they are found.

Dermatophytes multiply in warm, damp environments on the body and can be transmitted by touch from human or animal or soil. They are hyphomycetes that can degrade keratin. They

invade superficial layers of the epidermis, particularly the stratum corneum and the high keratin-concentration containing appendages, the hair and the nails of the living host (Fernandes *et al.*, 2001). This puts them in a position to cause infections of the keratin-containing superficial skin. The resulting clinical picture is called tinea infections. Dermatophytosis includes several distinct clinical entities, depending on the anatomic site and etiologic agents involved. These infections lead to a variety of clinical manifestations, including tinea capitis, tinea favosa, tinea pedis, tinea manuum, tinea unguis (onychomycosis), tinea barbae, tinea faciei, tinea corporis, tinea imbricata and Tinea cruris.

The pathogenesis and course of tinea is decisively determined by pathogen-related factors and by the defense mechanism of the host. An infection starts with an adherence of fungal propagules, followed by the formation of hyphae that can spread within the tissue. This process is accompanied by a release of fungal enzymes and other pathogenic factors. Next keratinocytes are activated, the epidermal barrier is destroyed, epidermal proliferation is enhanced and defensins are expressed within the epidermis. In addition, innate and specific immune responses are initiated, involving neutrophilic granulocytes, macrophages, antibodies and T cells. The cellular mechanisms are thought to be crucial for healing (Brasch, 2010).

1.1 Statement of Problem

In Aninri Local Government Area of Enugu State, tinea infections are sometimes seen in the primary school children especially when compared with children from other areas. This may be attributed to lack of water and poor hygiene as well as other factors present therein.

1.2 Justification

Preliminary studies have shown that children from Aninri Local Government Area of Enugu State suffer loads of skin infections with tinea infections being one of them. Tinea infections are highly contagious, present significant public health problems and unpleasant aesthetic status among pupils, hence the burden for this work. Assessment of tinea infections among primary school children in Aninri Local Government Area have not being conducted before to the best of the researcher's knowledge.

1.3 Aims and Objectives

1.3.1 General Objective

This is to clearly assess the presence of tinea infections among primary school children in Aninri Local Government Area of Enugu State.

1.3.2 Specific Objectives

1. To determine the prevalence of tinea infections among primary school children in Aninri Local Government Area of Enugu State.
2. To determine the most prevalent dermatophyte causing tinea infections among these primary school children.
3. To determine the risk factors associated with tinea infections in these children.

CHAPTER TWO

LITERATURE REVIEW

2.1 Classification of Tinea Infections

2.1.1 Tinea Capitis

Tinea capitis, also known as *Herpes tonsurans* (Bolognia *et al.*, 2007) is a superficial fungal infection of the hair, scalp, eyebrows and eyelashes with a propensity for attacking hair shafts and follicles (Freedberg and Fitzpatrick, 2003). The infection is primarily caused by dermatophytes in the *Trichophyton* and *Microsporum* genera that invade the hair shaft. The clinical presentation is typically single or multiple patches of hair loss, sometimes with a black dot pattern (often with broken off hairs), that may be accompanied by inflammation, scaling, pustules and itching. Uncommon in adults, tinea capitis is predominantly seen in pre-pubertal children. This has been evident in a recent study conducted in Anambra State on the prevalence of dermatophytic fungal infections in children in which tinea capitis was the predominant clinical infection present (Nweze and Okafor, 2005). The infection is contagious and can be transmitted by humans, animals or objects that harbor the fungus. The fungus can also exist in a carrier state on the scalp without clinical symptomatology (Maya, 1989).

Tinea capitis may appear as thickened, scaly and sometimes boggy swellings or as expanding raised red rings. Common symptoms are severe itching of the scalp, dandruff and bald patches where the fungus has rooted itself in the skin (Somorin *et al.*, 1977).

There are three types of Tinea capitis; microsporiasis, trichophytosis and favus. These are based on the causative microorganisms and the nature of the symptoms. In microsporiasis, the lesion is a small red papule around a hair shaft that later becomes scaly; eventually the hairs break off 1-

3mm above the scalp. It is caused by *Microsporum audouinii* and more frequently by *Microsporum canis*. The source of this fungus is typically sick cats and kittens; it may be spread through person to person contact, or by sharing contaminated brushes and combs. Trichophytosis is caused by *Trichophyton tonsurans* and *Trichophyton violaceum*. This fungus causes dry, non-inflammatory patches that tend to be angular in shape. When the hairs break off at the opening of the follicle, black dots remain. Favus is caused by *Trichophyton schoenleinii* and is characterized by a number of yellowish, circular, cup-shaped crusts (scutula) grouped in patches like a piece of honeycomb, each about the size of a split pea, with a hair projecting in the center. These increase in size and become crusted over, so that the characteristic lesion can only be seen around the edge of the scab (Richardson, 2003).

Several studies have come up with different causative agents for tinea capitis in different areas. For instance, in Enugu metropolis, Onyebueke showed that *Trichophyton mentagrophytes* majorily caused tinea capitis (Onyebueke *et al.*,2012) but it was a different scenario in the study conducted by Nweze and Okafor. They reported that, *Trichophyton tonsurans* was most prevalent in both rural and urban populations of Awka, Anambra State (Nweze and Okafor, 2005).

2.1.2 Tinea Corporis

Tinea corporis (also known as ringworm, tinea circinata and tinea glabrosa is a superficial fungal infection characterized by either inflammatory or noninflammatory lesions on the glabrous skin (Bolognia *et al*, 2007). It affects mainly the trunk, especially in exposed areas like the abdomen or limbs, causing red patches (Macura, 1993). It may have a variety of appearances; most easily identifiable are the enlarging raised red rings with a central area of clearing. Other classic features of tinea corporis include: the edge of the rash appears elevated and is scaly to touch;

sometimes the skin surrounding the rash may be dry and flaky, hair loss in areas of infection (Berman, 2008). Rarely, tinea corporis can present as purpuric macules.

Tinea corporis is common in children but can occur in people of all ages (Macura, 1993). This is seen in some recent studies (Ogbu *et al.*, 2015; Andrews and Burns, 2008; Nelson *et al.*, 2003). It is moderately contagious and can affect both humans and pets. It can be acquired by person-to-person transfer usually via direct skin contact with an infected individual. Animal-to-human transmission is also common. The fungus can also be spread by touching inanimate objects like personal care products, bed linen, combs, athletic gear or hair brushes contaminated by an affected person.

Individuals at high risk of acquiring ringworm include those who: live in crowded-humid conditions, sweat excessively, participate in close contact sports, wear tight constrictive clothing and have a weakened immune system.

Untreated tinea corporis infections could resolve in a couple of months especially when it is caused by a geophilic or zoophilic dermatophyte.

2.1.3 Tinea imbricata

Tinea imbricata is a specialized manifestation of tinea corporis caused by *T. concentricum*. It is chronic and usually characterized by concentric rings overlapping scales scattered throughout the body. It is geographically restricted to certain areas of the Pacific Islands of Oceania, Southeast Asia, Mexico and Central and South America (Rippon, 1988).

2.1.4 Tinea faciei

Tinea faciei is seen on the face especially on the non-bearded areas. The lesions are mostly pruritic with itching and burning sensation. Exposure to sunlight could make infected cases worse due to itching and burning. Some lesions resemble those of tinea corporis while others may have little or no scaling or raised edges. Tinea faciei is always confused with other skin diseases of the face especially in atypical cases. Most common agents include *T. tonsurans*, *T. mentagrophytes* and *T. rubrum*.

2.1.5 Tinea Pedis

Tinea pedis also known as athlete's foot or tinea pedum or moccasin foot is a common contagious fungal infection of the skin that causes scaling, flaking and itch of affected areas (Bell-Syer *et al.*, 2012). It has affected humanity for centuries, so it is perhaps surprising that the condition was not described until Pellizzari did so in 1888 (Pellizzari, 1888). It particularly affects the web of the toe where skin may be macerated and erythematous. It commonly affects the plantar surface of the foot. Erythema, vesicles and pustules may occur. It is more common in those who wear occlusive shoes (Macura, 1993). Anthropophilic dermatophytes are the major cause of tinea pedis. Symptoms are caused by *Epidermophyton floccosum* or fungi of the *Trichophyton* genus (such as *T. rubrum* or *T. mentagrophytes*). The infection is typically transmitted in moist communal areas where people walk barefoot and requires a warm, moist environment (example the inside of a shoe) to incubate. The conditions fungi like best are warm, moist and airless areas of the toes. The incidence also increases with age from adolescence (Male, 1990). Fungal infection of the foot may be acquired in many ways such as by walking in an infected locker room, by using an infested bathtub, by sharing a towel used by someone with

the disease, by touching the feet with infected fingers (such as after scratching another infected area of the body), or by wearing fungi-contaminated socks or shoes. Infection can often be prevented by keeping the feet dry by limiting the use of footwear that enclose the feet, or by remaining barefoot. During the past three decades, the incidence of tinea pedis has increased worldwide with an estimated prevalence of 10% in the developed world (Nelson *et al.*, 2003) and expectedly higher rate in most developing countries.

Tinea pedis may be subdivided into three different presentations: interdigital (between the toes), plantar (sole of the foot) and vesiculobullous (ulcerative condition characterized by vesicles and bullae) depending on where it occurs on the foot.

Persons who have had athlete's foot before are more likely to become infected than those who have not. People with weakened immune systems are more susceptible to the disease.

2.1.6 Onychomycosis

This is also known as tinea unguium and is a fungal infection of the nail (Rapini *etal.*, 2007). It is the most common disease of the nails and constitute about half of all nail abnormalities (Szepietowski and Salomon, 2007). This condition may affect toenails or finger nails, but toenail infection are particularly common and occurs in about 10% of the adult population.

The most common symptom of a fungal nail infection is the nail becoming thickened and discoloured. As the infection progresses, the nail can become brittle, with pieces breaking off or coming away from the toe or finger completely. If left untreated, the skin can become inflamed and painful underneath and around the nail. There may also be white or yellow patches on the nail bed or scaly skin next to the nail, and a foul smell. There is usually no other pain or other

bodily symptoms, unless the disease is severe. People with onychomycosis may experience significant psychosocial problems due to the appearance of the nail, particularly when fingers which are always visible rather than toenails are affected (Szepietowski and Reich, 2008).

Dermatophytids are fungus-free lesions that sometimes form as a result of a fungus infection in another part of the body. This could take the form of a rash or itch in an area of the body that is not infected with the fungus. Dermatophytids can be thought of as an allergic reaction to the fungus.

Both anthropophilic and zoophilic dermatophytes can cause tinea unguis. *T. rubrum* and *T. mentagrophytes* var *mentagrophytes* are the most common aetiologic agents (Macura 1993). Other dermatophytes that maybe involved include *E. floccosum*, *T. violaceum*, *M. gypseum*, *T. tonsurans*, *T. soudanese*. Other causative pathogens include *Candida* and nondermatophytic molds (Chi *et al.*, 2005).

Four classic types of onychomycosis include- distal subungual onychomycosis (usually caused by *T. rubrum* and invades the nail bed and the underside of the nail plate), white superficial onychomycosis (caused by fungal invasion of the superficial layers of the nail plate), Proximal subungual onychomycosis (fungal penetration of the newly formed nail plate through the proximal nail fold and is the least common type), *Candida* onychomycosis (*Candida* species invasion of the fingernails, usually occurring in persons who frequently immerse their hands in water) (James and Berger, 2006).

2.1.7 Tinea Manuum

This is otherwise known as tinea manus (Braun-Falco, 2000). It is a fungal infection of the skin of the hand and is typically more aggressive than tinea pedis. Itching, burning, scaling, and cracking are observable (Rapini *et al.*, 2007). It is most often caused by anthropophilic dermatophytes although zoophilic dermatophytes have also been reportedly recovered from tinea manuum infections (Nweze, 2010). In this form, the palms become diffusely dry, scaly and erythematous. Most common agents are *T. rubrum*, *T. mentagrophytes*, *E. floccosum*, *M. canis*, *M. gypseum*, and *T. verrucosum*.

2.1.8 Tinea Barbae

Tinea barbae is an infection of the skin and hairs in the beards and mustache area. It is more common in males. The lesions may include erythema, scaling and follicular pustules (Nweze, 2010).

2.1.9 Tinea Cruris

This is an infection of the groin and usually occurs in men. It is an itchy, red rash in the groin and surrounding area which is commonly seen in young men living in a warm climate (Macura 1993). It can coexist if the infection is spread by scratching the feet and then the groin. Axillary infection can be seen as an analogous tinea pattern in women. Anthropophilic dermatophytes are the major cause of tinea cruris. Burning and pruritis are the common symptoms. Pustules and vesicles at the active edge of the infected area, along with maceration, are found in a background of red, scaling lesions with raised borders (Nweze, 2010). *E. floccosum* and *T. rubrum* are the most common cause of tinea cruris. Other species include *M. nanum*, *T. mentagrophytes* and *T. raubitschekii*.

2.2 Ecological Groups of Dermatophytes

There are three ecological groups of dermatophytes: anthropophilic (mostly associated with humans), zoophilic (associated with animals) and geophilic (found in the soil) (Ajello, 1962).

2.2.1 Anthropophilic dermatophytes: They are dermatophytes that are natural pathogens and are restricted to the human host. Transmission is by close contact with infected host or contaminated objects. They include *T. rubrum*, *T. mentagrophytes*, *T. tonsurans*, *T. violaceum*, *T. schoenleinii* and *M. audouinii* which cause tinea corporis, tinea capitis, tinea pedis, tinea unguis and tinea cruris (Philpot, 1978).

2.2.2 Zoophilic dermatophytes: these are associated with animals. Among common zoophilic dermatophytes are *M. canis*, which is prevalent worldwide. They are responsible for infections in cats and dogs. *T. verrucosum* is the causative agent of tinea in cattle. They infect cattle breeders and veterinarians and are mostly present in temperate countries (Ghannoum *et al.*, 2003).

2.2.3 Geophilic dermatophytes: these are usually found in the soil and are transmitted to man by direct exposure (Disalvo, 2008). Dermatophyte involved is *M. gypseum*, which is commonly seen in certain parts of the tropics.

Anthropophilic dermatophytes produce fewer lesions in humans compared to geophilic or zoophilic forms.

2.3 Groups of Dermatophytes

2.3.1 *Microsporum* species

Microsporum consists of a number of species that attack hair and skin of animals and humans. These fungi may cause ringworm of the scalp, beard or body of humans (tinea capitis, tinea

barbae and tinea corporis). The *Microsporum* species are usually isolated on Sabouraud dextrose agar at room temperature with an addition of antibiotics. The colonies vary from moderately, slow growing, matted, and furrowed to fast growing, powdery or velvety, and light tan, ferruginous, yellowish to cinnamon in color. The hyphae produce characteristic, large, thin to thick, rough walled, 3 to 15 celled, fusiform to obovate macroconidia. Small one celled microconidia are produced on short stalks or are sessile on the hyphae; pectinate hyphae, racquet hyphae, nodular bodies, coils and chlamydoconidia may be present. The species listed here include *M. audouinii*, *M. canis*, *M. gypseum*, *M. distortum*, *M. ferrugineum*, *M. fulvum*, *M. nanum*, *M. cookei*, *M. vanbreuseghemii*, and *M. gallinae* (Ajello, 1968).

2.3.2 *Epidermophyton* species

Epidermophyton consists of two species: *E. floccosum* and *E. stockdalei*. *Epidermophyton floccosum*, the only pathogenic species in the genus, is a common cause of tinea cruris and tinea pedis.

It may cause epidermics in institutions, camps and other group settings.

On cultures, its colonies develop fairly rapidly, with a velvety to powdery surface, khaki-yellow color, and a cottony center, the reverse side of the colony is yellow to tan in colour. Microscopically, no microconidia are produced. Chlamydoconidia, usually racquet hyphae and nodular bodies may be present. (Ajello and Getz, 1954)

2.3.3 *Trichophyton* species

The genus *Trichophyton* consists of a large number of species which attack the skin, nails and hair, resulting in a wide variety of symptoms depending on the species and location of the infection. This genus is the most likely cause of tinea pedis and tinea unguium in humans. Other

types of ringworm may be due to species in this genus. The clinical symptoms vary considerably for this group of organisms so that laboratory identification is necessary for final diagnosis.

Most of the *Trichophyton* species may be isolated on Sabouraud dextrose agar at room temperature. The addition of antibacterial substances and antifungal substances for inhibition of saprophytes is desirable.

Colonies of this genus may appear cottony to velvety, granular to powdery, raised or wrinkled and folded with a velvety to waxy surface. Pigmentation varies from white, red, pink, violet, yellow or orange to brown.

Microscopically, some species have numerous microconidia that are small single celled, spherical, clavate or pyriform in shape and borne singly on the sides of hyphae or in grape like clusters. Macroconidia appear as long, thin walled, many celled, clavate to fusiform structures. Racquet hyphae, nodular bodies, coiled hyphae and chlamydoconidia may be present. The species here include *T. mentagrophytes*, *T. scoenleinii*, *T. rubrum*, *T. equinum*, *T. verrucosum*, *T. megninii*, *T. tonsurans*, *T. violaceum*, *T. gourvillii*, *T. simii*, *T. soudanese*, *T. yaoundei*, *T. concentricum*, *T. georgiae*, *T. terrestre* and *T. ajelloi* (Ajello, 1968).

2.4 Epidemiology of Tinea Infections

Tinea infections are a common global problem and their incidence continues to increase. Their distributions and causative agents varies with geographical region and is influenced by a wide range of factors, such as type of population, climatic factors, lifestyle, migration of people, cultural practices and socioeconomic conditions, incidence of peculiar comorbidities and drug therapy (Havlickova *et al.*, 2008; Ameen *et al.*, 2010). Some dermatophyte species appear to be homogeneously distributed worldwide whereas others showed a geographic restriction

(Havlickova *et al.*, 2008). In this era of rapid movement from one continent to another and the increasing mobility of humans, agents of dermatophytic infections can no longer be said to be restricted within a given geographical area. This implies that an infection contracted in one part of the world may become manifest in another country where the etiological agent is not normally found (Nweze, 2010).

In Nigeria, there are varying reports of dermatophytosis in different cities and communities (Nweze and Okafor, 2005). Considering its human and socioeconomic diversity and the staggering population, this is understandable.

The epidemiology of dermatophytoses in developed countries has also exhibited notable changes over the past decades as a consequence of variation in some environmental conditions, and the distribution of the etiological agents usually reflects the changing clinical patterns of dermatophytoses (Ameen *et al.*, 2010). Dermatophytes are best known to grow in warm and humid environments and are, therefore, more common in tropical and sub tropical regions and this probably explains why they are very common in Africa. For instance, some species of dermatophytes such as *Trichophyton mentagrophytes*, *Microsporum canis*, *Epidermophyton floccosum* and *Trichophyton rubrum* are distributed all over the world. However, some species probably have partial geographic restriction. For example, *Trichophyton schoenleinii* is found in Africa and Eurasia while *Trichophyton soudanense* is also restricted within Africa (Weitzman and Summerbell, 1995). Others are *Trichophyton violaceum* which are associated with Asia, Africa and Europe and *Trichophyton concentricum* is known to be common in the far East, India and the pacifics (Ameen, 2010).

Some types are more common than others, with tinea pedis being most common in adults and tinea capitis, the most common in children. Tinea capitis is endemic in many countries, affecting primarily pre pubertal children between 6 and 10 years. It's more common in males than females; rarely does the disease persist past age sixteen (Richardson, 2003). Onychomycosis is also extremely common. In fact, a 2003 survey of diseases of the foot in 16 European countries found onychomycosis to be the most frequent fungal foot infection and estimates its prevalence at 27%. Prevalence was observed to increase with age (Burzykowski *et al.*, 2003) Tinea capitis may extend to tinea corporis (Nweze, 2010). Tinea corporis occurs worldwide and relatively frequent. Males are infected more than females. Tinea pedis occurs in children and adults and is spread by using communal facilities such as showers at swimming pools. Adults are affected more than children and males more than females. Local socio-economic conditions and cultural practices can also influence the prevalence of a particular infection in a given area. For instance, Tinea pedis is more prevalent in developed countries than in emerging economies. In poorer countries, Tinea capitis is more prevalent. Infection is more frequent and severe in hot weather as this supports the ability of the dermatophytes to thrive. Tinea unguis occurs commonly but there are low rates of transmission, even to close family associates. *Trichophyton rubrum* is the most common organism worldwide (Achtermann and White, 2012). The epidemiology of dermatophyte infection is affected by migration pattern, increase in tourism, locality and changes in socioeconomic condition of the people.

Generally, tinea infections are predominantly present in children than in adults. In Gwalior, India, a study was conducted to investigate the incidence of tinea infections in children. 85.5% of the children were infected with dermatophytes with Tinea corporis (35.2%) being of highest incidence and Tinea manum being the least. *Trichophyton rubrum* (42.3%) was the most

frequently isolated dermatophyte for both *Tinea corporis* and *Tinea capitis* (Pandley and Pandley, 2013). This corroborates the predominance of tinea infections among children than in adults (Achtermann and White, 2012). For this reason, school surveys are good at measuring the prevalence of the infection.

Literature abounds on the health problems of tinea such as superficial disfigurement and deep invasion of human tissues due to symptomatic dermatophytoses, spectrum of etiological agents and epidermiology of dermatophytic infections from different parts of the world especially Nigeria (Weitzmann and Summerbell, 1995; Sahin *et al.*, 2004; Ngwogu and Otokunefor, 2007; Nweze, 2010)

ANINRI LOCAL GOVERNMENT AREA: ENUGU STATE



RAILWAY FROM PH

3.1 Study Area

The study was conducted from August 2014 to December 2014 at Aninri Local Government Area of Enugu State among primary school children. Study sites consisted of five communities in the area namely; Oduma, Nenwe, Ndeaboh, Mpu and Okpanku. The area lies approximately between longitude 7°35' East and Latitude 6°03' North and is located on the lower belt of the Niger. It has an area of 364km². There are two distinct seasons; the wet and the dry seasons. The former occurs between April and October, while the latter takes place from November to March. Farming is the major means of livelihood here. A systematic primary school based assessment of tinea infections has not been conducted in this area.

3.2 Study Design

3.2.1 Study Population

Primary school children selected randomly from primary schools in accessible areas were used for the study.

3.2.2 Sample Size

A total of 186 primary school children were recruited from the general population of 1,544 pupils for the study by purposive sampling. The sample size was calculated using the WHO standard formula of year 2009 and the proportion used was 15%, based on previous studies on the prevalence of tinea infections (Olaide *et al.*, 2014)

3.2.3 Inclusion Criteria

The pupils were selected based on those with physical appearance of tinea infections (erythema, alopecia, scaling, crusting, circinate lesions or follicular inflammation, pruritis). Also, those selected for the study were not above 15 years of age. This was because the study considered only primary school children and tinea infections are more rampant among these set of individuals.

3.2.4 Exclusion Criteria

The pupils that did not show obvious signs of tinea infections were excluded from the study. Also non primary school children were excluded from the study and those on antifungal treatment, orthodox or traditional, 2 weeks to the period of study.

3.2.5 Ethical Issues

Approval of this study was obtained from the Health and Education departments of Aninri Local Government Area of Enugu State. Also the selection of participants was with the permission of the headmasters/headmistresses. Informed consent was obtained from the pupils. This was based on the agreement that the participant's anonymity must be maintained, good laboratory practice/quality control ensured and that every finding treated with utmost confidentiality and for the purpose of the study only.

3.2.6 Sampling Method/ Techniques

The sampling method used here is the probability method. By random sampling method, seven primary schools were selected for this study.

3.2.7 Selection of Pupils

A total of 186 children with an age range of 4 ó 15 years suspected to have tinea infections (because of the obvious signs) were selected from the primary schools. Before examination and sample collection, the teachers and pupils were educated on the objectives of the study; including the nature of tinea infections, clinical features, laboratory diagnosis and mode of transmission. Questionnaires and physical observations were used to obtain information on the source of water, number of times uniforms and stockings are washed in a week, number of times these children take their bath in a day, frequency of barbing of hair, the type of domestic animals they keep and contact with these animals, skin lesions and duration, clinical picture, prior therapy as well as demographic data. The final selected positive samples for this study were 176 samples comprising of 55.1% males and 44.9% females.

Table 1: Distribution of pupils according to schools

Name of Primary school	Total number of pupils in the school	Number of pupils with tinea lesions
Community School Uwani Odumechara 1& 2	136	21
Central School Uhueze, Nenwe	293	32
MFCS, Agbada, Nenwe	155	28
Central School, Okpanku	175	23
Central School, Ndeaboh	313	32
Community Primary School, Ndeaboh	180	30
Community School, Mpu	292	20

3.2.8 Sample Collection

Physical examination of pupils was conducted to identify features suggestive of tinea infections. The skin, head, hands and nails were carefully examined for characteristic features.

Two sample collection methods were used in this study. In the first method, samples consisting of epidermal scales, crusts and infected hairs and nail clippings were scrapped from the active edge of lesions in the infected sites using sterile scalpel blades following cleansing of infected sites with 70% v/v ethanol. The scrapings were collected in sterile wide containers. The samples were divided into two portions: one for microscopic examination and the other for culture analysis. The samples were transported to the laboratory of the Department of Medical Laboratory Sciences, University of Nigeria Enugu Campus, Enugu State, Nigeria, immediately for microscopic and culture analysis. A second method was a brush culture technique as described by Mackenzie (1961). This method was used because hair plucks may potentially miss infected hairs and may not sample infected epithelium adequately. With this technique, new toothbrush was removed from its packaging and rubbed gently over the suspected area, including the skin and haired margins of alopecic or scaly lesions for about 1 minute. The unaffected area was brushed first before the lesions so as to avoid spreading spores to unaffected areas and to avoid losing spores from affected areas. The samples were also transported immediately to the same laboratory.

3.3 Mycological Procedure

3.3.1 Direct Microscopic Examination

The direct microscopic examination of scales and broken-off hairs placed on a microscope slide with one or two drops of 10% potassium hydroxide (KOH) (One drop for skin scales and hair

plucks and two drops for nail clippings) added and covered with a cover slip. This was heated gently over a flame in order to soften and clear the material and the specimen was examined with low (x10) and high (x40) power objective for the presence of hyphae and/or arthroconidia.

3.3.2`Fungal Culture

Each scrapping was cultured onto Sabouraud dextrose chloramphenicol actidione agar. The plates were incubated at 28^oc for up to 28 days and examined daily for fungal growth. Fungal isolates were subcultured unto plates of Sabouraud agar, potatoe dextrose agar and corn meal agar. The isolates were examined visually and microscopically for morphology of fungi using lactophenol cotton blue by slide culture technique. The slide culture technique was carried out by:

- a block of Sabouraud agar was aseptically cut and placed on the centre of a slide.
- the four sides of the agar were inoculated with spores or mycelial fragments of the fungi with the loop flamed intermittently.
- aseptically, a sterile cover slip was placed on the upper surface of the cut agar and the petri dish covered and incubated at room temperature for 48 hours.
- after 48 hours, the slide was examined for growth
- a drop of lactophenol cotton blue stain was placed on a clean slide and the coverslip from the slide culture removed.
- 95% ethanol was placed on the hyphae on the cover glass and the cover slip was placed mold side down ob the drop of lactophenol cotton blue stain on the slide and examined under the microscope

3.3.3 Identification of Isolates

The identification was based on morphological characteristics and appearance using lactophenol cotton blue, with the aid of a mycology manual. *Candida albicans* was further identified using the germ tube test. The germ tube test was carried out by putting 0.5ml of human serum into a small tube. A colony of the yeast was emulsified in the serum and incubated at 37°C for 2 hours. A drop of the serum was transferred to a slide and examined for production of germ tubes. *Aspergillus flavus* was identified by the nature of its conidia and conidiophores.

3.4 Data Analysis

The data was subjected to descriptive statistics and analyzed using Chi-square and student's t - test. Probability value of less than or equal to 0.05 were considered statistically significant.

CHAPTER FOUR

4.1 RESULTS

A total of 1544 pupils were examined for the presence of tinea infections in seven primary schools in Aninri Local Government Area of Enugu State. Using microscopy and culturing methods, it was found that out of 186 pupils with obvious signs of the infection, 176 (94.6%) were clinically diagnosed with tinea infections. **Table 1** shows a distribution of the pupils according to the various primary schools visited. **Table 2** shows a distribution of the various fungal isolates. Dermatophytes constituted 97.7% of the samples while non dermatophytes were 2.3%. Concerning the dermatophytes, 2 genera; *Trichophyton* and *Microsporum* were represented with 8 different species that included *Trichophyton mentagrophytes* as the leading organism isolated (56.1%). This was followed by *Trichophyton rubrum* (14%). *Trichophyton soudanese* was the least dermatophyte specie isolated (0.5%). Other isolates in this study were *Trichophyton tonsurans*, *Trichophyton schoenleinii*, *Microsporum audouinii*, *Microsporum gypseum*, *Microsporum canis* and *Trichophyton soudanese*. The non dermatophytes isolated were *Candida albicans* (1.6%) and *Aspergillus flavus* (0.5%).

Table 3 depicts the distribution of dermatophytes according to sites. Tinea capitis was the commonest accounting for 72.5% of the prevalence. Tinea corporis, tinea unguim (onychomycosis) and tinea mannum had a prevalence of 16.18%, 3.8% and 2.2% respectively.

Tables 4 show the relationship between the demography and risk factors in acquiring tinea infections. The males had higher isolates of dermatophytes (55.1%) as against 44.9% in the females. The age group of 6 to 10 years had the highest fungal isolates of 55.4% with the least isolates seen in those below 6 years of age;11.8%. Risk factors assessed such as poor personal

hygiene, overcrowding and intimate association with household pets among the children were the suspected sources of tinea infections.

Table 5 shows the different schools in relation to their nature and hygienic characteristics.

In 2 pupils, more than one type of tinea infection was seen (mixed infections). Tinea capitis was seen with tinea corporis in both cases with *Trichophyton mentagrophytes* isolated in one and *Trichophyton rubrum* isolated in the other (**Table 6**).

Table 2: Distribution of the various fungal isolates

TYPE OF FUNGI	f(%)
<i>Trichophyton mentagrophytes</i>	105 (56.1%)
<i>Trichophyton rubrum</i>	26 (14%)
<i>Trichophyton tonsurans</i>	23 (12.2%)
<i>Trichophyton schoenleinii</i>	7 (3.7%)
<i>Microsporum audouinii</i>	4 (2.2%)
<i>Microsporum gypseum</i>	4 (2.2%)
<i>Microsporum canis</i>	2 (1.1%)
<i>Trichophyton soudanese</i>	1 (0.5%)
<i>Candida albicans</i>	3 (1.6%)
<i>Aspergillus flavus</i>	1 (0.5%)

Table 3: Distribution of dermatophytes according to sites

SITE OF INFECTION	N	FUNGAL ISOLATE	f(%)	TYPE OF TINEA INFECTION
Head	135	<i>Trichophyton mentagrophytes</i>	95 (51.1%)	Tinea capitis (72.5%)
		<i>Trichophyton schoenleinii</i>	7 (3.8%)	
		<i>Microsporum canis</i>	1(0.5%)	
		<i>Candida albicans</i>	2 (1.1%)	
		<i>Trichophyton tonsurans</i>	22 (11.8%)	
		<i>Microsporum audouinii</i>	4 (2.2%)	
		<i>Microsporum gypseum</i>	4 (2.2%)	
		<i>Trichophyton mentagrophytes</i>	1(0.5%)	
Nail	7	<i>Trichophyton rubrum</i>	6 (3.2%)	Onychomycosis (3.8%)
		<i>Trichophyton mentagrophytes</i>	1(0.5%)	
Skin	30	<i>Trichophyton mentagrophytes</i>	11 (5.9%)	Tinea corporis (16.1%)
		<i>Aspergillus flavus</i>	1 (0.5%)	
		<i>Trichophyton soudanese</i>	1 (0.5%)	
		<i>Trichophyton rubrum</i>	16 (8.6%)	
		<i>Microsporum audouinii</i>	1 (0.5%)	
		<i>Trichophyton mentagrophytes</i>	1 (0.5%)	
Hand	4	<i>Candida albicans</i>	1 (0.5%)	Tinea mannum (2.2%)
		<i>Trichophyton rubrum</i>	2 (1.1%)	
		<i>Trichophyton mentagrophytes</i>	1 (0.5%)	

Table 4: Relationship between the demography and risk factors in acquiring tinea infections

VARIABLE	N	NUMBER OF ISOLATES (%)	p-VALUE
Sex:			0.523
Male	102	97 (55.1%)	
Female	84	79 (44.9%)	
Age:			0.804
<6	23	22 (11.8%)	
6-10	110	103 (55.4%)	
>10	53	51 (27.4%)	
Number of times school uniform is washed in a week:			0.74
1-2 times	58	58 (33%)	
Less than once	128	118 (67.1%)	
Number of times stockings is washed in a week:			0.67
1-2 times	43	43 (29.4%)	
Less than once	78	74 (47.7%)	
*Others do not wear at all	65	59 (22.9%)	
Number of times bathing is done in a day:			0.65
Once a day	41	41 (23.3%)	
Twice a day	145	135 (76.7%)	
Keeping/tending to animals:			0.95
Yes	83	83 (47.2%)	
No	103	93 (52.8%)	
Use of streams with animals:			0.46
Yes	50	50 (28.4%)	
No	136	126 (71.6%)	
Recurrent/reinfection:			<.01
Yes	68	68 (38.6%)	
No	118	108 (61.4%)	

Table 5: Different schools in relation to their nature and hygienic characteristics.

NAME OF SCHOOL	OVER CROWDING	PRESENCE OF CEMENT FLOOR	PRESENCE OF BENCHES/ DESK	WEARING OF UNIFORM	PRESENCE OF WATER
Community School Uwani Odumechara 1& 2	Yes	No	Yes	Yes	No
Central School Uhueze, Nenwe	Yes	Yes	Yes	Yes	Yes
MFCS, Agbada, Nenwe	Yes	Yes	Yes	Yes	No
Central School, Okpanku	Yes	No	Yes	Yes	No
Central School, Ndeaboh	Yes	Yes	Yes	Yes	No
Community Primary School, Ndeaboh	Yes	Yes	Yes	Yes	No
Community School, Mpu	Yes	Yes	Yes	Yes	No

Table 6: Multiple dermatophyte infections

Sample Number	Site of infection	Organism isolated
Sample 186	Head	<i>T. mentagrophytes</i>
	Skin	<i>T.mentagrophytes</i>
Sample 117	Head	<i>T.rubrum</i>
	Skin	<i>T.rubrum</i>

CHAPTER FIVE

5.0 DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 DISCUSSION

Tinea infections are common and remain an important public health problem among children worldwide and particularly in tropical regions (Akinboro *et al.*, 2013; Ajao and Akintude, 1985). This is evident in this study where prevalence of tinea infections was 12.1%. This is lower than in some previous studies (Ogbu *et al.*, 2015) but higher than that of Enemuor and Amedu in Northern Nigeria (Enemuor and Amedu, 2009) and that of Adefemi *et al.*, in Kwara State (Adefemi *et al.*, 2011). However, the low prevalence rate in this study was unexpected as all parameters known to favor person to person transmission, such as the presence of previous skin lesions, overcrowding in the home, practice of sharing personal belonging, practice of keeping and tending animals and factors that suggest poor personal hygiene are present in the pupils surveyed. This might not be unconnected to the use of traditional remedies whose mechanism of action are unknown, by some of the respondents to treat their lesions and this may perhaps have altered *invitro* isolation of dermatophytes.

In this study, tinea infections were recorded in pupils examined in seven primary schools in Aninri Local Government Area of Enugu State. This indicated that this infection is endemic in this part of the world where school age children were at greater risk of infection due to absence of control measures (Enemuor and Amedu, 2009).

The risk factor associated with high prevalence of tinea infections in this study is improper treatment of previous infection that leads to reinfection of the pupils infected. This maybe as a result of the use of inappropriate antifungal agent or recourse or probably use of herbs in such

treatments (Okafor *et al.*, 2001; Nweze *et al.*, 2004). Other risk factors assessed such as poor hygiene, overcrowding and intimate association with household pets among the children were the suspected sources of infection.

In a similar report, Enemuor and Amedu (2009) showed that tinea infection is a public health problem in tropical countries due to conducive climatic environment which favors their persistence and variability. This study is also similar to those recorded among primary school children in Ebonyi, South-Eastern Nigeria (Anosike *et al.*, 2005). Similar studies in Iraq and Egypt had a low prevalence of 2.7% and 7.4% respectively (Fathi and Al-Samarai, 2000). It has been suggested that differences in the prevalence of Tinea infections in different regions may be due to variation in climatic and environmental conditions of the areas being studied (Ogbonna *et al.*, 1985; Akinboro *et al.*, 2013).

This study showed that tinea infections are commoner in males (55.1%) than females (44.9%). Males usually keep short hair, visit the barber's shop more, have more frequent contact with playmates, play with sand more and are less concerned about hygiene and personal grooming than females (Soyinka, 1978). Also, females usually weave their hair and visit the barbers less, and practice general personal and hair hygienic management more. This male predominance was also observed in previous studies (Halickova *et al.*, 2008; Ogbonna *et al.*, 1985; Ayanbimpe, 2008).

Tinea infections have a higher prevalence among children less than ten years of age. This is comparable to what Nweze obtained in North-Eastern Nigeria and in other related studies (Nweze and Okafor, 2005; Omar, 2000; Enweani *et al.*, 1996; Nweze, 2001; Ajao and Akintunde, 1985; Ogunbiyi *et al.*, 2005; Popoola *et al.*, 2006). This affirms the observation that

tinea infection is predominantly a pre-pubertal disease. The prevalence of tinea infections was observed in all age groups of the pupils, though higher in those between six to ten years old. Also, the presence of tinea infections in younger age group supports the suggestion that the infection is related to absence of saturated fatty acids that provide a natural protective mechanism against fungal infections (Fischer and Cook, 1998) and children have the least awareness of personal hygiene. This agreed with Ayanbimpe *et al* (2008) that attributed the high degree of infection in this age group to the fact that they are more active at the playgrounds and with pets and will thus have closer contact with sources of pathogens and they engage in poor hygienic practices at this age. Other researchers like Omar in Alexandria (Omar, 2000), Figueroa in South-western Ethiopia (Figueroa *et al.*, 1997), Adel-Hafez in Sohag governorate (Adel-Hafez, 1997) as well as Venugopal and Venugopal in Saudi Arabia (Venugopal and Venugopal, 1993) have also subscribed to the age difference. It is expected that the younger the age, the poorer will be the hygiene and as such more likely it is to contact infectious diseases. As children approach their teenage age, they become more concerned with their outlook and are neater. These reasons are also advanced for the observed preponderance among those aged 10 and younger in this study.

Tinea capitis, a dermatophytosis, was the predominant tinea infection recorded among primary school pupils in the present study (72.5%). This agrees with other studies done in Africa, Europe and Asia (Anosike *et al.*, 2005; Chepchirchir and Ndinya-Achola, 2009; Omar, 2000; Adefemi *et al.*, 2011). It has been described as the most common paediatric dermatophyte infection among children worldwide (Ajao and Akintunde, 1985; Ogunbiyi *et al.*, 2005; Uneke *et al.*, 2006). Reasons that can explain the predominance of tinea capitis among children of primary school age include use of local barbers, poor personal hygiene, short hair that promotes transmission from

one scalp to the other due to its exposed nature, ignorance and increased frequent contacts with playmates at school and siblings at home (Akinboro *et al.*, 2013; Ogbonna *et al.*, 1985). This explains the high prevalence of the infection observed in this study. It indicates the need for early diagnosis, because it may result in destruction of hair, with severe hair loss and scarring alopecia if left untreated.

Tinea corporis is the next common type of tinea infection in this area. The disease remains endemic in Nigeria, largely because of lack of information on its prevalence and the absence of control measures (Olaide *et al.*, 2014). In this present study, tinea corporis was found to have a prevalence of 16.1% and this is comparable to the result observed in a study of primary school children in Northern Ebonyi of Ebonyi State, Nigeria (Anosike *et al.*, 2005).

The prevalence and distribution of tinea corporis in this study is relatively high compared with either the report of Ajao *et al* (1985) amongst primary school children in Ile-Ife, Nigeria (14.02%) or those of Omar (2000) in Alexandria (7.4%).

Other tinea infections such as tinea unguim (onychomycosis) and tinea mannum had a low prevalence rate of 3.8% and 2.2% respectively. This is corroborated by previous studies that show these infections to be uncommon in the age group being studied as they are not usually exposed to predisposing factors such as involvement in gardening (Degreef, 2008; Oyeka and Eze, 2008).

There were no cases of Tinea barbae, Tinea pedis (athlete foot) and Tinea cruris found in this study. This is probably due to the age group being studied. These have been found in older age group as documented by Moon *et al.*, (2001). It is also believed that the older age groups are more likely to grow and trim their beards, wear their shoes more constantly, and wear tight

underwear. This, with the hot and humid environment promotes moisture which will favour susceptibility to the infection (Soyinka, 1978).

The dermatophyte species isolated in this amounted to 94.6% as against 5.4% non dermatophyte species. This suggests that fungal infection generally are still much present within the locality surveyed. Reports on non dermatophytic fungi associated with dermatophytoses, etiological agents and control of their spread are scanty (Oyeka and Okoli, 2003; Vonshak *et al.*, 2003; Mbata and Nwajagu, 2007). Dermatophytes isolated in this study belonged to the two genera: *Trichophyton* and *Microsporum*. The genus *Trichophyton* was the most significant isolate which agrees with other studies done in developing countries, in African continent and parts of Asia (Enemuor and Amedu, 2009; Chepchirchir and Ndinya-Achola, 2009; Schmeller *et al.*, 1997). *Trichophyton mentagrophytes* was the commonest specie isolated followed by *Trichophyton rubrum*. Others include *Trichophyton tonsurans*, *Trichophyton schoenleinii*, *Trichophyton soudanese*, *Microsporum audouinii*, *Microsporum gypseum*, and *Microsporum canis*. The non dermatophyte species included *Candida albicans* and *Aspergillus flavus*. Most of the species were more predominant in the males. Studies have established variability in the species of dermatophytes isolated from one geographical region to the other and also per time (Ayanbimpe, 2008). In Nigeria, Nweze documented that the spectrum of pathogens and their clinical presentations in West Africa are different from those seen in other continents (Nweze, 2010).

Trichophyton mentagrophytes was the commonest dermatophyte specie isolated (56.1%) from the head, skin nail and hand. This is comparable to the findings of Ayanlowo that this fungi is predominant in children (Ayalowo, 2014) and Adefemi *et al.* (Adefemi *et al.*, 2011). The fungus is said to be cosmopolitan, and is one of the most common dermatophytes infecting man and

animals (Hainer, 2003). The presence of *Trichophyton rubrum* (14.5%) mostly isolated from the skin of pupils was an indication of poor hygiene and/or overcrowding at homes. Presence of non dermatophytes such as *Candida albicans* and *Aspergillus flavus* is becoming increasingly common and one of the factors attributed is the ubiquitous nature of their spores in our environment and that makes it to be carried transiently on healthy skin (Adefemi *et al.*, 2011; Chepchirchir *et al.*, 2009). These non dermatophytes isolated concurred with the reports of Rahbar *etal.* (2010) and Mbata and Nwajagu (2007) as well as implied that non-dermatophytic fungi (yeast and conidial forms) synergize with dermatophytic fungi in a yet undefined phenomenal interaction to cause symptomatic superficial fungal interactions across a range of human and animal hosts.

Poor infrastructures such as desks, classrooms may be a contributing factor to the prevalence of tinea infections among primary school pupils in Aninri Local Government Area of Enugu state since some of the schools assessed lacked standard studying accommodation as well as recreational facilities. Some children who sit on uncemented floors can contact the infection directly from the soil. This collaborates with the work of Ogbonna *et al.*(1985).

Two children had multiple site infection (tinea capitis and tinea corporis). This finding is also observed in most local and international studies, especially those studies that looked at other sites of the body (Nweze, 2001; Bergson and Fernandez, 2001; Lari *et al.*, 2005). The reason for this multiple site infection might be related to the ability of some strains of dermatophyte to affect more than one site concurrently in the same person.

5.2 Conclusion and Recommendation

The prevalence of tinea infections among primary school children in Aninri Local Government Area of Enugu State is 12.1%. Hence tinea infections are a public health problem among the primary school children studied. *Tinea capitis* was the commonest clinical variety encountered and *Trichophyton mentagrophytes* was the organism most frequently isolated. This study also confirmed the observations of other researchers that prevalence of tinea infections is influenced not only by age but also by sex (Fathi and Al- Samarai, 2000).

The researcher has recommended that constant monitoring; treatment and evaluation of infection in the area and in other primary schools in the country should be encouraged. There should be routine inspection of school children. Sharing of unhygienic personal belongings with the infected pupils and intimate association with pet animals could increase the mode of transmission. This should be discouraged. Regular health education about fungal infections that highlight their morbidities and modes of spread, should be given to these school children, their parents and teachers, in order to truly reduce the prevalence and burden of tinea infections in the area. Also there should be provision of good infrastructures in schools by Government, especially in schools where pupils resort to improvised seats or floors.

Finally, combined efforts of school children, teachers, parents as well as Local, State and Federal Governments in promotion of health education in schools, treatment using appropriate antifungal drugs are all recommended. This will provide a conducive dermatophyte free environment.

Limitation

The followings are the limitations of the study: cross sectional nature of the study and absence of a Wood light that enhances isolation of infected hair.



Figure 1: Tinea mannum

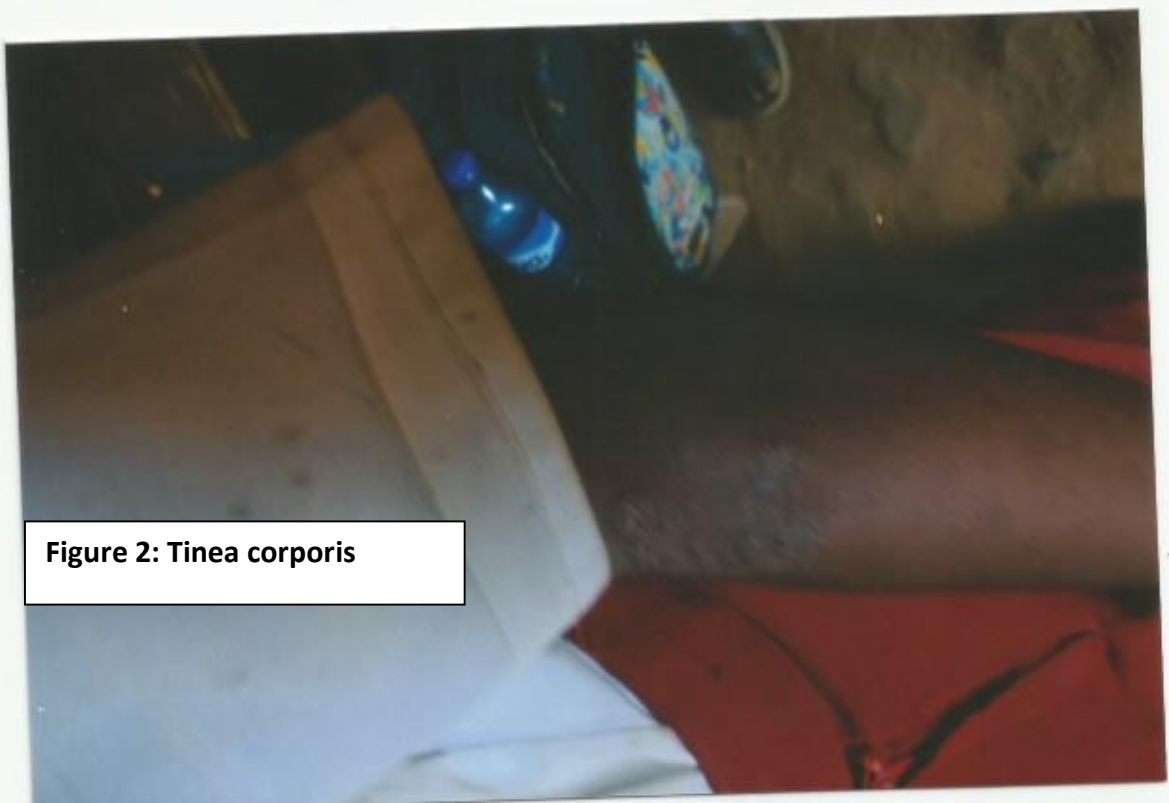


Figure 2: Tinea corporis



Figure 3: Tinea capitis



Figure 4: Tinea corporis

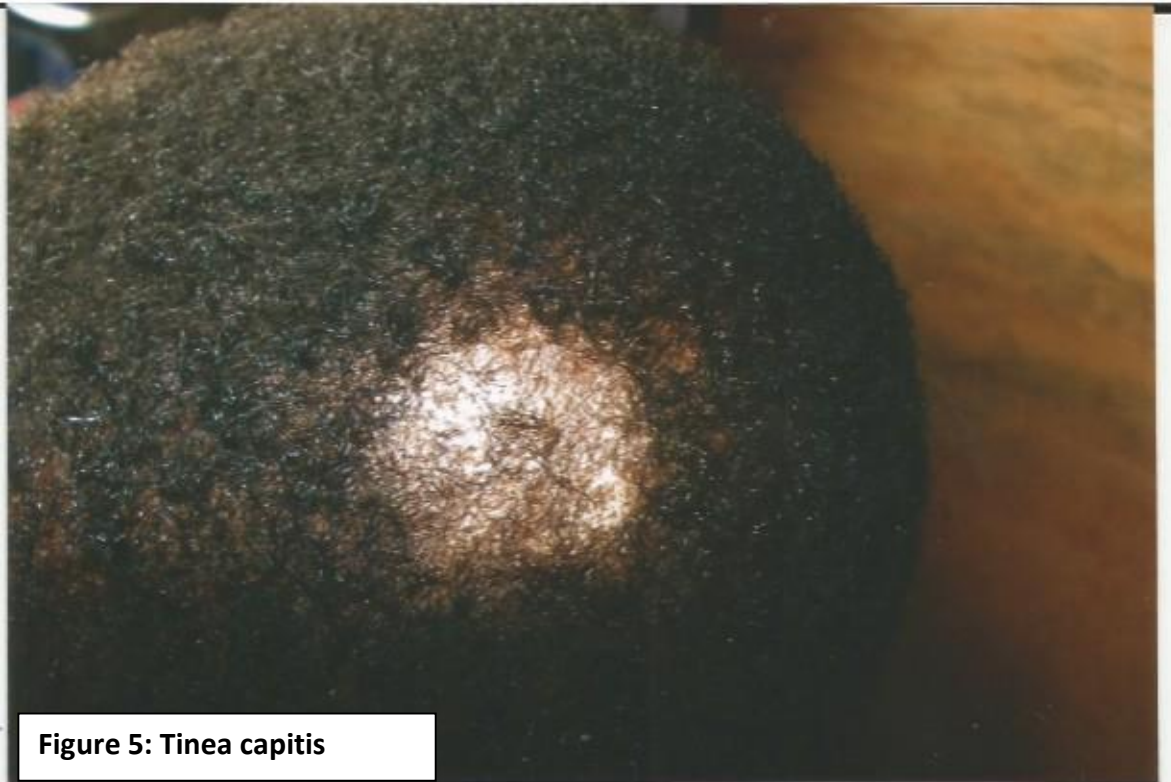


Figure 5: Tinea capitis



Figure 6: Tinea unguis (Onychomycosis)



Figure 7: Tinea capitis

REFERENCES

- Achterman, R.R., White, T.C. (2012). A foot in the door for dermatophyte research. *Plospathogens* 8(3):e1002564.
- Addel-Hafez, K. (1997). Adefemi, S. A., Odeigah, L. O., and Alabi, K. M. (2011). Prevalence of dermatophytosis among primary school children in Oke-oyi community of Kwara State. *Nigerian Journal of Clinical Practice* 14(1): 23-28.
- Ajao, A. O., and Akintunde, C. (1985). Studies on the prevalence of tinea capitis infection in Ile-ife, Nigeria. *Mycopathologia* 89(1): 43-48.
- Ajello, L. (1962). Present day concepts in the dermatophytes. *Mycopathologia* 17: 315-324.
- Ajello, L. (1968), a taxonomic review of the dermatophytes and related species. *Sabouraudia* 6:147
- Akinboro, A. O., Olasode, O. A., Onayemi, O. and Mejiuni, D.A. (2013). The impacts of Tinea capitis on quality of life: a community based cross sectional study among Nigerian children. *Clinical Medicine Insights. Dermatology* 6: 9-17.
- Ameen M. (2010). Epidemiology of Superficial Fungal Infections. *Clinical Dermatology* 28: 197-201.
- Andrews, M. D and Burns, M. (2008). Common tinea infections in children. *American Family Physician*. 77(10): 1415-1420.
- Anosike, J. C., Keke, I. R and Uwaezuoke, J. C., Anozie, J. C., Obiukwu, C.E., Nwoke, B.E.B and Amajuoyi, O. U. (2005). Prevalence and distribution of ringworm infection in primary school children in parts of Eastern, Nigeria. *Journal of Applied Sciences and Environmental Management* 9(3): 21-25.
- Ayanbimpe, G.M., Taghir, A.D and Wapwera, S. (2008). Tinea capitis among primary school children in some parts of central Nigeria. *Mycoses* 51: 336-340.

- Ayanlowo, O., Akinkugbe, A, Oladele, R. and Balogun, M. (2014).Prevalence of tinea capitis infection among primary school children in a rural setting in South-west Nigeria.*Dermatology* 5(1): 38-49.
- Bell-Syer, Khan, S.M. and Jorgerson, D. J. (2012).Oral treatments for fungal infections of the foot.*Dermatology* 22:122-134.
- Bergson, C.L and Fernandez, N.C. (2001). Tinea capitis: Study of Asymptomatic Carriers and Sick Adolescents, Adults and Elderly who live with Children with the Disease. *Revista do Instituto do Medicina Tropical dr Sao Paulo* 43:87-91.
- Berman, K. (2008). Tinea corporis- all information.*Multi Media Medical Encyclopedia*.University of Maryland medical Center.
- Bolognia, J.,Jorizzo, J.L., Rapini, R.P. (2007). *Dermatology* (2nd Edition). St. Louis,Mosby Elsevier. P1135.
- Brasch, J. (2010). Pathogenesis of Tinea.*Journal der Deutschen Dermatologischen Gesellschaft* 8(10): 780-786.
- Braun-Falco, O. (2000).*Dermatology*.Berlin: Springer, p.323.
- Burzykowski, T., Molenberghs, G., Abeck, D., Haneke, E., Hay, R., Katsambas, A., Roseeuw, D., Van de Kerkhof, P., Van Aelst, R., Marynisen, G. (2003). High Prevalence of Foot Diseases in Europe: Results of the Achilles Project. *Mycoses*46 (11-12): 496-505.
- Chepchirchir, C.B and Ndinya-Achola, J. O. (2009).Dermatophyte infections in primary school children in Kibera slums of Nairobi.*East African Medical Journal* 86(2):59-68.
- Chi, C.C., Wang, S.H., Chou, M.C. (2005).The Causative Pathogens of Onychomycosis in Southern Taiwan.*Mycoses*48 (6): 413-420.
- Crissey, J. T., Lang, H., Parish, L.C. (1995). *Manual of Medical Mycology*.Blackwell Science, Cambridge. P.36.
- Degreef, H. (2008). Clinical forms of dermatophytosis.*Mycopathologia*. 166(5-6): 257-265.

- Disalvo, A. (2008). *Mycology.Superficial Mycoses*.The Board of Trustees of the University of South Carolina, 1,-2.
- Enemuor, S.C and Amedu, A.S. (2009).Prevalence of superficial mycoses in primary school children in Anyigba, Kogi State, Nigeria.*African Journal of Microbiology Research* 3(2): 62-65.
- Enweani, I.B., Ozan, C.C., Agbonlahor, E.E and Ndip, R.N. (1996).Dermatophytosis in School Children in Ekpoma, Nigeria.*Mycoses* 39:303-305.
- Fathi, H.I and Al-Samarai, A.G.M. (2000).Prevalence of tinea capitis among school children in Iraq.*Eastern Mediterranean Health Journal* 6: 2-35.
- Fernandez, N.C., Akiti, T. and Barreiros, M.G. (2001). Dermatophytoses in Children: Study of 137 Cases. *Revista do Instituto de Medicina Tropical de Sap Paulo* 43:83-85.
- Figueroa, J.I., Hawranek, T., Abraha, A and Hay, R.J. (1997). Tinea capitis in South western Ethiopia: A Study of Risk Factors for Infection and Carriage. *InternationalJournalofDermatology* 36:661-666.
- Fischer, F. and Cook, N.B. (1998).*Fundamentals of Diagnostic Mycology*(7th Edition). WB Saunders Company, Philadelphia, pa, USA.
- Ghannoum, M., Isham, N., Hajjeh, R. (2003).Tinea Capitis in Cleaveland Survey of Elementary School Students.*Journal of the American Academy of Dermatology* 48: 189-193.
- Hainer, B.L.(2003). Dermatophyte Infections.*AmericanFamilyPhysician* 67:101-108.
- Havlickova, B., Czaika, V.A., Friedrich, M. (2008).Epidemiological Trends in Skin Mycoses Worldwide.*Mycoses* 51(4): 2-12.
- James, W.D. and Berger, T.G. (2006).*Andrews'DiseasesoftheSkin: ClinicalDermatology*. Saunders Elsevier.
- Lari, A.R., Akhlaghi, L., Falahati, M. and Alaghehbandan, R. (2005).Characteristics of Dermatophytes among Children in an Area South of Tehran, Iran.*Mycoses*48:32-37.

- Mackenzie D.W.R. (1961). The Extra-Human Occurrence of *Trichophyton tonsurans* var *sulphureum* in a Residential School. *Sabouraudia* 1:58-64.
- Macura, A.B. (1993). Dermatophyte infections. *International Journal of Dermatology* 32: 313-324.
- Male, O. (1990). *The Significance of Mycology in Medicine*. In: *Frontiers in Mycology*, Hawksworth, D.L. (Ed.). CAB International, Wallingford, pp 131-156.
- Maya, C.A. (1989). A study of tinea capitis in Sri Lanka. *Journal of Medical and Veterinary Mycology* 27:27-32.
- Mbata, T.I. and Nwajagu, C.C. (2007). Dermatophytes and other Fungi Associated with Hair-scalp of Nursery and Primary School Children in Awka, Nigeria. *The Internet Journal of Microbiology* 3 (2): 1-6.
- Moon, H., Moon, J., Lee, J., Kim, S., Won, Y. and Lee, S. (2001). Epidemiologic study of superficial fungal infections in outpatients of dermatologic clinic and healthy individuals. *Chonnam Medical Journal* 37 (4): 409-413.
- Nelson, M.M., Martin, A.G. and Heffernan, M.P. (2003). *Superficial Fungal Infections: Dermatophytosis, Onychomycosis, Tinea nigra, Piedra*. In: *Dermatology in General Medicine* (6th Edition). McGraw-Hill, New York, pp:1989-2005.
- Ngwogu, A.C and Otokunfor, T.V (2007). Epidemiology of dermatophytoses in a Rural Community in Eastern Nigeria and Review of Literature from Africa. *Mycopathologia* 164: 149-158.
- Noble, S.L., Forbes, R.C., Stamm, M.D. (1998). Diagnosis and Management of Common Tinea Infections. *American Family Physician* 58(1): 163-174.
- Nweze, E.I. (2010). Dermatophytosis in Western Africa: a review. *Pakistan Journal of Biological Sciences* 13(13): 649-656.

- Nweze, E.I and Okafor, J.I. (2005).Prevalence of dermatophytic fungal infections in children: A recent study in Anambra State, Nigeria. *Mycopathologia* 160: 239-243.
- Nweze, E.I., Okafor, J.I and Njoku, O. (2004).Antimicrobial activities of methanolic extracts of *Trema guineensis* (Schumm and Thorn) and *Morinda Lucida* Benth used in Nigeria herbal medicinal practice.*Journal of Biological Research* 2:36-39.
- Nweze, E.I (2001). Etiology of Dermatophytoses Amongst Children in Northeastern Nigeria. *MedicalMycology*39:181-184.
- Ogbonna, C.I.C., Robinson, R. O. and Abubakar, M.J. (1985).The distribution of ringworm infections among primary school children in Jos, Plateau state of Nigeria.*Mycopathologia* 89(2): 101-106.
- Ogbu, C.C., Okwelogu, I.S. and Umeh, A.C. (2015).Prevalence of superficial fungal infections among primary school pupils in Awka South Local Government Area of Anambra State.*Journal of Mycology Research* 2(1): 15-22.
- Ogunbiyi, A.O., Owoaje, E. and Ndahi, A. (2005).Prevalence of skin disorders in school children in Ibadan, Nigeria.*Paediatric Dermatology* 22(1): 6-10.
- Okafor, J.I., Nweze, E.I. and Njoku, O. U. (2001).Antimicrobial activities of methanolic extracts of *Zapoteca portericensis* Benth and *Cissus quadrangularis* Linn.*Nigeria Journal of Pure and Applied Science* 1:2.
- Olaide, O.O., Olaniyi, O., Olanyinka, A.O., Akinlolu, G.O. and Olumayowa, A.O. (2014).The prevalence and pattern of superficial fungal infections among school children in Ile-ife, South Western, Nigeria.*Dermatology Research and Practice* 7:312-320.
- Omar, A.A. (2000). Ringworm of the scalp in primary school children in Alexandria: infection and carriage.*Eastern Mediterranean Health Journal* 6(5-6): 961-967.
- Onyebueke, E.A., Onyemelukwe, N.F., Onochie, C.C., Oro-Areduo, G.E. (2012).Prevalence of Tinea Corporis Amongst Primary School Children in Enugu, South East, Nigeria.*Journal of Science Engineering and Technology*, 19 (2):10879-10889.

- Oyeka, C.A. and Eze, I.I. (2008).Fungal skin infections among prison mates in Abakaliki, Nigeria.*Mycoses* 51(1): 50-54.
- Oyeka, C.A. and Okoli, I. (2003).Isolation of Dermatophytic and non-dermatophytic fungi from soil in Nigeria. *Mycoses* 46: 336-338.
- Pandley, A., Pandley, M. (2013).Isolation and Characterisation of Dermatophytes with Tinea Infections at Gwalior, India. *International Journal of Pharmaceutical Science Invention* 2(2): 05-08.
- Pellizzari, C. (1888). Recherche sur *Trichophyton tonsurans*.*G Ital Mal Veneree* 29:8.
- Philpot, C.M. (1978). Geographical Distribution of the Dermatophytes: A Review. *J. Hug London* 80:301-313.
- Popoola, T.O., Ojo, D.A and Alabi, R.O. (2006).Prevalence of Dermatophytosis in Junior Secondary School Children in Ogun State, Nigeria.*Mycoses* 49:499-503.
- Rahbar, M., Mehrabani, H.G., Dahiml, P., and Dahn, P. (2010).Prevalence and etiological agents of cutaneous fungal infection in Milad Hospital of Tehran, Iran. *Egyptian Dermatological Online Journal* 6(2): 3.
- Richardson, M. (2003). *Fungal Infection: Diagnosis and Management*. Cambridge, M A: Blackwell Publishers. P 136-138.
- Rippon, J.W. (1988). *Medical Mycology: The Pathogenic Fungi and the Pathogenic Actinomycete*. W.B. Saunders, Philadelphia, USA.
- Sahin, I., Oksuz, S., Kaya, D., Sencan, I. and Cetinkaya, R. (2004). Dermatophytes in Rural Area of Duzce, Turkey. *Mycoses* 47: 470-474.
- Schmeller, W., Baumgartner, S. and Dzikus, A. (1997). Dermatophycoses in children in rural Kenya: Impact of Primary Health Care. *Mycoses* 40: 55-63.
- Seebacher, C., Bouchara, J.P. and Mignon, B. (2008).Updates on the Epidemiology of Dermatophyte Infections.*Mycopathologia* 166 (5-6): 335-352.

- Shinoda, H. and Nishimoto, K. (2007). Clinical study of 57 cases of infection with *Trichophyton tonsurans* examined at a dermatology clinic in Saitama Prefecture, Japan. *Dermatology* 48(2): 79-84.
- Singh, D., Patel, D.C, Roger, K., Wood, N., Riley, D., Morris, A. J. (2004). Epidemiology of Dermatophytosis in Auckland, New Zealand. *Le Journal Medical Libanais*
- Somarin, A.O., Nwabudike, I., Adesotoye, A.I. and Honponowusu, O.O. (1977). Dermatophytosis in school children. *Nigerian Journal of Pediatrics* 4: 39-42.
- Soyinka, F. (1978). Epidemiologic study of dermatophyte infections in Nigeria (clinical survey and laboratory investigations). *Mycopathologia* 63(2): 99-103.
- Szepietowski, J., Salomon, J., Pacan, P., Hichorow, E. and Zalewoke, A. (2007). Body dysmorphic disorder and dermatologists. *Journal of European Academy of Dermatology* 30 (4):200-212
- Szepietowski, J. and Reich, A. (2008). Stigmatisation in onychomycosis patients: a population based study. *Mycoses* 52 (4): 343-349.
- Uneke, C.J., Ngwu, B.A. and Egemba, O. (2006). Tinea capitis and pityriasis versicolor infections among primary school children in the South-eastern Nigeria: the public health implications. *The Internet Journal of Dermatology* 4(2).
- Venugopal, P.V. and Venugopal, T.V (1993). Tinea capitis in Saudi Arabia. *International Journal of Dermatology* 32: 39-40.
- Verenkar, M.P., Pinto, S., Rodrigues, W.P., Singh, I. (1991). Clinico-Microbiological Study of Dermatophytoses. *Indian Journal of Pathology and Microbiology* 34:193-212.

Vonshak, A., Barazani, O., Sathiyamoorthy, P., Vardy, D and Golan-Goldhirsh, A. (2003). Screening South Indian Medicinal Plants for Antifungal Activity against Cutaneous Pathogens. *Phytotherapy Res.* 17:1123-1125.

Weitzman, I. and Summerbell, R.C. (1995). The dermatophytes. *Clinical Microbiology Review* 8:240-259.