EPIDEMIOLOGICAL STUDIES ON SOME MICROBIAL AND PARASITIC INFECTIONS OF NOMADIC FULANI HERDSMEN IN EBONYI STATE, NIGERIA

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CERTIFICATION

I, Mfon Edem Charlie Umo do hereby certify that this research work was carefully carried out by me under supervision of Prof. C.O. Akueshi and Professor F.C. Onwuliri.

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DECLARATION

I hereby declare that this work is the product of my own research efforts; undertaken under the supervision of Professor C.O. Akueshi and Professor F.C. Onwuliri and has not been presented elsewhere for the award of a degree or certificate. All sources have been duly acknowledged.

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DEDICATION

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TABLE OF CONTENTS

CHAPTER THREE
MATERIALS AND METHODS

CHAPTER FOUR
RESULTS

CHAPTER FIVE
DISCUSSIONS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

Abstract

Over the years, nomadic Fulani herdsmen have established different settlement camps outside the traditional villages of their indigenous host communities in Ebonyi State. With increasing concerns about the health condition of the nomads, this study was undertaken to investigate the prevalence and distribution of some microbial and parasitic infections amongst the spartially distributed population of the nomadic Fulani herdsmen in Ebonyi State. This investigation was carried out between June 2005 and June 2007 using standard bacteriological, mycological and parasitological techniques. In addition, the knowledge, attitudes and perception of Fulani herdsmen about microbial and parasitic infections was studied using questionnaires. Out of 1218 samples taken from 7 bush encampments, 677 (55.6%) had various bacterial organisms with Enterococcus spp (21.3%) and Nesseria spp (19.5%) being predominant followed by Enterobacter sp (14.6%) Staphylococci (10.6%) while the least was Acinetobacter sp (0.14%). Out of 280 persons examined for dermatophytes infections, 59(21.1%) were infected with ringworm of the scalp being most predominant. Although the prevalence varied amongst age and sex, both male and female within age bracket of 11-15 years were significantly infected than other age categories ($P<0.05$). *Microsporum spp* and *Trichophyton* spp were the most predominant isolates. Two (2) species of *Microsporum*, namely *M. audouinii*, (35.1%) and *M. canis* (28.0%) and four (4) species of *Trichophyton*, namely *T. mentagrophytes, T. quickenum, T. soudanense and T. schoenleini* were isolated. Infections decreased with increase in age. Out of 573 samples examined for parasitic infections a total of 263 were positive with an overall prevalence of 45.9%. *Plasmodium sp* 61(10.6%) and *Schistosoma haematobium* 48(8.4%) showed the highest prevalence; the least prevalent was *Trypanosoma* sp

(0.7%). Distribution of these infections varied significantly amongst bush encampments, sex and age group. Out of the four (4) human *Plasmodium* species encountered, *P. falciparum* was significantly higher than others (P<0.05). The results of filarial studies showed *Onchocerca volvulus* (3.8%), *Mansonella* sp (2.8%) and *Wuchereria bancrofti* (2.4%) in decending order of prevalence.Among the nomads that participated in the Knowledge, attitude and perception survey, 82% displayed total lack of knowledge about the cause of microbial infection. The proportion that accepted western medication was very low (6.5%). Poor infrastructures, lifestyle and beliefs, low personal hygiene by the Fulani's are contributing factors to the high frequency and severity of these infections in the area. Adequate and quality education campaign should be carried out in the various bush encampments in Ebonyi State.

CHAPTER ONE
INTRODUCTION

1.1 THE NOMADIC FULANI PEOPLE

The ethnological name Fulani represents the people based on a peculiar origin, whereas the name Fulakunda represents one of the many sub-groupings of the Fulani people. Each of the sub-groupings is based on dialect and geographic location (Gandiri *et al*., 2001)

The more popular anthropological studies, as well as the obscure oral traditions of the Fulani people, trace their origins to the Ethiopian Empire of Eastern Africa. The people were predominantly nomadic herdsmen of cattle, sheep, and goats. Their movements were based upon the availability of food supplies for their herds. Whereas the cattles were rarely eaten and remained a symbol of wealth, the sheep and goats were used for trade in the villages to obtain rice, millet, corn, clothing, etc (Gandiri *et al*., 2001)

The Nomads are a race without fixed abode, moving from place to place according to the state of pasturage or food supply (Anosike *et al*., 2005). They consist of several groups made up of hunters, collectors, fishermen as well as pasturalists. The last group which makes up the majority of the nomads today domesticates animals, usually cows, sheep, camels and goats. They often employ horses and donkeys for transportation (Ogbonna *et al.,* 1986). The animals are kept for the provision of meat, milk and sometimes blood apart from the utilization of their hides and hair for clothing, tents and professional equipment. Basically, the nomads have a primitive pagan religion, often with animism as dominating ingredients (Ogbonna *et al.,* 1986). The reasons for nomadism are several and differ in different parts of the world. Generally, the leading causative factor for inhabiting certain areas by nomads is availability of

water, extreme winds, high-temperatures and high altitudes which mitigate against land cultivation and effective farming. Moreover, Nomadism is a way of life and they love the lifestyle.

In the south eastern and south-south parts of Nigeria, activities of these groups of people are increasing on daily basis (Nwoke, 2004). They gradually mingle with the people of these areas and introduce their products like fura, nono, and various dairy and farm products to the people and in the process, they could introduce to the area, infections contracted or developed in the process of their migratory activities.

1.2 JUSTIFICATION FOR THE STUDY

Although, several studies have been carried out on various infections amongst nomadic Fulanis in several parts of Africa particularly in the savanna region, there are very few studies conducted on Nomads in the rainforest region, (Anosike *et al*., 2005). Since these Nomads are highly mobile herdsmen who are exposed to various environmental adversities in the course of their occupation, it becomes important to investigate the microbial infections associated with them.

The aim of this study, therefore, is to investigate some of the microbial and parasitic infections associated with these herdsmen in parts of Ebonyi State in South Eastern Nigeria. It is believed that data from these studies will help appreciate the role of microbial and parasitic infections in the overall health status of these nomadic herdsmen. This will assist in proper formulation of health policy aimed at protecting this special group of people. Further more, the information gathered will also provide very useful data for deeper appreciation of the ecology of diseases amongst Nomads.

1.3 OBJECTIVES

1. To determine the prevalence and distribution of some microbial and parasitic infections among the nomadic Fulani in bush encampments in Ebonyi State, Nigeria.
2. To identify the nomadic Fulanis' local knowledge and beliefs about microbial and parasitic infections, in particular their perception about the causes of the diseases; methods of treatment and prevention as well as those habits and customs that contribute to predisposition of the disease in the population.

CHAPTER TWO
LITEREATURE REVIEW

2.1 THE ORIGIN OF NOMADIC FULANI HERDSMEN

The nomadic Fulanis migrated to the Hausa region and Borno State of Nigeria from the West around the 13th Century. According to Ezeomah (1983), most pastoral Fulanis could not give a detailed account of their ancestors' social and political life before the Jihad. They lived in rather large and mobile bush encampments in which they were prepared either to defend themselves or flee, depending on the strength of their enemy. As people whose subsistence came largely from their herd, they were less dependent on land and had little contact with Hausa rulers. Their origin is unknown, although some claim to have originated from Chad Republics, Cameroon and Benin Republic. They move from the northern part of Nigeria during the end of the dry season to the southern parts mainly for green pasture for their animals. Apart from the initial major movements of the nomadic Fulanis into Hausa and Borno State, they had drifted to Jos in Plateau State, Bauchi in Bauchi State, southern Adamawa and Muri in small groups immediately after the British had pacified these areas in the early 1900s (Ezeomah, 1983). These nomads then found these areas suitable for grazing until major migrations started from 1932-1937. The nomadic Fulani (Bororo or migrant) are traveling people, taking their huge herds from one area to another in search of pasture. They possess no land of their own and have no permanent abode. They combine at the same time a distinctive life style, a great attachment to their own customs and a way of making easy relations with those whom they meet, whether African or European. They have a rare empathy for their cattle and are superb stockmen (Anosike, 1996).

The movement of the nomadic Fulanis is seasonal. Such seasonal movements are motivated by many factors, such as the desire of the nomads for freedom from the

interference and supervision by sedentary authorities, freedom from cattle raiding, the avoidance of disease infected areas and the never-ending search for new pastures as they do not own any land of their own (Ezeomah, 1983). In fact, it is mainly the seasonal shortages of grazing and water that impose a nomadic way of life on the nomadic Fulani and his animals.

Herding is a difficult task which calls for a great skill, much agility and close attention. This is especially so during the cropping season when the animals must be prevented from destroying the crops of the farmers. In the wet season, when grass is abundant, the herdsmen spend less time in the field with their animals. The harsh way of life has usually left the nomads with high tolerance threshold for suffering, and they feel a reduced need for health services. They are adapted to nature and extreme climate and they have a slow-swimming gait which is energy saving and does not overheat them. A fair degree of harmonious co-existence with animals has also been involved (Anosike, 1996)

2.2 THE NOMADIC FULANI IN EBONYI STATE, NIGERIA

The nomadic Fulanis found in Ebonyi State, graze cattle and other ruminants on the tsetse fly infested areas of Ebonyi State, mainly because of green pastures for their animals during the dry season months. The nomads are located in various bush encampments in the state. The Fulanis in each bush encampment live in huts and sleep on raised platforms made of wood and during the rainy season (March – November) the huts are covered with large polyvinyl sheets (Anosike *et al.*, 2004). The nomadic Fulani herdsmen are found with their cattle on the outskirts of the villages around each bush encampment in clearings similar to the description of Nwoke (2004). Epidemiologically, this exposure makes them very susceptible to the attack of various insects and vectors of filariasis particularly *Chrysops*. The indigenes in the area are

mainly Ibos who live in towns and villages and work on the farms. The Fulanis move along the water systems and valleys in the area herding their animals.

2.3 MICROBIAL INFECTIONS

These could be referred to as infections caused by microorganisms and are broadly differentiated into groups- those caused by bacteria, viruses, protozoas and fungi. Microbial infections are studied from the point of view of understanding their mode of transmission, pathogenesis and pathology with a view to improving diagnosis, treatment, prevention and control. Particular attention is paid to mechanisms of microbial pathogenesis and damage to host tissues, mode of infection and transmission. Mechanisms of resistance to drugs and chemical agents are also studied with applications in the areas of clinical infection, public health and the food industry (Haraldson, 1975). Studies on nomadic herdsmen in Ebonyi State became necessary in view of the reported cases of disease outbreaks among nomads around Africa and the entire world (Anosike *et al*, 2005). This is with a view to safeguarding the entire population, and make information available on the health status of these special groups of people.

2.4 MICROBIAL INFECTIONS AMONGST FULANI HERDSMEN

Infections caused by pathogenic bacteria such as *Salmonella typhi, Escherichia coli, Shigella spp* and other pathogenic species in nomads have been reported in various parts of the world, although very few cases have been cited in the savannah region of Nigeria, but because of the milk and other by-products produced by their herd which could serve as a breeding medium for these pathogens, it became necessary to examine the health status of these groups of people to enable health policy formulators and the general public appreciate their health challenges. Common bacterial skin pathogens include *Staphylococcus aureus* and group b-haemolytic *Streptococcus* (WHO 1990a).

Among the dermatophytic fungi, *Trichophyton rubrum* is the most prevalent cause of skin and nail infections. Ogbonna *et al.* (1986) had reported a significant prevalence of dermatophyte infections amongst Fulani herdsmen of Plateau State, in Nigeria.

2.5 RINGWORM INFECTIONS

Anglo-Saxon ancestors coined the word ringworm in the 16th century. This term described the form of the lesion and relates it to the Roman tinea (Ajello, 1974). This name reflects the ignorance that prevailed in the past about the true aetiology of this disease.

The infection medically known as dermatophytosis is caused by dermatophytes, which are a group of fungi which affect the superficial keratinized tissue (skin, hair and nails) of humans and animals. Hence, ringworm can be defined as a superficial skin infection caused by a group of fungi known as dermatophytes. The ability of these fungi to invade, colonise and nourish themselves on the tissues of man and animals is due to the enzymatic systems they possess. These enzymes enable them to digest keratins – a highly specialized class of proteins elaborated by epithelial cells (Ajello, 1974). Ringworm (dermatophytosis) can be unsightly or disfiguring; causing varying symptoms depending on the part of the human skin they are found. Ringworm of the skin (*Tinea corporis*) for example causes annular lesions with a clearing; scaly centre surrounded by a red advancing border that may be dry or vesicular. There is also ringworm of the scalp (*Tinea capitis*) which gives rise to dull gray, circular patches of alopecia, scaling, itching and black dot (Higgins *et al.*, 2000).

There are other ringworms like *Tinea pedis*, *Tinea curis*, *Tinea barbac* and *Tinea unguinum* which affect the feet, groin, beard and nails respectively. The name ringworm for many people still evokes the specter of social stigma, with vision of dirt, slums and the shaven scalps that were evidence of vast epidemics in European cities

100 years ago (Fathi and Al-samarai., 2000) This infection is highly contagious and represents a significant public health problem, particularly among school children (Elowski and Hary., 1996). It can be transmitted through body contacts (person to person transmission) mainly in refugee camps or schools (Omar, 2000) or through inanimate objects like clothes, combs or hairdressers' equipment etc.

2.6 TYPES OF RINGWORM INFECTIONS

Ringworms are classified based on the part of the skin that is infected and the type of lesions caused by the causative agents (dermatophytes). Of the two types of ringworms, that is, *Tinea capitis* and *Tinea corporis*, the latter attacks the skin while the former attacks the scalp.

2.7 AETIOLOGY OF RINGWORM INFECTIONS

Aetiology is defined as the study of the organisms that cause infection. In this context, it means the study of those fungal organisms that cause ringworm infections. The first mycotic aetiology of skin infection was discovered by a great Polish physician Robert Remak in 1837. Remak's studies helped many other scientists to discover the three main genera that cause these ringworm infections. David Gruby discovered and named genus *Microsporum* in 1843, Per Herdrik Malmstan in 1845 discovered the second genus *Trichophyton* and the third genus *Epidermophyton* was discovered by Raymond Saboraud in 1910.

Today, one species of *Epidermophyton*, 15 species of *Microsporum* and 21 species of *Trichophyton* are considered to be living members of these genera. All of these species, however, are not dermatophytes, if we define a dermatophyte as a fungus classified in these genera, which parasitize the tissues of humans and other animals. Some of them even though frequently isolated from the bodies of animals, are not known to cause disease. However, since they possess the basic generic characteristic of

Microsporum and *Trichphyton*, they must be classified in those genera on purely mycological ground (Ajello, 1974). Against this information, the natural habitat of the various species of *Epidermophyton, Microsporum* and *Trichophyton* was presented (Ajello, 1974).The three genera of the dermatophytes that cause ringworm was further divided into three based on ecology namely; Anthropophilic dermatophytes, Zoophilic dermatophytes and Geophilic dermatophytes.

2.7.1 Anthropophilic Dermatophyte

These are those species of dermatophytes that live on humans and are transmitted from person to person by direct and indirect contacts. *Epidermophyton floccosum* the only species of the genus *Epidermophyton* has a worldwide distribution and is reported to infect only humans.(Ajello, 1974) This species of *Epidermophyton* invades only the skin and nails of humans and lacks the ability to invade the hair. Of the 15 species of *Microsporum,* only 3 species are anthropophilic, *M. ferugineum, M. auodouinii and M. praclox. M. ferugineum* has been found to be one of the causative agents of *Tinea capitis* and *Tinea corporis*. Of the 21 species of *Trichophyton*, 9 are Anthropophilic. They include *T. mentagrophytes var interdigitalis*, which is the most prevalent and it is of great public health importance (Ajello, 1974). Other species include *T. rubrum* which infects not only the skin, but nails and hairs as well (Ajello, 1974). Other species of this genus which affect either the skin or the scalp include *T. schoenleinii, T. tonsurans, T. violaceum, T. megnimii, T. soudanense and T. concentricum.*

Table 1: Common Dermatophyte Pathogen in Man

SPECIES	COMMON SITE(S) OF INFECTION	MAIN AREA OF DISTRIBUTION
M. audouinii	Scalp,body	Africa, America and Europe
M. ferrugineum	Scalp,body	Africa and Asia
T. mentagrophytes	Feet (nail), groin	Worldwide
T. concentricum	Body	South pacific
T. rubrum	Feet, nail, groin	Worldwide
T. schoenleinii	Scalp. body,nail	Eurasia and North Africa
T. soudanense	Scalp, body	Africa
T. tonsurans	Nail, Scalp	Europe and America
T. violaceum	Body, nail	Africa and Asia

Source: (Greenwood, 1998)

2.7.2 Zoophillic Dermatophytes

These organisms occur mainly in animals and can be transmitted to healthy humans only through contact with infected animals. There exist numerous species of *Trichophyton* and *Microsporum* in this group of dermatophytes. *Epidermophyton* species are yet to be isolated and classified into this group of dermatophytes.

2.7.3 Geophillic Dermatophytes

These organisms are found mainly in the soil and can be transmitted to animals and man. According to Al-Doory (1968), the origin of the dermatophytic isolates could be the soil. Many species of *Microsporum* occur in this group. Of the three groups of dermatophytes discussed above, anthropophilic species cause the greatest number of human infections (Higgins *et al.*, 2000). They cause ringworm infections in human and this may be either mild or chronic and very difficult to eradicate. The two remaining groups are rarely implicated in cases of ringworm infection, and when they do, their effects are severe. Some ringworm infections are caused by a single species or a combination of genera. Ringworm of the scalp for example is sometimes caused by genus *Microsporum* species but in some cases, it is caused by a group of *Microsporum* and *Trichophyton* species. Table 2 below shows the common dermatophytic pathogens of man, their common site(s) of infection and their main areas of distribution. Eight species in the genus *Microsporum* and ten among the *Trichophytons* (Tables 2 and 3) have perfect or sexual states that are known (Ajello, 1974). Dermatophytes are divided into two genera based on the perfect or sexual states. These are genus *Arthroderma* and genus *Nannizzia*. Tables 2 and 3 below represent the perfect or sexual states of *Microsporum* and *Trichophyton*.

Table 2: Perfect and impefect states of *Trichophyton* Species

PERFECT STATE	IMPERFECT STATE
Arthroderma behamiac	*Trichophyton mentagrophytes*
A. ciferii	*T. georgiae*
A. flavescens	*T. flavescens*
A. gertleri	*T. vanbreueghenii*
A. gloriac	*T. gloriac*
A. insingulare	*T. terrestre*
A. simu	*T. simu*
A. uncinatum	*T. ajelloi*

Source: (Greenwood, 1998)

Table 3: Perfect States of *Microsporum* Species

PERFECT STATE	IMPERFECT STATE
Nannizzia cajetani	*Microsporum cookie*
N. fulva	*M. fulvum*
N. grubyia	*M. vanbreuseghemi*
N. gypsea	*M. gypseum*
N. incurvata	
N. obtuse	*M. nanum*
N. persicolor	*M. persicolor*
N racemosa	*M. racemosum*

Source: (Ajello, 1974)

2.8 EPIDEMOLOGY OF RINGWORM

Ringworm is predominantly a disease of pre-adolescent children. Although worldwide in distribution, its prevalence in some parts of the world is low but higher in other parts. The main pathogens are anthropophillic organisms with *Trichophyton tonsurans* now accounting for more than 90% of cases in the UK and North America (Leeming *et al*., 1995; and Fuller *et al.*, 1997). *T. violaceum* infections are especially common in the Far East and Africa (Ajello, 1974) *T. schoenleinii* was formerly wide spread in Europe, is now found to be prevalent in North Africa and near East. *T. gouvilli* and *T. soudanense* have been found in many parts of Africa. *T. soudanense*, however, has also been reported from Australia, Europe, South America, and the United States (Fuller *et al*., 1997) It may be that *T. soudanense* is becoming established in non African countries and that we are witnessing an extension of its range (Frey, 1970).

T. tonsurans is a dermatophyte that has already extended its geographic range. Although *T. tonsurans* has been a common dermatophyte in Latin America, it was only occasionally encountered in the United States until the middle of this century (Ajello, 1974). However, (Higgins *et al.*, 2000) documented a remarkable increase in the incidence and prevalence of *T. tonsurans* in the South Western United States of America is reported (Higgins et al., 2000). *Tinea capitis*, caused by this fungus, commonly occurs throughout the United States of America (Somorin *et al.*, 1977). The change of status of this fungus from a rare to a relatively common disease agent or the wide and rapid spread of the disease is attributed to the transmission of infections to susceptible humans in the native population by infected immigrants from Mexico and Puerto Rico (Ajello, 1974).

In Nigeria, dermatophytes might have originated from the Nigerian environment or any of the neighbouring West African countries (Ogbonna *et al.*, 1986). In non-urban communities, sporadic infections acquired from puppies and kittens are due to *M. canis*, and account for less than 10% of cases in the U.K. Occasional infection from other animal hosts (cattle) e.g. *T. verrucosum* occurs in rural areas (Higgins *et al.,* 2000).

These infections frequently spread among family members and classmates (Greenwood, 1998). Certain hairdressing practices such as shaving of the scalp, plaiting, sharing of towels, clothes etc may promote disease transmission (Higgins *et al*., 2000).

2.9 PATHOGENESIS AND CLINICAL FEATURES OF RINGWORM

The outbreaks of this disease appear to be caused by indirect spread via external agents (combs or hair-dressers' equipment) or by person to person transmission in overcrowded conditions, for example in schools or refugee camps (Figueroa, 1997). Also, the attitude of most school pupils in the rural areas in playing on the ground or their constant contact with the soil has been suspected to be one of the major sources of this infection in most school pupils in endermic areas. *Tinea corporis* that usually attacks the skin commonly gives rise to the annular lesions of ringworm, with a clearing scanty centre surrounded by a red advancing border that may be dry or vesicular. The dermatophytes grow only within dead, keratinized tissue, but fungal metabolites, enzymes, and antigens diffuse through the viable layers of the epidermis to cause erythema and vesicle formation. Infection with geophillic and zoophillic dermatophytes produces more inflammation than anthropophylic species. The lesions expand centrifugally, and active hyphal growth is at the periphery, which is the most likely region from which to obtain material for diagnosis (Higgins *et al*., 2000).

Tinea capitis, which is the ringworm of the scalp and hair, begins with hyphal invasion of the skin of the scalp, which subsequently spreads down the keratinized hair follicle to the hair root. The hyphae grow downward on the non-living portion of the hair and at the same rate as the hair grows upward. The infection produces dull gray, circular patches of alopecia, pealing and itching. As the hair grows out of the follicle, the hyphae of *Microsporum* species produce a chain of spores that form a sheath around the hair shaft (ectothrix). These spores impart a greenish to silvery fluorescence when the hairs are examined under woods light (365nm). In contrast, *T. tonsurans*, the chief cause of "black dot" Tinea capitis, produces spores within the hair shaft (endothrix). The hairs do not fluoresce; they are weakened and typically break easily at the follicular opening. In pre-pubescent children, epidemic Tinea capitis is usually self-limiting (Higgings *et al.,* 2000).

Zoophilic species may induce a severe combined inflammatory and hypersensitivity reaction called a Kerion. Another manifestation of Tinea capitis is favus, an acute inflammation of scutula (crests) around the follicle.

TABLE 4: Some Clinical Features of Ringworm Infection

Skin Disease	Location of Lesions	Clinical Appearance	Fungi most frequently responsible
Tinea corporis	No hair, Smooth skin	Circular patches with advancing red vesiculated border and central scaling	*M. canis* *T. mentagropytes*.
Tinea capitis	Scalp hair, Endothrix, Fungus Inside hair shaft Ectothrix fungus on hair surface	Circular bald patches with shoot hair stubs or broken hair within hair follicle. Kerion	*M. caris*. *T. tonsumans*.

Source: (Figueroa, 1997)

2.10 PARASITISM AMONG NOMADS

In the natural environment many animal species are free living while many others maintain some form of association with another. Associations involving members of the same species are known as homo specific association (for example, herds, colonies and flocks etc). However, of particular interest are heterospecific associations involving members of different species. In this type, the two individuals of different species may be so loosely associated that they can survive and live apart when separated. On the other hand, the association could be so intimate that it becomes obligatory and the individuals can no longer survive apart or maintain a separate existence. Heterospecific associations in which animals are literally living together are collectively known as symbiosis. As originally coined by de Bary in 1879, it implies that there is no mutual or unilateral benefit, or metabolic dependency – merely living together. The study of this phenomenon is known as symbiology (ogbule *et al.*, 1998).

Parasitism is defined as an association in which the smaller symbiant, known as the parasite, is metabolically dependent on the larger one known as the host. It cannot survive and live if it is prevented from making contact with the host. In addition to this one-sided metabolic dependency, parasitism differs remarkably from all other categories of symbiosis in that it includes immunological response to antigens of parasitic origin introduced into the body of the host. These attributes are usually used to describe parasitism. Some authors believe that parasitism is the intrinsic ability of the parasite to do harm to, or inflict some form of injury on its host (Shulman *et al.*, 1984). The injury may be so severe as to cause disease or death or less severe to cause some irritation, inconvenience or discomfort. Its effects may be so mild that they can be ignored or may go unnoticed. Whatever the case may be, it is claimed that some degree of injury is always there (Langraf *et al*., 1994).

While it is true that many important parasites of man and his domestic animals do cause harm which results in disease and death, it is equally true that the injury inflicted by many parasites, if any at all is difficult to interpret or assess using presently available techniques. However, the infliction of injury is not a necessary ingredient for the definition of parasitism, since the attributes of metabolic dependence of the parasite and immunological response by the host are usually sufficient to distinguish parasitism from phoresis, commensalisms and mutualism (*Langraf et al., 1994*).

2.10.1 Types of Parasites

There are:

1) Ecto-parasites
2) Endo-parasites

ECTOPARASITES are organisms (e.g. fleas, lice, ticks) that live on the outside of their host, usually attached to the stem, feathers, hairs, gills etc. These types of parasites can never live a complete parasitic existence, but may utilize the oxygen from outside the host.

Many of the ecto-parasites maintain only periodic contacts with their hosts and cannot be considered parasites but essentially special kind of predators.

ENDO-PARASITES are parasites living within their hosts, in guts, body cavity, gall bladder, lungs or other tissues. These forms of parasites always live a completely parasitic existence, for example: *Schistoma haematobium*, *Plasmodium* species, Hookworm and round worm. Some parasites fall into both ecto-parasites and endo-parasites. For example is the itch mite (*Sarcoptes scabies*) which borrows in tunnels. Other terms associated with parasitism are:

i) Facultative parasites: These are organisms that can live either a parasitic or non-parasitic existence i.e. free living.

ii) Obligate parasites: are parasites which are obliged to live a parasitic existence and are incapable of surviving outside the host environment.

iii) Accidental or Incidental Parasite: is one which accidentally gains access to an unnatural host and survives.

iv) Permanent parasite: is one which lives its entire life in a host.

v) Temporary or Intermittent parasite: is one which only makes contact with the host for feeding, after which it leaves, example, mosquito

vi) Pathogenic parasite: This produces the disease state of the host

vii) Hyper parasite: Is a parasite which is parasitic on or in another parasite. Example is plasmodium oocyst in the mosquito stomach.

Host: Host is the larger of the two symbionts which harbours and/or gives metabolic support to the smaller symbiont known as the parasite.

Definitive Host: This is one in which the parasite reaches sexual maturity.

Intermediate Host: This is one in which some developmental stages of the parasite takes place.

Vector: This is a carrier that transmits disease from one party to the other. Example, the mosquito is the vector of the malaria parasite.

Transport host: This Is a host which is not necessary for the completion of the life cycle of the parasite, but nevertheless serves useful purpose by being a temporary refuge in which a stage of the parasite accumulates to ensure successful transfer of the parasite to the definitive host. It also serves as a bridge in cases where the intermediate and the definitive hosts are ecologically isolated.

Reservoir host: This is an infected animal which serves as a source from which other susceptible animals can derive an infection.

Zoonosis: An infection common to both humans and animals and which is transmissible from one to the other.

Active transmission: This is one in which:

i) An active stage of a parasite locates a host and penetrates it or;

ii) A vector locates the host and transmits the infection.

Passive transmission: This is one in which the parasite makes contact with or gains access to the host more or less by chance. Examples are when eggs and cysts of parasites are accidentally ingested by the host.

Direct or monogenous life cycle: This is a life cycle in which only one definitive host is present, no intermediate host is involved.

Indirect or heterogeneous life cycle: This is one involving alternation between a definitive host and one or more intermediate hosts.

Homogonic Life cycle: This is one in which either all generations are parasitic or all are free living.

Heterogonic life cycle: This is one which involves alternation of parasite and free living generations.

Parasitaemia: This is the presence of parasites in the circulating blood of the host.

2.10.2 Parasitic Infections Among Various Nomadic Groups

The term parasite refers to those small organisms which live in another organism called "host" benefiting and depending solely on such host for their existence as they are unable to complete all their development and reproductive processes without the aid of the hosts which suffer some injuries (Beaver, 1975).

Information on the various ethnic or tribal groups in different parts of the world in relation to parasitic infections or parasitic diseases has not been highly publicized in the literature, except a few reports from parts of Africa and environs. In Kenya for example, the disease pattern of the nomadic people in Samburu district has been studied (Green, 1979). It was observed that fever was the most severe, followed by respiratory and alimentary diseases.

In South Africa, Hausen *et al.* (1969) discovered that 83 adult Kalahari bushmen, living as nomad hunters, suffered some medical conditions like obesity, heart disease, cirrhosis and rheumatoid arthritis. They found that hunting accidents were common. Comparable studies by the same investigators on nomadic Masai in Kenya gave about the same picture of a surprisingly healthy population. Haraldson (1975) in a survey carried out in 1963 on 406 Masai population reported that 35 (8.6%) were found to have serological evidence of syphilis, indicating that this disease was not as serious a problem in this population as has been suggested. The prevalence was lower than for the native population of Nairobi. The same author reported that bilharziasis (schistosomiasis) as well as hookworm did not thrive amongst this population and were regarded as minor problems. However, both human and cattle (Nagara) trypanosomiasis were in some area a serious obstacle for pastoralist in Nairobi. In places such as Tirma in Ethiopia, the disease had forced nomads to settle down and initiate farming. Malaria and tuberculosis were other health scourges. Due to handling of hides, anthrax was more prevalent in some areas occupied by nomadic Kenya pastoralists. In Kenya, more than 200,000 people develop tuberculosis annually and over 40,000 nomads and settled people die of the disease (Ngere and Ndiranga, 2007). Recently, Mangesho *et al.* (2005) noted that malaria/fever was the most important public health problem among pastoral communities of Ngorongoro Crater, Northern Tanzania. They pointed out that the long distance to health facilities was considered an important constraining factor in seeking treatment for malaria.

In Nigeria, there are very few reports on the types of diseases associated with the nomadic Fulani. The nomadic Fulani are so committed to cattle rearing that most of their children are not sent to school but only allowed to herd cattle. Wijeryaratue *et al.* (1982) documented evidence of human filariasis amongst the Fulanis, Hausas and Maguzawa of Kaduna State, while Arene and Atu (1986) reported on the *Mansonella*

perstans microfilaria among the Bori people of Rivers State of Nigeria. Ogbonna *et al.* (1986) worked on the dermatophyte infections amongst nomadic Fulani herdsmen of Plateau State, Central Nigeria. They found that ringworm infection was a major public health problem of the nomads in that area. In Taraba State, Northern Nigeria, Akogun (1991) recorded 39.6% of onchoccereasis among the Hausa Fulani ethnic group. Ufomadu *et al.* (1991) observed that filarial infections were relatively higher among the Fulanis than among members of Jarawa, Berom and Hausa tribes in Jos Plateau, Nigeria. Anosike, (1994) observed a 40.9% of human filariasis among cattle rearers (Nomadic Fulani's) in Dorazo Local Government Area of Bauchi State, Nigeria. He also gave a detailed account of Mansonelliasis among the Ibos of Imo and Abia States, South Eastern Nigeria (Anosike *et al*., 1992). Human taeniasis amongst the Goemai tribe of Northern Nigeria has been documented. Out of the 1,000 people examined 115 (11.5%) were infected (Nwoke, 2004).

Anosike *et al.,* (2003) working on the endermity of vesicle schistosomiasis in the Ebonyi and Benue River valley, South Eastern Nigeria, noted that 23.5% of the Ezza and 21% of the Izzi ethnic groups were infected. Symptoms associated with the disease include visible haematuria (63.1%), suprapubic pain (10.3%) as well as stranguary (9.9%). Furthermore, they observed female genital schistosomiasis (FGS) of the lower reproductive track in 19 females of child bearing age who complained of the lower reproductive pain. Throughout the developing countries, parasitic diseases remain the most ubiquitous and serious public health problem with depressingly high prevalence rates of helminths and protozoa infections.

According to WHO (1986), parasitic infections may produce a broad spectrum of diseases of major public health or social importance. Parasitic infections harm the host in several ways and are often associated with malabsorption, diarrhoea, iron deficiency anaemia and retarded growth. Beaver (1975) reported intestinal blockage

caused by *Ascaris lumbricoides* in a child in New Orleans, U.S.A. According to Chandler and Read (1961), most of the children who had parasitic infections may suffer mental and physical retardation.

For renewd emphasis, the parasitic infections studied among the nomadic Fulani's include:

i) Helminths and protozoa.

ii) Blood parasites – the filarid nematodes (Filarial worms), the blood protozoan – *Plasmodium* species, trypanosomes.

iii) Urine parasites – *Schistosoma haematobium*, *Trichomonas vaginalis*.

2.11 SOME INTESTINAL PARASITES.

2.11.1 The Helminths

The name helminth is derived from the Greek words "helmis" or "helminthos" literally meaning "worm". The term worms are loosely applied to an assemblage of organisms with elongated bodies and are more or less of creeping habit (Warrisc and Ibe, 1994). The human intestinal helminths are among the most common infections occurring throughout the developing world. The infections have been associated with low standard of sanitation, and between 500 million to one billion people are estimated to be infected annually worldwide (Warrisc and Ibe, 1994). The intestinal helminths include the nematodes comprising the hookworm, *Strongyloides stecoralis*, *Trichuris trichuria,* and *Enterobium vermicularis.*

2.11.2 The Cestodes

Are groups of helminths known as tapeworms due to their tape-like body appearance. These include *Taenia saginata and Taenia solium.*

2.11.3 The Trematodes

They include the *Fasiola* species and some schistosome (*S.mansoni* and *S.japanicum*).

2.12 HOOKWORM

The Human hookworm infection is caused by two similar species namely- *Ancylostoma duodenale* and *Necator americanus*. Hookworms derive their names from the fact that the anterior end of their body is curved dorsally giving the worms a hook-like appearance.

2.12.1 Morphology of Human Hookworm

Ancylostoma duodenale is a small cylindrical grey or reddish brown (from ingested food) thread-like worm. Both the male and female worms possess two pairs of teeth with which they attach to the intestinal mucosa of their host. The male measures about 0.8 – 1.1cm in length and 0.4 – 0.5cm in breadth. It has an umbrella-like expansion of the cuticle at the rear end known as the copulatory bursa. The female is slightly larger than the male measuring 1 – 1.3cm in length and 0.6cm in breadth. The ovary and the coiled uterine tubes which are laden with eggs, occupy the body cavity of the female.

Necator americanus is morphologically similar to *A. duodenale* except that it is shorter (0.9 – 1.1cm by 0.4m) and the anterior end is more curved and hook-like than *A. duodenale*

A. duodenale is believed to be mainly subtropical in distribution being found in Southern Europe, North Coast of Africa, Northern India, while *N. americanus* has been reported to be predominant in the tropical countries like South Africa, West Africa, Philippines, South Asia, and India (Anderson, 1982).

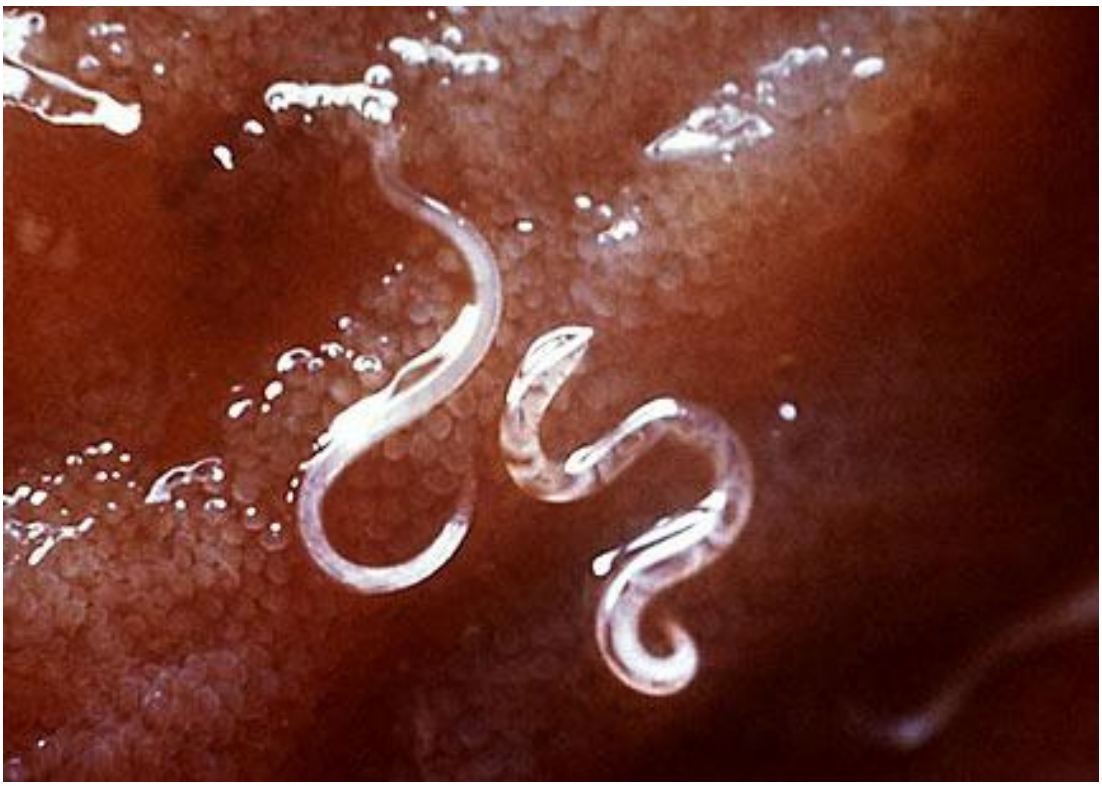

Plate I. Hook worm (*Necator americanus*)

Note: The shorter one has a more curved and hook-like anterior end than the longer one.

Source: (Anderson, 1982)

2.12.2 Life Cycle of Hookworm

The life cycle of hookworm is very paramount in the study of human hook-worm infection; hence, it was widely studied by previous researchers and scientists (Edungbola, 1988). The life cycle is direct and there is no intermediate host, According to reports the eggs of *A. duodenale* are deposited into the lumen of the intestine by the adult female worm from where they are passed out in faeces. The first stage larva known as the rabbidity form larva hatches out of the eggs deposited in damp shaded soil. The larvae are first free-living and possess a bulbous oesophagus. After moulting, the filariform larva moves away from the faeces into the soil and moults to form the infective filariform larva. In the absence of direct sunlight, desiccative or salt water which are lethal to the larva, they move towards oxygen rich area being found in greater numbers in the upper 2.5cm of the soil, but can ascend from deeper layers (Edungbola, 1988). When the filariform larva comes in contact with the skin of the human host, it penetrates the unbroken skin and enters the blood stream and down to the lungs. *A. duodenale* can infect via the mucosa membrane of the mouth as well as the skin while *N. americanus* infects only through the skin.

2.12.3 Epidemiology of Hookworm

Udonsi (1984) reported a prevalence rate of 26.3% for hookworm infection among Nigeria army units stationed in the Northern part of Nigeria. The epidemiological picture is similar in rural areas (Nwosu and Anya 1981; Anderson 1982), but may be altered in the urban areas where the highest prevalence rate of over 68% was reported among the middle aged artisan and construction workers exposed to contaminated undeveloped parcel of land (Udonsi, 1984). In areas of co-occurrence of both species, it has been observed that *A. duodenale* tends to persist in older individuals thus maintaining a high prevalence (Udonsi, 1984). This persistence has been

suggested to imply that there is a reduction in the virulence and immune response of *A. duodenale*.

2.12.4 Pathology of Hookworm

A. duodenale causes discrete skin lesions, catarrh, dyspharia, nasal and curicular pruritis. There may be duodenitis with abdominal pains, nausea and anaemia. Waite and Nelson (1995) showed that hookworm infection adversely affected the mental development of school children in the San Diego area of California, United States of America.

In Nigeria, among others, Nwosu and Anya (1981) observed that prevalence and worm burden in Nsukka, Enugu State was highest in children during rainy season noting that 78.3% of the endemic population in villages harbour soil transmitted intestinal nematodes of which hookworm was dominant. In their intestinal phase, hookworms pull out the intestinal mucosa of the host into their buccal cavity and this causes intestinal bleeding. (Udonsi 1985a)

2.12.5 Control of Hookworm

The control of hookworm infection at the community level involves mainly two methods: the use of anti helminths to reduce morbidity and the use of environmental interventions and improved personal hygienic behavior of the population. The success of both approaches depends on community participation and effective health education. The importance of the human environment in the transmission and maintenance of the endemic status of hookworm infection has been extensively studied in Nigeria (Udonsi, 1985a, Ukoli, 1992). Environmental intervention and sanitation, therefore, remains the hallmark of hookworm control and prevention in endemic communities.

2.13 *ASCARIS LUMBRICOIDES*

Ascaris lumbricoides is a parasite of man but has been reported from apes and pigs (Ukoli, 1992). Two species are recognized*: A. duodenale* in man and Ascarisum in pig.

2.13.1 Morphology

It is cosmopolitan and is by far the commonest and the largest of all the nematode parasites of man in tropical Africa. It is stout pinkish yellow and characteristically possesses an oval opening surrounded by three lips with no buccal cavity. The males are 10 – 250mm in length by 3 – mm in width. The females are about 200 – 400mm by 5 – 6mm long with the vulva located at the anterior one-third of the body.

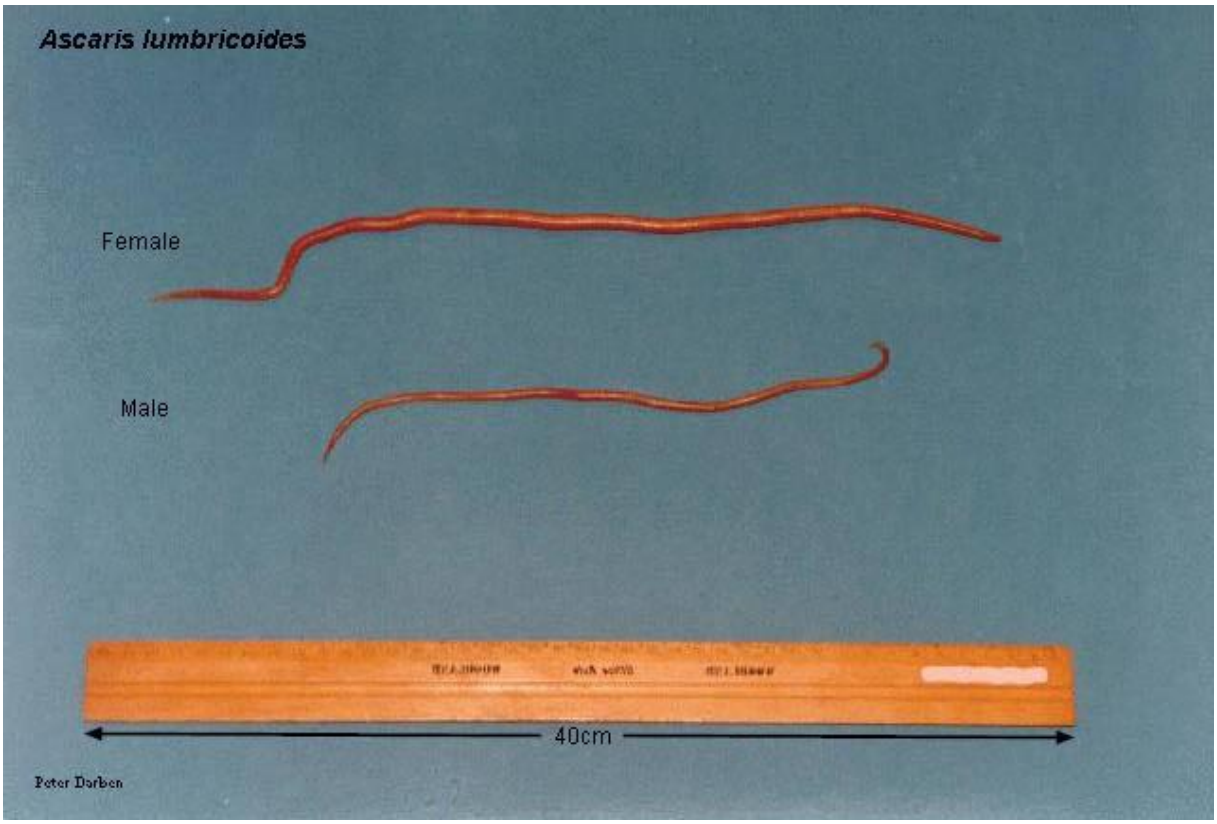

Plate II: ***Ascaris lumbricoides.***

Note: The female is longer than the male.

Source: Villanizer *et al.*, (1996)

2.14 EPIDEMIOLOGY OF *Ascaris lumbricoides*

Basic epidemiological information on the prevalence of *Ascaris lumbricoides* in some tropical African countries has been summarized by some authors like Ukoli (1992). Others have attributed a significant proportion of deaths among age group 1-5 years in Sri Lanka to be *A. lumbricoides* infection. In Ibadan, Anosike, (1996) reported prevalence of 70.1% *Ascaris lumbricoides.* In different parts of the world, several studies have been carried out on the incidence and prevalence of ascariasis (Leaver, 1975). According to Villanizer *et al.* (1996), it is a common parasitic disease that affects children with limited socio-economic means. Tschikuka *et al.* (1996a) in their own study observed that relatives and live-in visitors contribute to ascaris transmission among children with higher socio-economic means. As such, the prevalence of Ascaris can affect children of all social status.

2.14.1 Pathology of *Ascaris lumbricoides*

Ascariosis is most common in children and can lead to retarded growth and development (Leaver, 1975). Ascaris infection may affect nutrition of infected children especially those in the state of marginally adequate nutrition (Stephenson *et al.*, 1980). *Ascaris* worms have been found clogging the appendix, pancreatic duct, trachea, and urino-genital duct with serious consequences. Worms have been reported to migrate up to the stomach resulting in nausea that causes the individual to vomit live worms through the mouth. They can also emerge involuntarily through the nose and mouth. In heavy *Ascaris* infection, the patient experiences intense enlargement of the liver and generalized toxicity. Cook (1990) reported gangrene of the small intestine, appendicitis and intestinal perforation as important complications due to Ascariasis. The transmission and prevalence of ascariasis is affected by certain factors like educational status, housing, sanitation, population density, socio-economic factors and others

(Akwelley *et al.,* 1985). *A. lumbricoides* infection can cause a reduction in fat, protein and vitamin A utilization and mucosal damage that gives rise to secondary hypolactasia. It is note worthy that the majority of people with moderate infections are rarely symptomatic. This has made many people to take ascaris infection for granted. Nevertheless, ascariasis remains a serious public health problem and a serious cause of morbidity and mortality in tropical Nigeria. Holland and Asaolu, (1990) reported prevalence of 0.1% *Ascaris lumbricoides* in a study carried out in rural community in Ibadan. Onubuogu (1978) recorded a prevalence of 62.6% among urban children in Anambra and Imo States. According to Anderson *et al.* (1993), the parasitic nematode *A. lumbricoides* is large, easy to detect and treat, and globally abundant.

2.15 *TRICHURIS TRICHURA*

Trichuris trichura is commonly known as whipworm due to its pointed anterior end and blunt swollen posterior end. It is found mainly in the tropics of Africa, and in South East Asia and is contracted from polluted water or hands contaminated with infested moist soil and is common in areas where there is abundant moisture in the soil due to rainfall in dense shade (Ejezie 1981). Other morphological characteristics and life history of the parasite as presented by Edungbola (1988) are as follows: The male measures about 4cm in length and its posterior swollen part has a breadth of about 2mm. The posterior extremity is spirally coiled and the cloacae are terminal. The female measures about 5cm in length with the posterior parts (the last two of a fifth part) having a breadth of about 2mm. The vulva lies at the junction of the anterior and posterior parts of the body. The barrel-shaped egg measures about 50nm in length and 25nm in breadth and possesses a characteristic plug at each pole. The development of infective larva within the egg is complete in three or more weeks after the egg is passed out and deposited in damp soil. When the egg is swallowed, the larva escapes from the

eggs, moves down to the caecum and grows directly into adult worm. The mechanism by which *T. trichuris* causes diarrhoea remains unclear although several theories have been suggested, including intoxication with various products of metabolism and direct mechanical damage to the intestinal mucosa (Anosike *et al*., 2004).

It has also been suggested that every trichuris worm ingests 0.005ml of blood which adds to the loss of blood oozing from the mucosa (Anosike *et al.,* 2004). Nevertheless, no direct causal relationship has ever been established between trichuris infection and malnutrition and anaemia. In an experimental animal study using labeled erythrocytes, no evidence of intestinal loss of blood due to trichuris infection was demonstrated (Edungbola, 1988). In view of the fact that the trichuris infection is widely prevalent and that in the area where it is found there is a high frequency of anaemia, malnutrition and secondary infections. *Trichuris* also has been associated with appendicitis and a form of dysentery resembling that caused by amoebasis (Kate, 1982). *Trichuris* is most commonly found in the tropics where the prevalence may be as high as 80% or more. It has been observed that warm/moist soil in the tropical and subtropical areas favors transmission of *Trichuris*. It is also reported that direct sunlight for 12 hours or exposure to temperature in excess of 40^{o}C for 1 hour destroys the eggs (Kate, 1982).

2.16 *STRONGYLOIDES STERCORALIS*

This nematode parasite inhabits the upper part of small intestine in the intestinal mucosa and is transmitted by skin penetration of the infective larva in moist soil. Though wide-spread in distribution, it is prevalent in humid and warm countries of the world with inadequate sanitation such as in Africa, Asia and South America (Kate, 1982).

2.16.1 Morphology of *Strongyloides stercoralis*

The morphological characteristics of the parasite forms are as follows: the female is about 2.2m long and 50nm wide, being so small as to be hardly detected by the eyes of a careful observer. The eggs measure about 55nm in height and 30nm in breadth. The rhabiditi form larvae after hatching bore their way out of the lumen and are passed in the faeces. The eggs are therefore, not easily seen in stool. The rhabiditi-form larvae, evacuated with the faeces may either give rise to free-living generation if the environmental conditions are favourable or may develop into infective larvae (filariform larvae) if the conditions are unfavourable. The infective filariform larvae resemble hookworm infective larvae but can be differentiated by the presence of a notch at the tip of the tail which is not present in hookworm larvae.

2.16.2 Pathogenesis of *S. stercoralis*

Infection of humans with infective filariform larvae is usually accomplished by the penetration of the skin or by swallowing the infective larvae through contaminated food. Within the body the larvae enter the blood or lymph vessels and are carried to the heart and then to the lungs. Here, some of the larvae moult and develop into young adults which move up to the trachea and through the oesophagus to the intestine. In the presence of the male, fertilization of the female adult worms may be effected in the lungs, the trachea or the intestine.

2.16.3 Pathology of *S. stercoralis*

The pathology, clinical signs, diagnosis and treatment of *S. stercoralis* have been documented by Nwosu and Anya (1981) and Anderson (1982). Clinical signs of strongyloidiasis are mainly inferable to the gastro-intestinal tract, lung and skin, especially the skin of the buttocks and thighs. Heavy infection with *S. stercoralis* is often associated with severe diarrhoea. In immune suppressed individuals with

strongyloidiasis, bacterial infections are common causes of death (Nwosu and Anya, 1981). In cases of external auto infection, infective larvae invade the perennial skin and produce a very characteristic form of cutaneous larval migrans. The larva of *S. stercoralis* has a speed of 10cm in 1hr. Because of this rapidity of movement, cutaneous larval migrans caused by *S. stercoralis* has been dubbed racing larva. General manifestations include fever, weakness and weight loss.

2.16.4 Diagnosis of *S. stercoralis*

The diagnosis depends on microscopic examination of fresh stool and the finding of the rhabditiform larvae in the fresh stool. It is necessary to examine the stool within 24hrs of collection. If left unexamined and unpreserved for 24hrs, hookworm eggs when present (as they commonly are) may hatch to produce rhabditiform larvae which may not easily be distinguished from those of *S. stercoralis*. However, discovery of *S. stercoralis* is made more likely by examination of duodenal fluid or mucosa biopsy

2.16.5 Treatment of *S. strecoralis*

The drug of choice for both enteric and tissue forms of infection with this organism is oral thiabendazole (mintezol) administered at 25mg twice daily for 2 days or more. It is highly effective in uncomplicated cases of strongyloidiasis. Rectal administration should be considered for patients unable to take the medication orally. Studies in the past few years have shown that Ivermectin (MECTIZAN) is also safe and highly effective and safer than Thiabendazole, and more effective than and safe as albendazole (Anderson, 1982).

2.17 THE *PLASMODIUM* PARASITES

Malaria is one of the most serious of the diseases with which man is affected. According to Chessbrough (1987), it is the most important and widespread of the

parasitic diseases in the tropical developing countries. Malaria is a combination of the Italian word "Mal" – which means bad and "aria" which means air. It refers to the belief formally held that the disease came from "bad air" of the marshes and swamps in which, as it is known the mosquitoes which transmit the disease to man breed and multiply.

2.17.1 Life Cycle of Malaria Disease

The life cycle of malaria takes place in two hosts, a vertebrate (man) and invertebrate (mosquito). The asexual phase which occurs in the vertebrate host is known as schizogony and the sexual phase known as sporogony occurs in the non-vertebrate host. Some authors have reported that the schizogony development occurs in the following three stages in the hepatic cells of the liver and the red cells (erythrocytes) of the peripheral blood.

2.17.2 Pre-Erythrocytic Schizogony

This occurs when an infected mosquito takes blood from man and injects saliva containing tiny elongated sporozoites (a very early infective stage of the parasite normally found in the female Anopheline mosquito vector) into the blood stream. The sporozoites disappear from the peripheral blood within 30 minutes of arrival in the human body and enter the parochial cells of the liver where they multiply asexually. The pre-erythrocytic schizogony starts when the hepatic cell ruptures, releasing merozoites into the blood stream.it ends when the merozoite enters the blood stream.

2.17.3 Erythrocytic Schizogony

This is when the merozoites released from the liver invade the erythrocytes of the blood. *Plasmodium vivax* merozoites invade early young erythrocytes, the reticulocytes, and apparently are unable to penetrate mature red cells.

Soon after the invasion of the erythrocytes and formation of ring stages, the cytoplasm of the *Plasmodium* becomes actively amoeboid, throwing out pseudopodia in all directions thereby justifying the name *vivax*.

Plasmodium falciparium merozoites can invade erythrocytes of any age; hence falciparium malaria is characterized by high levels of parasitaemia than the other types. The earliest stage of the parasite seen in the red blood cells is the trophozoite or ring stage with nucleus conspicuously displayed at one stage.

The trophozoites develop into the young schizont and eventually become a mature segmenting schizont in which dividing chromatin splits into merozoites. The merozoites are of variable number depending on the species of the *Plasmodium.*

2.17.4 Exo-Erythrocytic Schizogony

This is a situation where some of the merozoites liberated from the hepatic cells after the pre-erythrocyte stage do not enter the blood stream, but re-enter the human cells and grow into schizonts. This cycle may be repeated several times. Exo-erythrocytic schizogony appears not to occur, in *P. falciparum* infections, but is well recognized in infection due to other species, especially *P. vivax* and *P. malariae* in which it accounts for the occurrence and relapses of other periods of quiescence. After an indeterminate number of asexual generations, some merozoites enter erythrocytes and become macro gametocytes and microgametocytes. The macro and microgametocytes cannot develop further in the blood of man until they enter the blood of the mosquito. When the female anopheles mosquito sucks up human blood during a blood meal at night the gametocytes and any other phase of malaria parasite that may be present in the blood are taken up by the mosquito. Inside the mosquito's alimentary canal, only gametocytes escape the digestive process.

Fertilization is effected by the union of microgamete and the macrogamete. Soon after fertilization, the resultant zygote becomes a motile organism about 18-24mm long and is now called ookinet. The ookinet penetrates the inner epithelium lining the mid-gut wall and develop into a spherical oocyst. The nucleus of the oocyst divides into minute, spiracle-shaped organisms called sporozoites.

The sporozoites break out of the oocyst into the haemocoel and migrate through the mosquito's body. On reaching the salivary gland, the sporozoite awaits injection into a new host or the next feeding by the infected mosquitoes (Bell, 1999).

2.17.5 Pathology of Malaria Disease

The characteristic feature of malaria is fever. It usually occurs in three stages as follows:

i) Cold stage, characterized by rigor and headache. The patient feels cold and shivers, even though his or her temperature is rising.

ii) Fever stage, in which the temperature rises to its maximum and the headache, is severe. Usually there are pains at the back and joints and often vomiting and diarrhoea.

iii) Sweating stage, in which the patient perspires. The temperature falls and the headache and other pains are relieved until the next rigor.

With falciparum malaria, a series of fever episode may reoccur on alternate days or more commonly the fever tends to be continuous or irregular. It differs from *P. vivax* and *P. malariae*.

Plasmodium falciparium infection is said to be highly severe when more than 5% of the red cells become parasitized (WHO, 1986). Severe falciparium malaria is more likely to occur in non-immune person, person with lapsed immunity, pregnant woman in particularly.

Complications associated with *P. falciparum* malaria infection are:

i) **CEREBRAL MALARIA:** This is the commonest cause of death in falciparum malaria, as a result of parasitized cells and fibrin blocking capillaries and veins in the brain. In 1982, Warrel recommended a definition of cerebral malaria as the presence of unrousable coma, exclusion of other anphalopathies. Children and non-immune adults are more commonly affected.

ii) **ANAEMIA:** Anaemia in *P. falciparum* infections can be severe and occurs rapidly, particularly in young children. During the later cases leucopenia with 20% or more monocytosis is considered as diagnostic of malaria. The pigmentation noted in the tissue of malaria victims is due to phagocytosis of haemozon. The pigmentation constantly increases with the age of the infection so that it may be grossly observed in autopsied cases of chronic malaria. Anaemia in *P. falciparum* is due mainly to the mechanical destruction of parasitized red cells. These parasitized cells also lose their deformability and are rapidly phagocytosed and destroyed in the spleen. The production of red cells in the bone marrow is also reduced and there is a slow reticulate response.

iii) **BLACK-WATER FEVER:** Although, the aetiology of the black water fever is unknown, it is also associated with malaria infection especially that of *P. falciparum*. It is a rapid and massive intravascular haemolysis of both parasitized and non-parasitized red cells, resulting in fall in haemoglobin. It is accompanied by high fever, vomiting and jaundice and is often fatal due to renal failure. As a result of the haemolytic attack, the parasites are difficult to find in the blood. The urine appears dark-red to brown-black due to the presence of free haemoglobin in form of meta haemoglobin and oxy-haemoglobin. The urine contains protein hyalites and epithelial cells.

2.17.6 Diagnosis of Malaria Disease

The reliable diagnosis of malaria is a pre-requisite for selecting the correct treatment and consequently for reducing malaria morbidity and mortality (WHO, 1986). At present, thick blood film on a clean slide stained with Geimsa stain and examined with the light microscope is the best means of accurate diagnosis of parasitaemia. Despite being tedious and labour intensive, light microscopy continues to be the main stay of diagnosis for the epidemiological studies on which current malaria control strategies are based (WHO, 1988). However, recently serodiagnostic methods have been introduced by Amrad Laboratories, Australia. This method is specific for *P. falciparum* and *P. vivax* infections (Armad, 2000).

2.17.7 Prevention and Control of Malaria

The 1986 report of the WHO Expert Committee on Malaria, recommended that malaria control should be based on epidemiological approach, and that it should be planned and co-ordinated with primary health care with the active participation of the community. WHO in 1993 set up an implementation of the Global Malaria Control strategy. This report went on to state that despite efforts in this century to eradicate or control it, malaria is still the most prevalent and most devastating disease in the tropics. In October 1992, in Amsterdam, WHO brought together Ministers of Health from all countries to adopt a resolution to fight malaria. A control strategy was agreed, aimed at preventing mortality and reducing morbidity, social and economic loss due to the disease.

The four basic technical elements of the Global Strategy are to:

i) Provide early diagnosis and prompt treatment;

ii) Plan and implement selective and sustainable preventive measures, including vector control;

iii) Detect early, contain or prevent epidemics;

iv) Strengthen local capacities in applied research to permit and promote the regular assessment of a country's malaria situation, in particular the ecological, social and economic determinants of the disease (WHO, 1996).

Methods used to prevent and control malaria include:

i) Avoiding mosquito bites.

ii) Using drugs to treat active infection, particularly in young children. Also to preventing infection especially in non-immune persons visiting or going to work in malaria infested area.

iii) Preventing the breeding of mosquito larvae.

iv) Destroying adult mosquitoes by regular spraying of all houses with residual insecticides twice yearly.

v) Health Education in schools and villages and training health care workers on the control measures against malaria.

2.17.8 Epidemiology of Malaria

Malaria in humans is characterized by fever which tends to be proximal by anaemia splenomegaly and often by symptoms resulting from lesions in particular organs as liver and spleen. In Nigeria, children are particularly at risk of the disease. Malaria is one of the major childhood diseases in rural tropical Africa. The disease causes anaemia in children and pregnant women and increases vulnerability to other diseases. Malaria is one of the most common diseases in young adults and tends to strike at the time of the year when agricultural work is at its height (WHO, 1993). Malaria is easily the most important parasitic disease and its morbidity is felt by the entire population with the higher mortality rate in children (Ejezie *et al.*, 1991). The

four species of malaria parasites responsible for human malaria belong to the same genus, *Plasmodium*. The genus *Plasmodium* belongs to the phylum Protozoa, sub phylum Sporozoa, subclass Coccidian and family Plasmodiae. In Africa, South of the Sahara, 7.8 million malaria cases were reported by WHO in 1981 as opposed to 8.0million in 1980 and 7.9 million in 1979 (WHO, 1985). According to WHO (1985), many countries have scaled down on malaria control measures and rarely make available accurate information on the disease. It has been noted that about 300 to 400 million acute attacks of malaria per year are estimated to occur worldwide and about 80% of the cases and death in the world occurring in tropical Africa (WHO, 1990a). An estimated 250 million people in Africa are carriers of malaria parasites and reports from Africa Health 1998 indicated that the disease kills an estimated 1.5 – 2.7 million people each year in Africa (WHO, 1990b).

2.17.9 Treatment of Malaria

Over 90% of mortality due to malaria occurs in the sub-Sahara Africa region and for decades the drug of choice was chloroquine phosphate, which is administered orally or intramuscularly. The treatment is usually repeated at lower doses after 6 hours and confirmed for two or more doses at daily intervals. *P. falciparum* is resistant to chloroquine and is normally treated with quinine sulphate, pyrimethamine, and sulphadiazine given for 3 days. Drug resistance, which can be partly attributed to the way in which these drugs are massively used for prophylactics, have now spread across Africa, South East Asia, and South America.

CHAPTER THREE
MATERIALS AND METHODS

3.1 STUDY AREA

EBONYI STATE is one of the thirty six (36) states that make up the Federal Republic of Nigeria (Fig 1). It was created on October 1, 1996, with Abakaliki as its capital. The state was carved out of the former Abia and Enugu states. It derives its name from the River Aboine, and is located in the south eastern region of Nigeria. It is bounded to the north by Benue State, to the west by Enugu State, to the east by Cross River State and to the south by Abia State. With a land area of about 5,935 sq. km, the state lies approximately within Longitudes 7°30' and 8°30'E and Latitude 5°40' and 6°45'N. Ebonyi State is popularly known as the 'Salt of the Nation,' apparently because of the large deposits of salt in the state. There are thirteen local government areas (LGAs) in the State (Fig 2). The state is also divided into three senatorial zones, namely, Ebonyi North comprising Abakaliki, Ebonyi, Ishielu, Ohaukwu and lzzi LGA, Ebonyi Central made up of lkwo, Ezza North and Ezza South LGAs, and Ebonyi South made up of Afikpo North, Afikpo South, lvo, Ohaozara and Onicha LGAs. The State is viewed as the hub for nomadic activities by the Fulani herdsmen in the south eastern part of Nigeria. The seat of the head of the Fulani in south eastern state is also located in Ebonyi State. There is an estimated population of about 15,000 mobile herdsmen present in different bush encampments scattered all over Ebonyi State, Anosike *et al.*, 2004.

Figure 1: MAP OF NIGERIA SHOWING THE LOCATION OF EBONYI STATE
Source: (Ebonyi State Ministry of Information, Abakaliki, 2007)

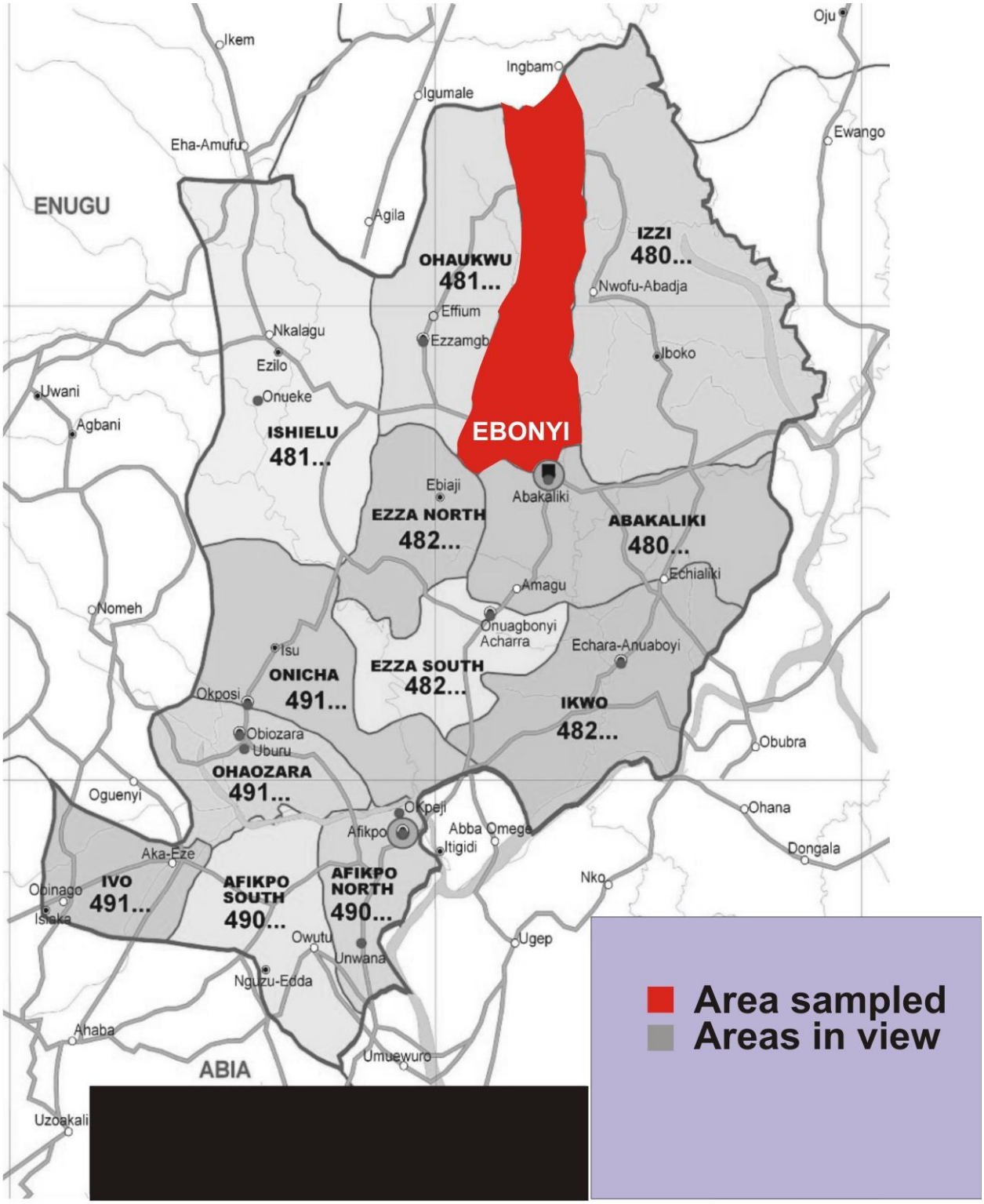

Figure 2: Map of Ebonyi State showing study area
Source: (Ebonyi State Ministry of Information, Abakaliki 2007)

Seven communities of Ebonyi Local Government area of Ebonyi State, Nigeria were chosen for this research. These communities are: Ndufu, Ojianya, Item, Ugboenyi, Amike-aba, Oroke, onnoha. Ebonyi Local Government Area is situated in the North Eastern part of Ebonyi State. It also shares boundaries with Benue and Cross River States as well as Izzi and Abakaliki Local Government Areas respectively.

3.2 STUDY POPULATION

Ebonyi Local Government Area is inhabited by several people who are mainly farmers. They are good in producing cash crops such as rice, yam, cassava, potato etc. The people depend mainly on pond water for their domestic use and these ponds, as were noticed, normally get dry during the dry season. This brings about the scarcity of water in the area since the few boreholes are only located in the big villages with affluent men in politics. Thus many of the inhabitants have to trek many kilometers in search of water. There are few block houses. Most of the houses are of mud type. Most of these block houses are poorly constructed, incomplete and many are not even cemented, paving way for the children to be in constant contact with the soil.

Nomadic Fulanis who rear some domestic animals such as cattle, goats, sheep, and camel among others are found in the state. They live in various bush encampments within the state from where they herd their animals in search of green pasture. The typical buildings in these encampments are huts made of leaves without proper doors. Nomads inhabiting these huts are easily susceptible to mosquito bites (Anosike, 1996). Only nomads inhabiting bush encampments located in Ebonyi State were enlisted in the study and examined for microbial and parasitic infections between June 2005 and May 2007. These Nomads speak mainly Fulani Language (Fulfulde) and Hausa. A few understand English. Their children rarely go to school as they follow their fathers in herding. Their women go out to the nearby towns to sell “fura” and “nunu”. The main

diet of the nomads is milk, meat, fish, garri, rice, beans, corn as well as orange, mango and banana.

3.3 PRE-SURVEY CONTACT, ADVOCACY AND MOBILIZATION

Preliminary survey was carried out in June 2005 in the seven bush encampments chosen for the study. Considering the socio-cultural and religious observances peculiar to the nomads, a pre-survey visit and advocacy preceded actual data collection. This was necessary to ensure maximum co-operation from the nomads. This was successfully carried out through the encampment heads. The bush encampment heads introduced the research team to the "*Sarikin Fulani"* in charge of the entire State for permission. This was granted after series of meetings and explanations. The people in each bush encampment were fully mobilized before sample collection. Only research assistants that are fluent in Fulfulde and Hausa languages were allowed to carry out sample collections. Plate III shows the appearance of a typical Fulani family.

Plate III: Fulani Chief and his family.

3.4 EPIDEMIOLOGICAL TECHNIQUES

3.4.1 Bacteriological Examination

A combined total of 1218 samples of urine, stool and blood were collected from herdsmen in various bush encampments. Sterile plastic sampling bottles were used for urine sample collection. Blood samples were collected using finger prick or vein puncture method depending on the volume required. Samples were kept in cold boxes and taken to the Microbiology Laboratory of Ebonyi State University College of Health Science, Abakaliki, Ebonyi State. Microbiological methods as described by Cowan and Steel (1974) were used. Bacterial isolates were further identified and grouped to species level using biochemical and morphological attributes at the Bacteriology Laboratory of the National Vetinary Reseach Institute (NVRI), Vom, Plateau State, Nigeria.

3.4.1.1 Urine Sample Collection

Hands were washed just before the collection of urine samples. Participants were advised to use soap to clean the penis for male while females were advised to wash the external genitalia, holding the labia apart. The above procedure was repeated at least twice. Participants were advised not to collect the initial stream of urine since it may be contaminated with skin and urethral bacteria. Midway through the urination process, urine samples were collected using sterile plastic sampling bottles. The container was tightly capped and hands were washed thoroughly. Urine splashes on the body of the bottle were cleaned with tissue paper and samples were taken to the laboratory for further examination (Cheesbrough, 2002).

(i) Urine Culture Procedure

The media used for cultures were Blood Agar, MacConkey Agar, Violet red bile Agar (VRBA), Cystein Lactose Electrolyte Deficiency Agar (CLED Agar), Sabouraud Dextrose Agar, (SDA) and Chocolate Agar. The media were prepared

according to the manufacturer's recommendation. Urine sample, measuring 0.1ml was aseptically transferred into a sterile agar plate. It was swirled in clockwise and anticlockwise positions to ensure proper dispersion.

Plates were allowed to solidify at room temperatures before they were transferred into the incubator and allowed to incubate for 18-24hrs at $37 \pm 1^{o}C$.

To ensure the sterility of the agar medium, a control was set up by incubating the agar plate without sample at the same temperature and for the same duration. The chocolate agar plate was incubated at increased carbondioxide (10%) for 24hrs at $37\ ^{o}C$.

If there is no growth on the control, the resultant growth on the other plates can be accepted, but if there is growth, the results of the other plates are doubtful. The resultant growths on the various agar plates were further subjected to biochemical and morphological test for further identification (Cheesbrough, 2002).

3.4.1.2 Blood Sample Collection

Hands were washed and dried; alcohol or isopropyl impregnated wipes were used to clean hands. Hands were covered with gloves. Sterile lancet was used to prick the thumb after cleaning with alcohol impregnated wipes. Then blood samples were collected. The puncture site was covered with an antiseptic dressing. For volumes up to 1.0ml, a tourniquet was used to make the veins more visible. Because contamination can come from a number of sources which includes the patient's skin, the hands of the person taking the blood sample and the general environment were kept in aseptic conditions.

3.4.1.3 Stool Sample Collection and Culture

Participants were advised to urinate before collecting the stool so that they do not pass urine into the stool. Participants were also advised to pass stool (either solid or liquid) into a dry sterile wide mouth plastic container. Participants were advised not to

collect samples from toilet bowl or surface as the case may be, not to mix toilet paper, water or soap with the sample. After closing the lid of the container, the sample was properly labeled by the research assistant. Stool samples collected were inoculated into the various culture media which included Nutrient Agar, MacConkey agar and Deoxychocolate citrate agar. Incubation was done at $37^{o}C \pm 1^{o}C$ for 18-24hrs. The resultant bacterial growth was purified and characterised by their morphological, biochemical and serological attributes.

3.4.1.4 Identification of Bacterial Isolates

The colour and mode of development of the microbial colonies were noted. The various bacteriological isolates were examined under the microscope for the clarification of their morphological features. The bacterial isolates were further subjected to Gram staining in order to find out whether they were gram positive or negative rods and cocci.

Gram Stain

Gram staining was performed according to the method described by Cowan and Steel (1974). A colony of the organism was smeared on a grease-free slide and allowed to dry. This was then heat fixed by passing the slide over a flame for about 4 to 5 times. The smear was then covered with crystal violet (primary stain) for 30 seconds and washed with water. The smear was then covered with Lugol's iodine and allowed for 30 seconds and washed with water. The stained slide was placed in acetone (decoloriser) for a second and washed with water. This was finally covered with safranin (counter stain) for 30 seconds, washed with water and air dried. The stained slide was then observed under microscope using oil immersion.

Capsule Stain

In order to determine the capsule staining reaction of the isolates, a suspension of the isolate was placed on a glass slide and then mixed with Congo red. The mixture was then allowed to dry. It was flooded with Maneval's staining reagent and allowed to stain for 3 minutes. The smear was then washed with distilled water and blotted dry. On observation with x100 objective under oil immersion, capsules appear unstained while the back ground and bacterial vegetative cells appeared red (Onwuliri, 1996).

Motility Test

In order to find out whether the test organism was motile or not the test isolate was cultured in peptone water and incubated for about 4 hours at 37^{o}C. A loopful of the culture was then taken from the peptone water and placed on a cover slip in the middle of the plasticine ring. This was inverted carefully into a clean slide and viewed with the microscope using x40 magnification. A whip- like movement indicated motility (Cheesbrough, 2002).

3.4.1.5 Biochemical Test for the Bacteria Isolate

The bacterial isolates were further subjected to various biochemical tests.

Sugar Fermentation

In order to determine the sugar metabolism of the isolate, lg/100ml each of glucose, lactose, sucrose, maltose and mannitol was prepared in sterile distilled water. Sterile Durham tubes were placed in the sugar solution in such a way that no air-space was created. The test organism was inoculated into each of the bottles containing the sugar solutions. The bottles were incubated at 37^{0}C for a period of 24 hours. A colour change from yellow to red indicated acid production. Occurrence of air space in Durham tubes indicated production of gas.

Catalase Test

Catalase test was also performed and this depends on the ability of the bacterial isolates to produce catalase enzyme. A drop of hydrogen peroxide (H_2O_2) was placed on a clean slide and a colony of the organism was emulsified in a drop of hydrogen peroxide. The evolution of oxygen (effervescence) indicated the presence of catalase.

Coagulase Test

A smear of the test organism was emulsified on the slide using saline solution and a loop full of human plasma was added. A control without plasma was also set up. The slide was then rocked and kept for a period of 2-3 minutes and then observed. Clumping of the cells indicated presence of coagulase.

Oxidase Test

Oxidase test was also carried out on the isolate. This test depends on the ability of the organism to oxidize tetramethyl phenyl diamine hydrochloride into indole phenol. Small pieces of filter paper were soaked in 1% aqueous solution of Oxidase reagent (1% tetramethyl phenyl diamine hydrochloride aqueous solution). A little quantity of each bacteria colony was taken with the aid of a glass wire loop and then rubbed in the filter paper. A purple coloration indicates the presence of Oxidase.

3.4.1.6 Antimicrobial Sensitivity Test

Antimicrobial sensitivity test was carried out by a slight modification of the Stokes disc diffusion technique (Stokes and Ridgway, 1980). About 25mls of the Mueller Hinton Agar (prepared and sterilized according to manufactures instructions) were poured into sterile petri dishes. Suspensions of bacteria were prepared in sterile peptone water. Using a sterile loop of about 4mm diameter, a loopful of the test organism suspension was applied to the center of the sensitivity testing plate. A sterile dry cotton wool swab was used to spread the inoculum evenly across the plate. The inoculum was allowed to dry for a few minutes with the petri dish lid in place.

Commercially prepared antibiotics disc (optudisc) were applied to the sensitivity plates using sterile forceps and the plates incubated aerobically at 35-37^{o}c for 24hrs. The reaction of the test organism to each antibiotic was simply interpreted as sensitive or resistant. Radius of inhibition zone was recorded in percentages as clearly marked on the disc. Test with no zone of inhibition was read as resistant.

3.4.2 Mycological Studies

280 Samples of urine and stool were also tested for fungal growth using Sabouraud Dextrose Agar. Mycological procedures as described by Fathi & Al-Samarai (2000) were applied to samples.

3.4.2.1 Skin Scrapping Collection and Examination

Skin scrappings were also collected and examined. In all suspected cases of Tinea capitis and Tinea corporis, the diseased areas of the skin or head were thoroughly cleaned with alcohol and after hairs and scales were collected for mycological examination. The scale scrapings were collected with a sterile surgical blade and about 8 to 10 hair roots (stumps). The scraped hairs and scales were placed in a clean – labeled envelope and transferred to the laboratory for further examination.

3.4.2.2 Mycological Culture

Four to five hairs were mounted on a clean slide (new ones) in a drop of 10% potassium hydroxide (KOH) solution, and then it was covered with a cover slip. The slide was flamed for few seconds over a low flame in order to digest the Keratin and clear the fungal elements. The slide was examined under low (x10) and high (x 40) lens magnification for the presence of spores, hyphae and/or mycelia. The size and distribution of spores on the hair can give information about the species of dermatophyte.

The only medium used in the culturing of the samples was Sabouraud dextrose Agar (SDA). In the preparation of the medium, 65g of the medium was dissolved in

one litre of distilled water in a clean conical flask. The mouth of the flask was corked with cotton wool plug, covered with aluminium foil paper and put into an autoclave for sterilization using the method described above for 15 minutes. The medium was allowed to cool until it reached the temperature of 43^{o}C. Thereafter 15 – 20ml of the molten agar medium was then poured into each sterilized Petri dish and was allowed to solidify. All samples from suspected cases were cultured irrespective of the negative or positive microscopic examination. Each sample was cultured on two plates of SDA, one with 0.05mg of chloramphenicol and 0.05mg of cycloheaximide and the other with only chloramphenicol. The agar was inoculated by transferring some of the hair stubs and scales to the surface of the medium using a sterile wire loop and forceps. The plates were labeled and then incubated for four weeks at 27^{o}C – 30^{o}C. Sub-culture was made on SDA for further identification after the growth of the dermatophytes was established.

3.4.2.3 Microscopic Examination of Culture

Wet Mount

Wet mount and slide culture technique were carried out as described by Ogbulie *et al*. (1998) for final identification. A small portion of the mycelial growth was carefully removed from the culture in the medium using a pair of sterile dissecting needles and placed in a drop of cotton blue- in- lactophenol on a slide. The growth was well teased out with dissecting needles, and a cover slip was used to cover the mixture. This was then examined under the microscope with x10 objectives.

Slide Culture Technique

SDA medium was prepared, poured in a Petri dish and allowed to solidify. Then a small piece of the SDA was cut from the plate using a sterile slide. Sterile wire loop was used to inoculate into the vertical side of the square agar pieces with a portion of the culture. This was covered with cover slip and placed into a Petri dish on top of a

bent glass rod to elevate it above the surface of a moistened filter paper placed on the bottom of the dish. The dish was covered and was incubated at 27^{o} – 30^{o}C for 3 – 5 days. After the third day, the cover slip was lifted from the surface of the agar piece and placed in a drop of lacto phenol cotton blue on another slide. This was examined under a microscope.

3.4.3 Parasitological Examination

3.4.3.1 Stool Sample Collection and Culture

Out of 573 nomads examined, 267 (46.6%) were males and 306 (53.4%) were females.

Collection of Stool Specimen

Fresh faecal samples were collected in wide containers with lids by the nomads. These samples were collected and processed within a few hours. Specimen which could not be analyzed immediately was preserved in the refrigerator. A total of 573 nomads were examined for parasitic infections.

Macroscopic Examination of Stool

This is the visual examination of the stool sample, noting the appearance, the colour, consistency (whether it was formed, semi-formed or watery). The presence or absence of blood, mucus, pus, or parasite segments (e.g adult *A. lumbricoides, E.vermicularis* species segments etc) was noted.

Saline (Wet) Preparation

A drop of physiological saline was placed on a grease-free slide using an applicator stick; 0.01gm of the stool sample (match-head size) was picked and emulsified on the drop of the saline. The preparation was covered with cover slip and examined under x10 and finally with x40 (higher power objective) lenses. Bloody and mucoid specimens were properly smeared on the slide and covered with a coverslip without adding physiological saline.

Such specimens were kept in warm environment (25–37^{o}C) until examined to ensure the adequate motility of amoebic trophozoites, if present. The saline preparations were used for the detection and identification of motile parasites such as *Amoeba*, flagellates, and larvae including helminth eggs. The protozoan cysts could also be detected but not easily identified without the use of iodine preparation.

Iodine (Wet) Preparation

In this method, a drop of Lugol's iodine was substituted for normal saline in the preparation. It was used for the identification of protozoan cysts since the nuclear and glycogen inclusions were stained. However, the chromatoid bodies remained stained.

Sodium Chloride Floatation Technique

The principle underlying all floatation techniques is to increase the specific gravity of the emulsifying solution so that helminth ova, larvae, protozoan cysts or adult forms of parasites float to the surface. Sodium chloride floatation technique is one of the ideal techniques for the identification of most helminth eggs and protozoan cysts (Cheesbrough, 1987). A tube was filled to a one quarter level with Sodium chloride solution (specific gravity measured with a hydrometer was 1200). A small portion (0.5g) of faeces was emulsified in the solution with the aid of a glass rod or an applicator stick. The tube was subsequently filled with the sodium chloride solution; mixed well and kept in a completely vertical position in a tube rack. Using a plastic pipette or Pasteur pipette, a further solution was added to ensure that the tube is filled to the brim. A completely clean (grease-free) cover slip was carefully placed on top of the tube avoiding trapping any air bubbles. The tube was left undisturbed for 30 – 45 minutes to give time for the cysts and eggs to float. The cover slip was carefully lifted up from the tube by a straight pull upwards and placed face downwards on a slide. (The eggs and cysts were found adhering to the cover slip).

The entire preparation was examined microscopically under x10 objective with the condenser Iris closed sufficiently to give contact. Then a drop of iodine was run under the cover glass, and the cysts were identified under x40 objective.

3.4.3.2 Collection and Analysis of Blood Samples

Blood samples were collected from the nomads for the diagnosis of plasmodium parasites, microfilaria and trypanosome.

The Wet Blood Film Collection

The thumbs of the subjects were cleaned with cotton wool swab soaked in ethanol. Clean and sterile lancets were used to prick the fingers of the nomads. The first drop of the blood that appeared was collected in the middle of the slide. An equal volume of saline was dropped on the blood. Blood was mixed with the corner of cover slip. The slide was then covered with same cover slip and examined on the microscope under x10 and x40 objectives lens. This method was used to identify motile parasites such as the trypanosome and microfilaria.

Thin Blood Film

A drop of blood sample was placed on a clean grease-free microscope slide. Using a smooth edge slide (spreader) the film was immediately spread at angle 45^{o}C. The film was allowed to dry and later stained with Lieshman stain. The stained film after drying was examined with the oil immersion (x100) objective of the microscope. Malaria parasite, trypanosome and microfilaria were identified and recorded.

Thick Film

A drop of blood sample from the pricked finger of the subject was placed on the centre of a clean microscope slide using a plastic bulb pipette. Without delay, the end of the plastic pipette or piece of stick was used to spread the large drop of blood to make the thick smear.

Staining of the Thick Blood Film

The thick film was allowed to air dry. It was then stained with diluted Geimsa stain (1:50, v/v) for 50mins. The slide was then washed in clean water for 3-5mins. Slide was air dried in vertical position. The film was examined using oil-immersion at x100 magnification.

3.4.3.3 Collection and Examination of Urine Samples

The subjects (Nomads) were given dry leak-proof and sufficiently wide- necked universal containers for the collection of urine. The specimen containers were labeled with the subject's names and time of collection. The subjects were advised to make sure that the first and the last drops of urine enter the bottle.

Each urine specimen was centrifuged 2–4 minutes at 2000 r.p.m. The supernatants were discarded and the sediments placed on a slide, covered with cover slip and examined under the microscope using x10 and x40 objective lenses for the identification of the *Schistosoma haematobium* ova and other parasites like *Trichomonas vaginalis*.

3.4.3.4 Parasitological Examination of Filaria

A total of 573 persons were examined for both skin-swelling and blood microfilaria between March and December 2007. This was possible because of the cooperation of the leaders of the various encampments. They were very helpful in the initial mobilization of the sampled herdsmen prior to health education and physical and parasitological examination. They also provided the team with additional interpreters to complement the ones that came to assist the team in the local language interpretation. Data collected were grouped according to sex and age. For each person, physical examination for clinical manifestations was carried out on the lower limbs, the groin, the trunk, and the shoulder and head region. Bloodless skin-snips were taken from each person from the shoulder and left iliac crest, using a Holth type Corneoschera punch (2

mm, E2802, STORZ LTD JAPAN). Each skin snip was placed in a microlitre plate (Flat bottom, 96 wells containing 3 drops of 0.085% physiological saline solution) and incubated for 24 hours. Microfilaria that emerged were examined, counted and recorded. Preparations were selected randomly, fixed in Methyl alcohol, stained with Geimsa, and examined under the microscope to confirm the species of the microfilaria morphology (Eberhard and Lammie, 1991).

Both day and night, blood samples were collected from the subjects whose skin snips had been collected. Adopting the finger prick method a thick blood smear of about 20mm cube was collected using a disposable sterile blood lancet. The blood films were fixed in methanol, stained with Geimsa and examined microscopically for microfilaria. The Community Microfilaria Load (CMFL) is calculated as the geometric mean of microfilaria scores of all adults 20years of age or older (Brown and Shannon, 1998: Anosike *et al.*, 2004).

3.4.4 Analysis of Soil, Water and Air Samples

Further investigations of the soil, the water and the air were carried out on the environment where the Fulani herdsmen live. Samples of the top soil, well water and air around their settlement were collected and examined. All glassware was treated in the hot-air oven at 160^{o}C for 2hrs. Growth media and diluents (distilled water) were autoclaved at 121^{o}C for 15 min.

3.4.4.1 Microbiological Analysis of Soil Sample

The soil samples were collected from 3 different locations in the Fulani's settlement. The samples were labeled according to the site of collection as PG (Play Ground samples), WS (well side samples), and MP (Meeting Place samples). Randomly located, samples of the topsoil (5x5cm depth and width) were collected and put into a sterile glass flask using an auger of 6cm diameter. The samples were transported to the Microbiology Laboratory at Ebonyi State University, Abakaliki.

When samples could not be processed immediately, they were stored at $6^{o}C$ for no longer than 24hrs.

The soil sample was mixed, and a suspension of 1 g (dry weight equivalent) in 10 ml of sterile water was prepared. One ml of the soil suspension was then diluted serially (ten-fold) and used in the estimation of aerobic heterotrophic bacterial and fungal populations by standard spread-plate dilution method described by Seeley and VanDemark (1981). Nutrient agar containing 0.015% (w/v) nystatin (to inhibit fungi growth) was used for bacteria isolation and incubation was at $35^{o}C$ for five days. Sabouraud dextrose agar to which 0.05% (w/v) chloramphenicol has been added (to inhibit bacteria growth) was used for fungal isolation, and incubation was at $27^{0}c$ for seven days. Pure isolates of representative microbial communities were maintained on agar slant at $4^{o}C$. Identification of isolates was based on cultural, microscopic, and biochemical characteristics.

Soil pH was determined according to the procedure described by Akpor et al. (2006). Comparisons of means were analyzed statistically, using one-way Analysis of Variance (ANOVA) and SPSS 16.0 software.

3.4.4.2 Microbiological Analysis of Water

Only one shallow well was found in the settlement and this served as the source of drinking water and cooking water. Occasionally they supplement their water needs by trekking long distances to fetch from the nearby stream. Women and children were seen around the well with buckets and calabash similar to what they use in the sales of NuNu. In the same container they used in fetching water from the well, I collected water into a sterile glass sampling bottle. Sample was taken to the Microbiology Laboratory of Ebonyi State University, Abakaliki for further analysis. Standard microbiological procedures as described by Cowan and Steel, (1974) were used.

3.4.4.3 Analysis of Air Sample

Sterile agar plates containing SDA were exposed at 5 different locations in the settlement. Also, another 5 sterile agar plates containing Plate Count Agar(PCA) was also exposed for 20mins duration. Plates were taken to the Microbiology Laboratory at Ebonyi State University, Abakaliki for further processing and examination.

3.5 KNOWLEDGE, ATTITUDE AND PERCEPTION (KAP) ABOUT MICROBIAL AND PARASITIC INFECTIONS

The knowledge, attitude and perceptions regarding microbial and parasitic infections especially causes of disease as well as methods of treatment in the various bush encampments were examined. This was achieved through administration of questionnaires to adult Fulani herdsmen who presented themselves for this survey. Parameters examined included awareness of infections; reasons for acceptance of treatments; reasons for rejection of treatments; and reasons for rejection of medication.

3.6 DATA ANALYSIS

Analyses were done using Statistical Processing Systems Software (SPSS) designed by International Business Machines (IBM) Version 16.0. The Chi-square test was also used to determine significance of disease prevalence. The t-test was also performed to compare mean values, simple averages and group data scores.

CHAPTER FOUR
RESULTS

4.1 PREVALENCE OF MICROBIAL AND PARASITIC INFECTIONS

4.2 PREVALENCE OF BACTERIAL INFECTION

A total of 1218 nomads were sampled in the survey. Out of this number, 677(55.6%) individuals harboured various bacterial organisms in the urine and stool. The most prevalent organism was *Enterococcus* sp (30.3%), *Neisseria* sp (23.3%), *Enterobacter sp* (20.0%) and *Staphylococcus aureus* (14.2%), while the least prevalent was *Acinetobacter* sp-(0.3%) (Table 5). The biochemical tests including sugar fermentation, acid and gas production carried out on these isolates for identification purposes are shown on Plate IV. Plate V shows the morphological appearance of *Staphylococcus sp* on plate count agar. Table 6 shows the distribution and prevalence of bacteria infections in the different bush encampments, While taking note of some encampments with large herds, occupied by rich nomads and with commendable hygiene practice, others were visibly noticed to be occupied by seemingly poor nomads with little herds and poor hygiene practice around the camp. There were no significant percentage differences in the number of male and female nomads having bacterial infection in the various bush encampments (Table 7).

Plate IV. Biochemical tests including sugar fermentation, acid and gas production

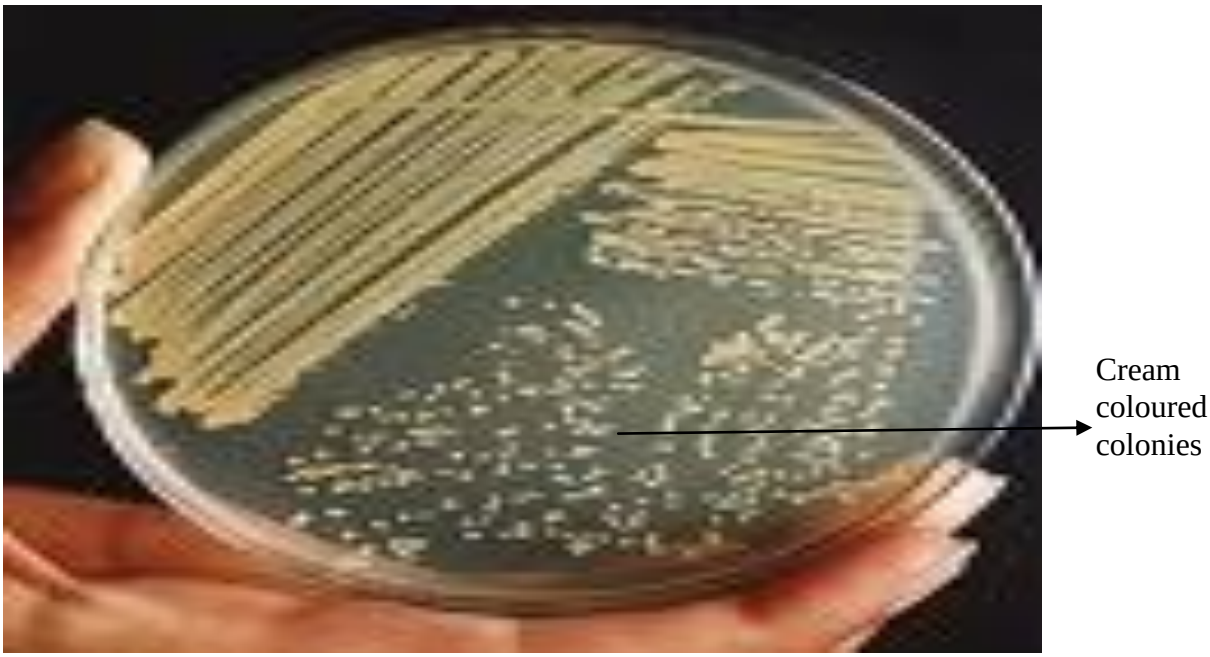

Plate V. Morphological appearance of *Staphylococcus sp* on Plate Count Agar

Table 5: Prevalence of bacterial infections amongst nomadic Fulani of Ebonyi State, Nigeria (n= 1218)

Bacterial Isolate	Number Infected	% Infection
Staphylococcus aureus	96	14.2
Neisseria sp	158	23.3
Enterococcus sp	205	30.3
Escherichia coli	63	9.3
Pseudomonas sp	5	0.7
Klebsiella sp	12	1.8
Acinetobacter sp	2	0.3
Enterobacter sp	136	20.0
Total	677	99.9

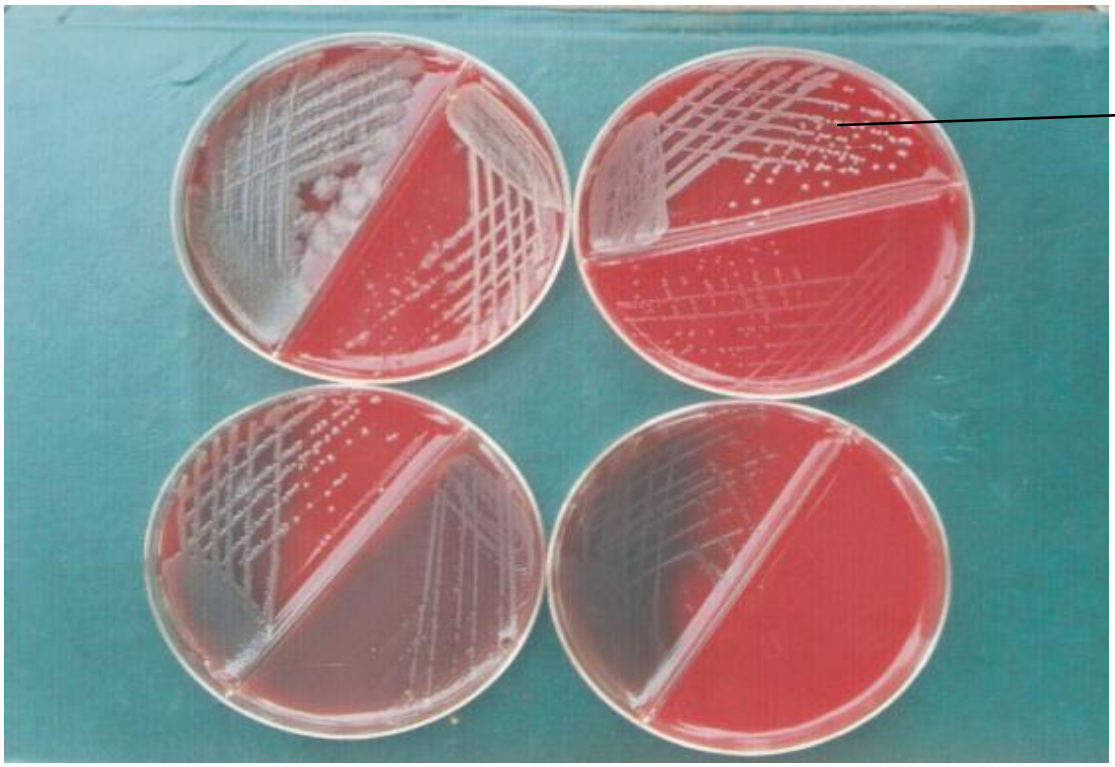

Plate VI. Growth plates for *Enterococcus sp* on MacConkey Agar

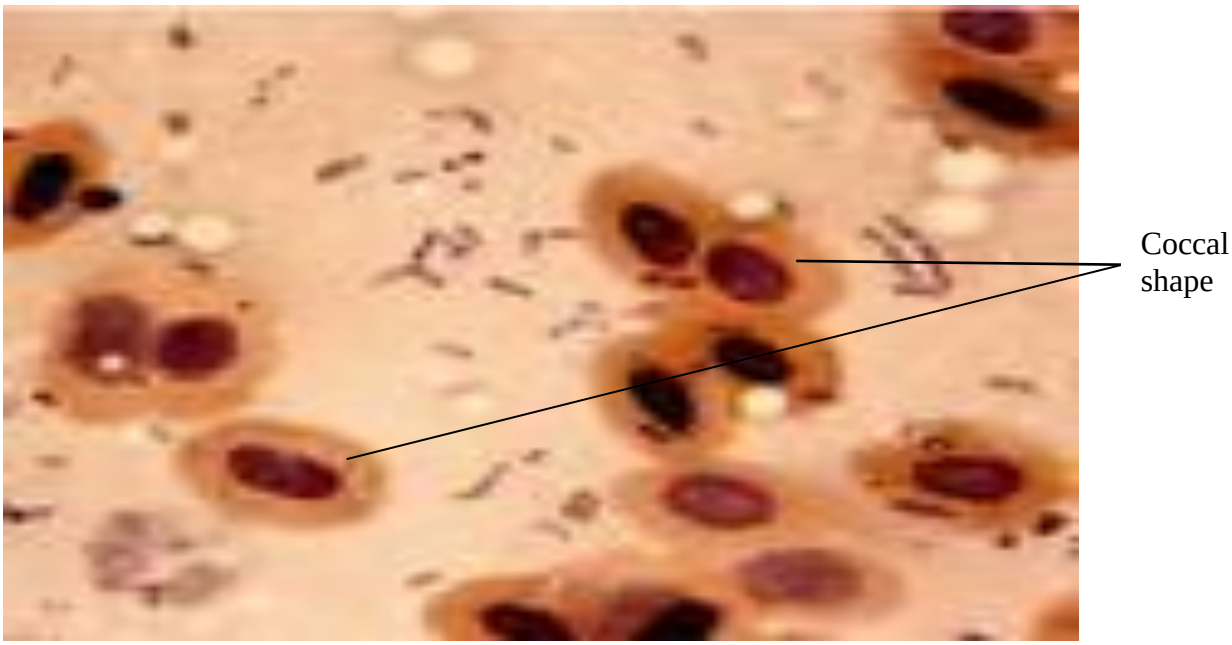

Plate VII. Microscopic view of *Enterococcus* with its characteristic coccal appearance. X10 magnifications.

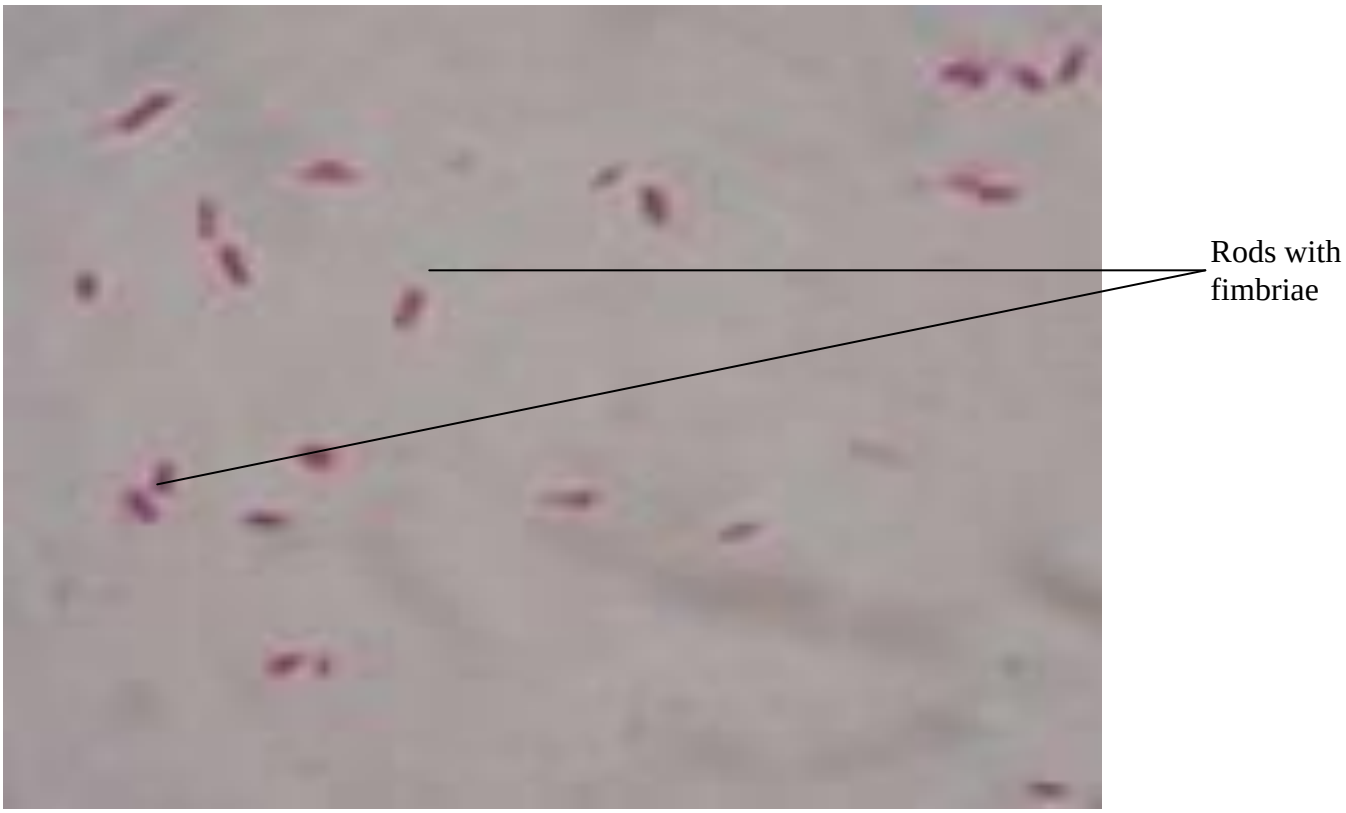

Plate VIII. Microscopic appearance of *Escherichia coli*

Table 6: Distribution and prevalence of bacterial infections in some selected bush encampment in Ebonyi State. (n= 1218)

Bush	No. Examined	No. Infected	% Prevalence
1	166	121	72.9(b)
2	172	96	55.8(b)
3	180	121	67.2(b)
4	156	72	46.1(a)
5	189	73	38.6(a)
6	173	108	62.4(b)
7	182	86	47.3(a)
Total	**1218**	**677**	**55.6**

a = seemingly rich nomad encampments with large herd of cattle and good sanitation practice around household environment

b = visibly poor nomad encampments with small herd of cattle and poor sanitation practice around household environment

Table 7: Sex-related prevalence of bacterial infections amongst nomadic Fulani in selected bush encampments in Ebonyi State

Bush Encampment	Male			Female			Total		
	No Examined	No Infected	% Prevalence	No Examined	No Infected	% Prevalence	No Examined	No Infected	% Prevalence
1	70	45	64.2	96	76	79.2	166	121	72.9
2	89	42	47.2	83	54	65.1	172	96	55. 8
3	74	53	71.6	106	68	64.2	180	121	67.2
4	59	40	67.8	97	32	32.9	156	72	46.1
5	80	35	43.8	109	38	34.9	189	73	38.6
6	97	68	61.3	76	40	52.6	173	108	62.4
7	97	54	70.1	85	32	37.6	182	86	47.3
Total	**566**	**337**	**59.5**	**652**	**340**	**52.1**	**1218**	**677**	**55.6**

4.3 PREVALENCE OF FUNGAL INFECTIONS

Mycological examination of the hair pluckings, scalp and skin scrapings, yielded only 59(21.1%) positive samples out of 280 samples.while 220 (78.9%) samples had no growth. Two fungal genera and six species were isolated (Table 9). The genera are *Microsporum* and *Trichophyton.* The morphological characteristics of the isolated fungal species are presented in Plates IX to XV.The distribution of species and percentage prevalence rates are shown in Table 10. *T. mentagrophytes* has the highest prevalence 25(42.3%), followed by *T. soudanense* with a prevalence rate of 12(20.3%). *M.audouinii* had a prevalence of 9(15.3%) while *T. schoenleinii* had a prevalence of 7(11.9%) and finally *T. quinckeanum* (10.2%). Table 11 shows the age-related distribution and prevalence of ringworm infection in the population of Fulani herdsmen that were sampled. Nomads with ages 11-15 had the highest infection prevalence (45.6%), followed by those with ages 6-10 with 38.3%. Nomads within ages 26-45 had no infection.

Out of a total of 280 persons examined for lesions suggestive of mycotic infections, 59(21.1%) nomads were positive. Encampment 2 had the highest distribution and prevalence 19(32.2%); followed by Encampment 1, 17(28.8%) and Encampment 3 with 13 (22.0%). The Encampment with least infected nomads was encampment 4 with a total of 10 (16.95%). It was observed that *T. mentagrophytes* had the highest distribution and prevalence rate. Of the 59(21.1%) nomads infected with the disease, 25 (42.3%) were infected by this particular species. This was followed by *T. soudanense*; infecting 12(20.3%) nomads in the seven selected bush encampments *M. audounnii* infected a total of 9(15.3%) nomads in the entire encampments. Seven (11.9%) nomads were infected by *T. schoenleinii*. *T. quickaenum had* the least distribution and prevalence 6(10.2%). Of the six species isolated, all occurred in

encampments 1 and 2. Encampment 3 had a total number of 4 species while encampment 4 had a total number of 3 species. *T. mentagrophytes, T. soudanense* and *M. audouinii* occurred in the entire bush encampments *T. schoenleinii* occurred in three encampments while *T. quinckaenum* and *M.audouinii* occurred in encampments 5, 6 and 7.

Table 8: Antibiotic Sensitivity test on Bacterial Isolates

Organism	**% sensitive to the indicated antibiotic**														
	Gm	To	Am	Crm	Caz	Cax	Cft	Imp	Azt	Aug	Pip	Cfz	Fox	Amk	Cp
Acinetobacter spp	60	55	85	75	40	90	75	10	50	25	75	90	90	25	0
Pseudomonas aeruginosa	40	40	30	-	-	45	70	70	10	15	-	15	30	15	-
Enterobacter spp	35	30	100	75	60	60	45	0	30	60	80	85	85	30	0
Enterococcus	60	100	100	45	30	35	30	35	80	85	85	0	10	0	
Escherichai. Coli	35	0	85	50	25	25`	35	0	25	25	70	70	25	25	0

Gm=gentamicin; Tob=tobramycin; Am=ampicillin; Crm=cefuroxime; Caz=ceftazime; Cax=ceftriaxone; Cft=cefotaxime; Imp=imipenem; Azt=aztreonam; Aug=Augmentin; Pip=piperacillin; Cfz=cefazolin; Fox=cefaxitin; Amk=amikacin; Cp=ciprofloxacin

Table 9: **Type and species of ringworm organism encountered on the skin and scalp amongst herdsmen in selected bush encampment in the study area**

GENERA	**SPECIES**
Microsporum	*M. audouinii*
	M. canis
Trichphyton	*T. mentagrophytes*
	T. quickaenum
	T. soudanense
	T.schoenleinii

Table 10 Distribution and Percentage Prevalence of Fungal Isolates

Fungal Isolate	Distribution	% prevalence
T. mentagrophytes	25	42.3
T. soudanense	12	20.3
M. audouinii	9	15.3
T. schoenleinii	7	11.9
T.quinekeanum	6	10.2
Total	59	100

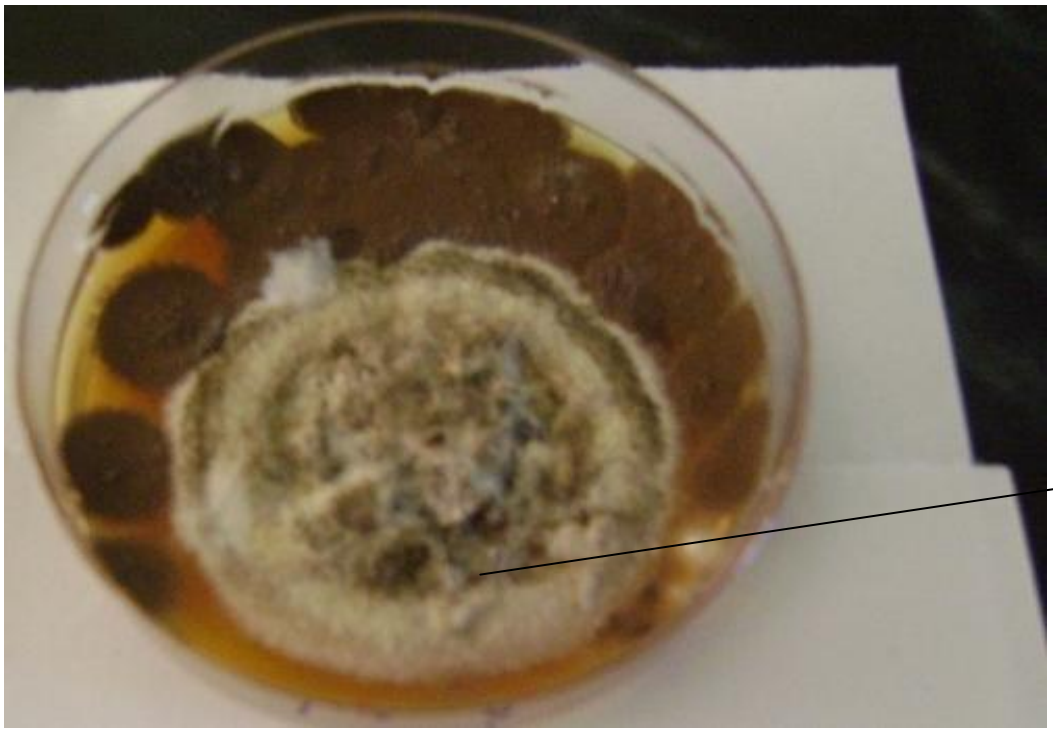

Plate IX. Morphological appearance of *Trichophyton mentagrophytes* on Sabouraud Dextrose Agar

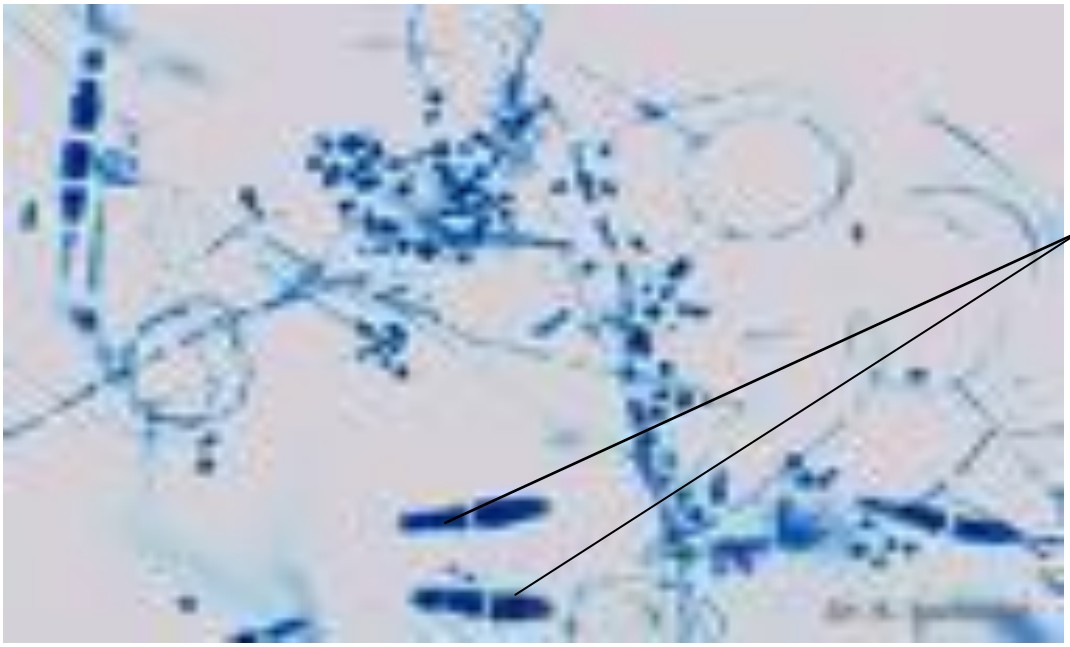

Plate X. Microscopic appearance of *Trichophyton mentagrophytes* showing its barrel shaped spores, rounded tip with halved septum.

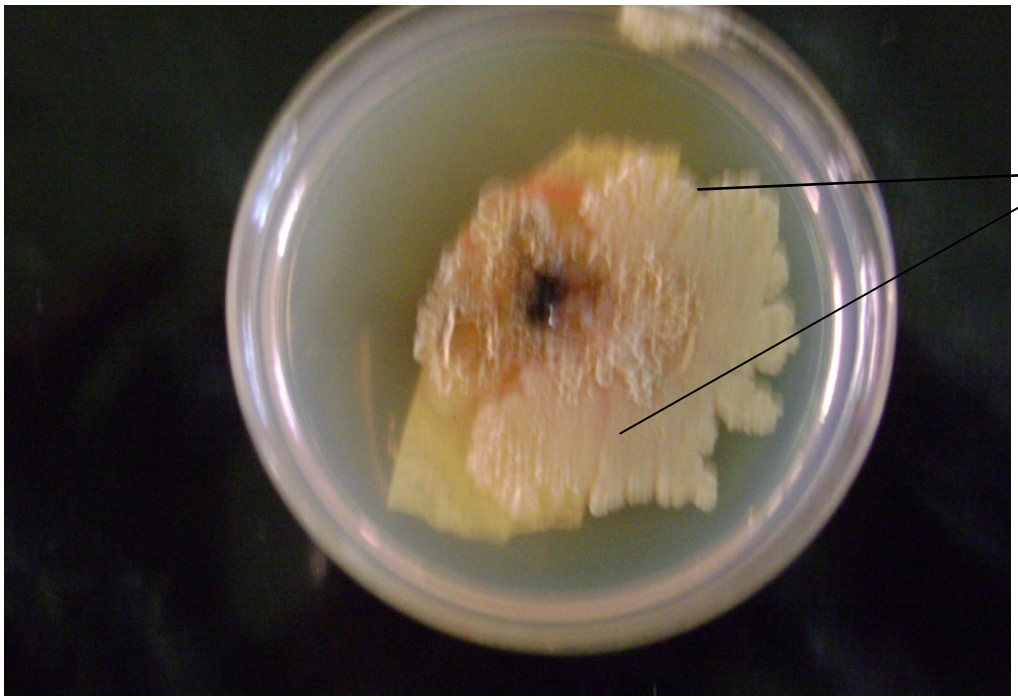

Plate XI. Morphological appearance of *Trichophyton schoenleinii* on Sabouraud Dextrose Agar

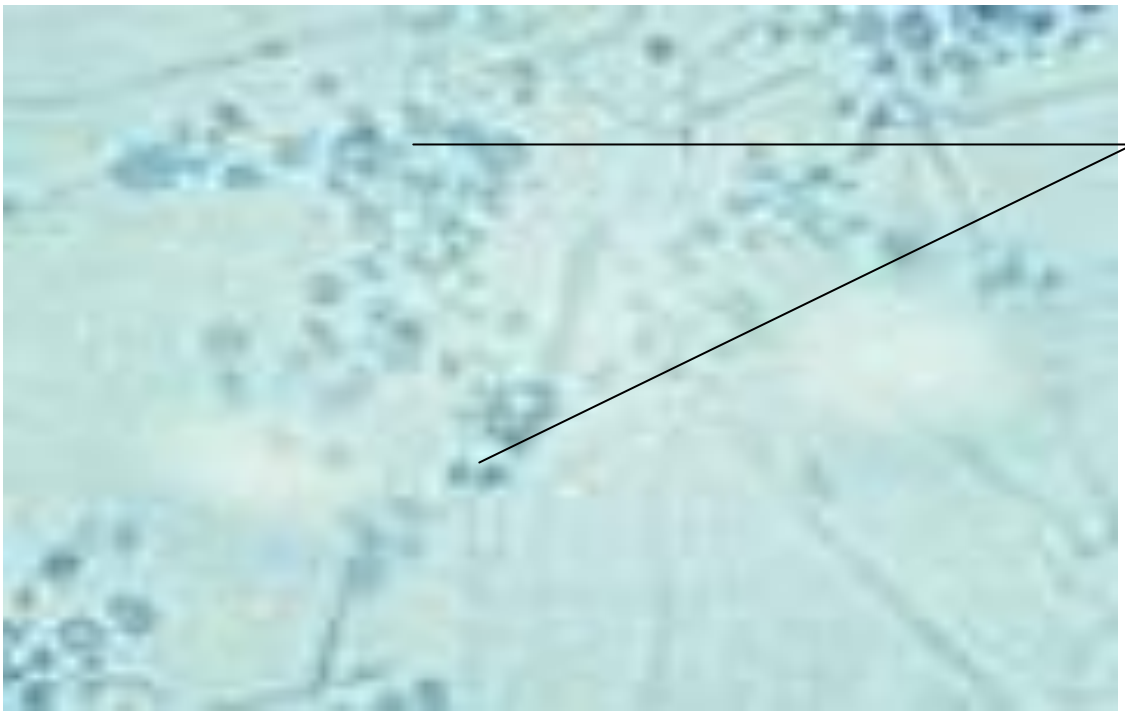

Plate XII. Microscopic view of *Trichophyton schoenleinii* showing numerous chlamydospores.

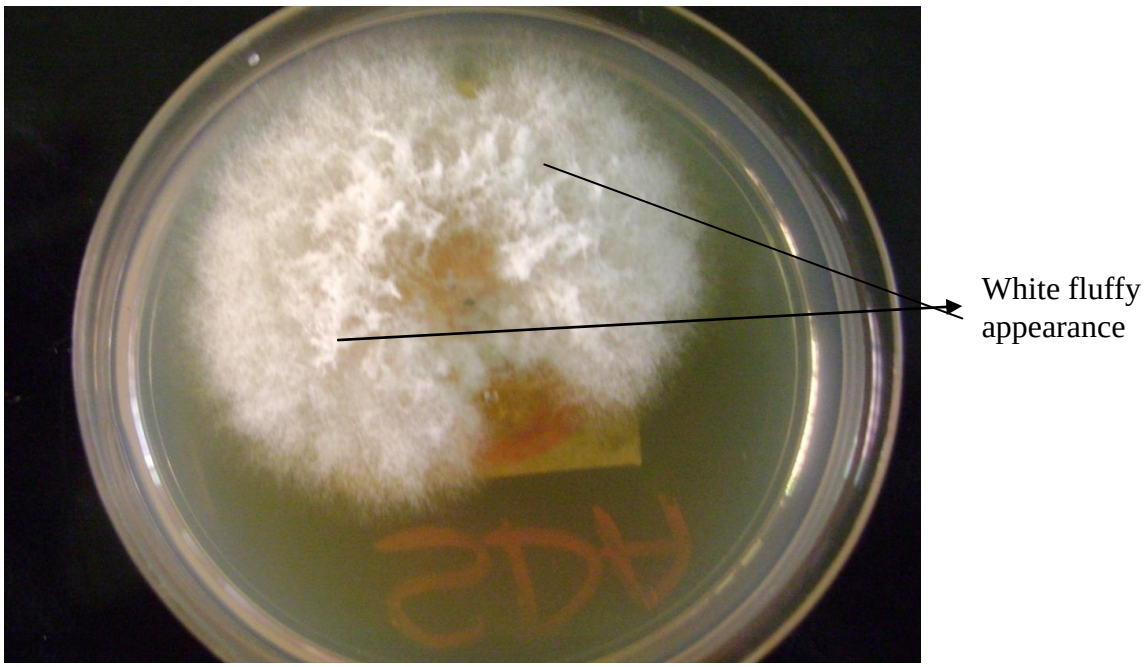

Plate XIII. Morphological appearance of *Microsporum audouinii* on Sabouraud Dextrose Agar

Plate XIV. Microscopic appearance of *Microsporum audouinii* with its Characteristics Spindle-shaped macronidia and pointed appearance

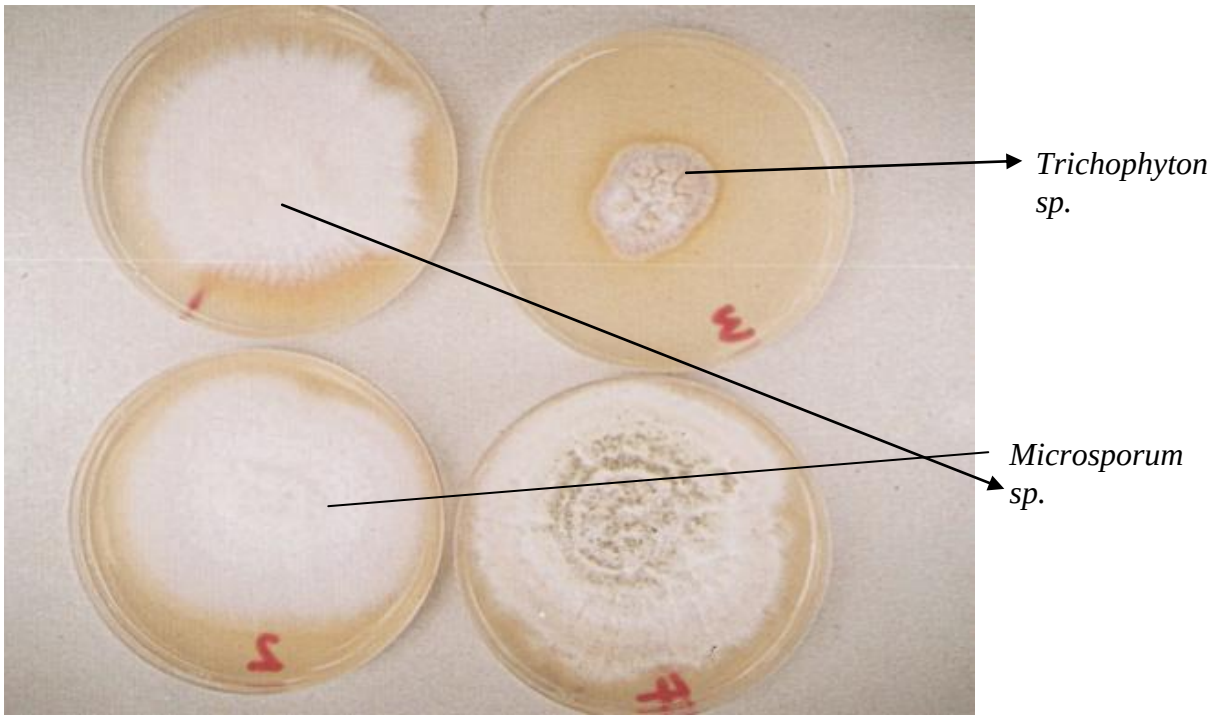

Plate XV. Growth plates for *Trichophyton sp*. on Sabouraud Dextrose Agar is label 3, while *Microsporum sp*. Is label 1, 2 & 4.

TABLE 11: **Age-related prevalence of fungal infections amongst Fulani herdsmen in the study area**

AGE GROUP (IN YEARS)	NO. EXAMINED	NO. INFECTED	% PREVALENCE
1 – 5	52	5	9.6
6 – 10	47	18	3.8
11 – 15	68	31	45.6
16 – 20	36	3	8.3
21 – 25	31	2	6.5
26 – 30	14	0	0
31 – 35	11	0	0
36 – 40	7	0	0
41 – 45	9	0	0
46+	5	0	0
TOTAL	**280**	**59**	**21.1**

4.4 PREVALENCE OF PARASITIC INFECTIONS

The overall prevalence for parasitic infections among the nomads is 45.9% (Table 12). The most prevalent parasitic infections were *Plasmodium* spp (10.6%) followed by *Schistosoma heamatobium* (8.4%). Other parasitic infections isolated were *Mansonella* spp (4.2%), Onchocerca volvulus (3.8%), *Entamoeba histolytica* and Hook worm recorded 2.6% each. *Trichuris trichuria* 2.4%, *Wuchereria bancrofti* 2.4% and the least of the parasitic infection was *Trypanosome* spp (0.7%). It is worthy to note that two protozoan blood parasites were identified in the study namely *Plasmodium* spp and *Trypanosome brucei rhodesiense*. The distribution of parasitic infections among nomads by bush encampment is shown in Table 13. In the said Table 13, encampment 3 recorded the highest prevalence of 58.7% followed by encampment 5 with 50%. Although infections were found in all encampments, number 7 encampments recorded the least prevalence (25.8%). Table 14 shows the overall Sex-related prevalence of parasitic infections amongest nomads. The males recorded overall infection prevalence of 52.4% while the females had 40.1%. Encampments number 5 had the highest male prevalence of 60.3% while the female highest prevalence (59.5%) was recorded in encampment number 3. The least prevalence for males (33.3%) was recorded in camp 7. While that of the females (21.2%) were recorded in camp number 1.

TABLE 12: Types and occurrence of parasitic infections amongst nomadic Fulanis of Ebonyi state, Nigeria.

PARASITIC INFECTIONS	NUMBER SAMPLED	NUMBER INFECTED	% OCCURRENCE
Ascaris lumbricoides	573	13	2.3
Hook worm	573	15	2.6
Strongyloides stercoralis	573	10	1.7
Trichuris trichura	573	14	2.4
Enterobius vernicularis	573	6	1.0
Schistosoma mansoni	573	9	1.6
Entamoeba histolytica	573	15	2.6
Schistosoma haematobium	573	48	8.4
Mansonella sp	573	24	4.2
Onchocerca volvulus	573	22	3.8
Mansonella streptocerca	573	8	1.4
Wucheraria bancrofti	573	14	2.4
Trypanosome brucei rhodesiense	573	4	0.7
Plasmodium sp.	573	61	10.6
Total		263	45.9

Plate XVI: *Trichuria trichuris* parasite photograph taken with a x 10 Magnifying lens

Table 13: Overall distribution and prevalence of parasitic infections in the study Area

BUSH ENCAMPMENT (SITES)	NO. EXAMINED	NO. INFECTED	% PREVALENCE
1	55	17	30.9
2	81	28	34.6
3	181	106	58.7
4	90	40	44.4
5	110	55	50.0
6	25	9	36.0
7	31	8	25.8
TOTAL	**573**	**263**	**45.9**

Table 14: Overall sex-related prevalence of parasitic infections amongst nomadic Fulani in selected bush encampments in Ebonyi State

Bush Encampment	Male			Female			Total		
	No Examined	No Infected	% Prevalence	No Examined	No Infected	% Prevalence	No Examined	No Infected	% Prevalence
Number 1	22	10	45.4	33	7	21.2	55	17	30.9
Number 2	33	15	45.4	48	13	27.1	81	28	34.6
Number 3	92	53	57.6	89	53	59.5	181	106	58.7
Number 4	46	22	47.8	44	18	40.9	90	40	44.4
Number 5	53	32	60.3	57	23	40.3	110	55	50.0
Number 6	12	5	41.6	13	4	30.7	25	9	36.0
Number 7	9	3	33.3	22	5	22.7	31	8	25.8
Total	**267**	**140**	**52.4**	**306**	**123**	**40.1**	**573**	**263**	**45.9**

4.4.1 Prevalence of Trypanosomiasis

The distribution and percentage occurrence of trypanosomiasis amongst nomads in various bush encampments in Ebonyi State is shown in Table 12. Out of 573 nomads examined, 4(0.7%) were infected with trypanosomiasis due to *Trypanosoma bruci rhodesiense*. Parasitic infections varied significantly amongst different bush encampments in the area. Site number 3 bush encampment had significantly higher prevalence (58.7%) than others ($P<0.05$). This was followed closely by site 5 with 50.0% and site 4 with (44.4%) while site 7 bush encampment had the least (25.8%), in the overall parasitic prevalence (Table 13). However, in all the encampments, the percentage prevalence for trypanosomiasis was quite low (0.7%).

4.4.2 Malaria Infection Amongst Nomads In The Study Area

Four *Plasmodium* species known were identified (Table 15). *Plasmodium falciparum* (45.9%) was significantly higher than others, followed by *P. malariae* (26.2%) with *P. ovale* as the least (4.9%). Co-infection of *P. falciparum* and *P. malariae* was also observed. Table 16 shows the prevalence and distribution of malaria infections amongst nomads in various bush encampments in the study area. Out of the 573 nomads examined, 61 (10.60%) were infected. Out of the seven bush encampments studied, infection was significantly higher in bush encampment number 5 than the others ($P<0.05$). . The relationship between sex of nomads and prevalence of malaria is shown in Table 17. Out of the 61(10.6%) nomads infected, 42(15.7%) and 19(6.2%) were males and females respectively. Malaria infection was significantly higher in males than in females, in bush encampments 5, 6 and 7 than in others ($p<0.05$).

Table 18 shows the age-related prevalence of malaria in the study area. Of the 25 nomadic Fulani children examined in the 1 – 5 years age bracket, only 2(8.0%) were

infected. It was surprising that no child below 2 years was infected. The 6 – 10 years age cohort had the highest prevalence of 32.4% compared to other age groups. This was followed by the 11 – 15 years age group (14.6%) and 16 – 20 years age group (9.8%) with 46+ year's age bracket as the least (4.7%).

Generally, prevalence of malaria in nomads within the first three decades of life was significantly higher than the other years ($P<0.05$) (Table 18).The sex –related intensity of malaria infections among nomads in the study area is shown in Table 19. Of these, 27 had counts above 10,000/mm^3 while only 7 nomads had counts less than in 100/mm^3. Malaria parasitaemia above 10,000/mm^3 was also significantly higher in males than females ($p<0.05$).

Table 15: Type and distribution of *Plasmodium* species amongst nomadic Fulani in selected encampments in Ebonyi state, Nigeria

PLASMODIUM SP	No. EXAMINED	No. INFECTED	% PREVALENCE
Plasmodium falciparum	*573*	28	45.9
Plasmodium malariae	*573*	16	26.2
Plasmodium vivax	*573*	4	6.6
Plasmodium ovale	*573*	3	4.9
Plasmodium falciparum & P. malariae	*573*	10	16.4
Total	*573*	61	10.6

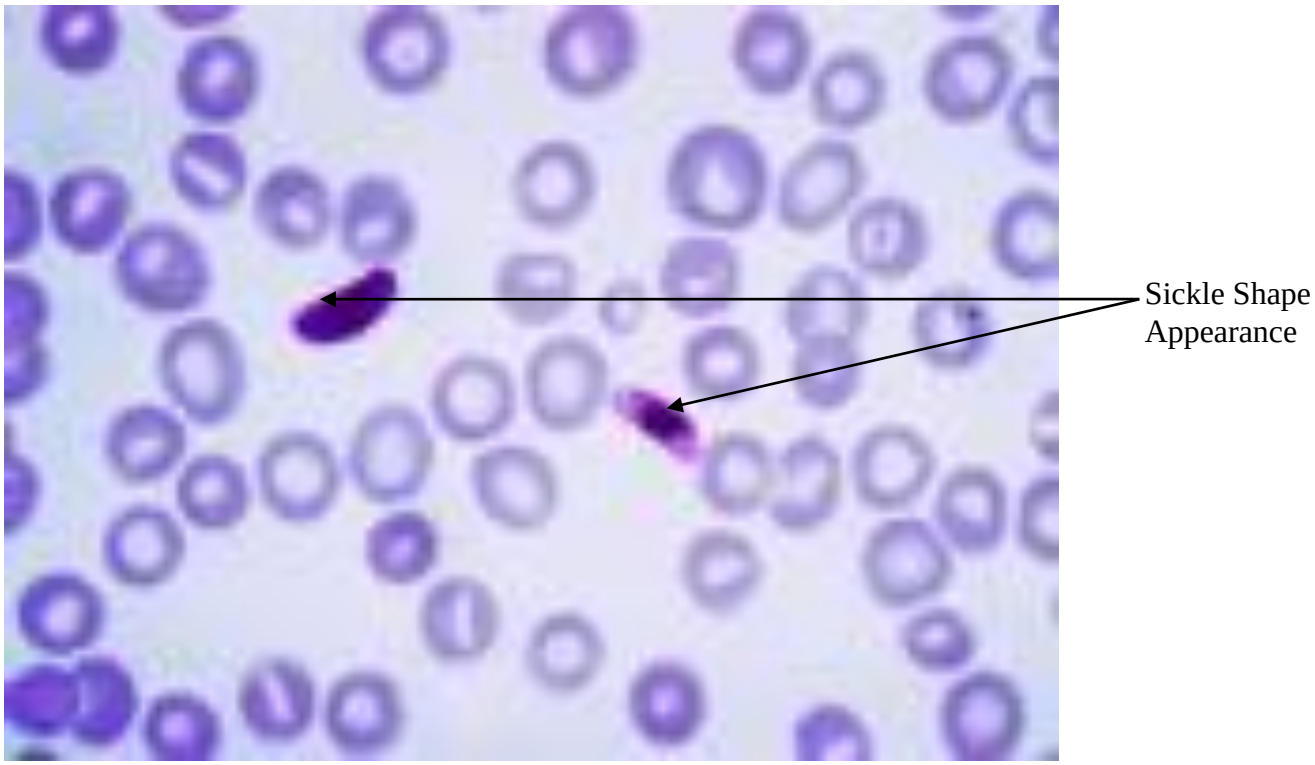

Plate XVII. Microscopic view of *Plasmodium falciparum* with it characteristics sickle shape appearance. X100 magnifications

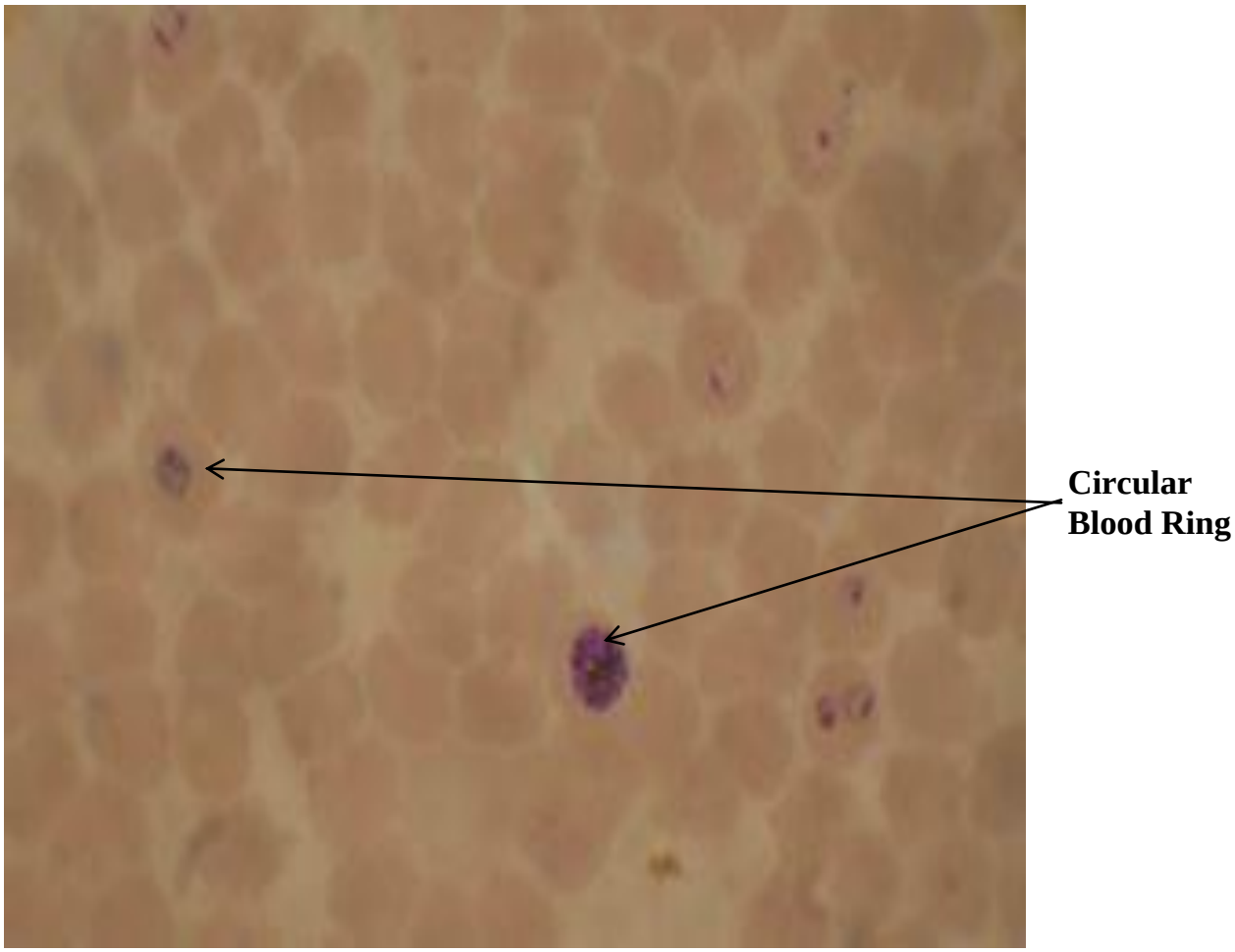

Plate XVIII. Microscopic view showing circular blood ring; A Characteristic of trophozoite development stage in *Plasmodium* X100 magnifications

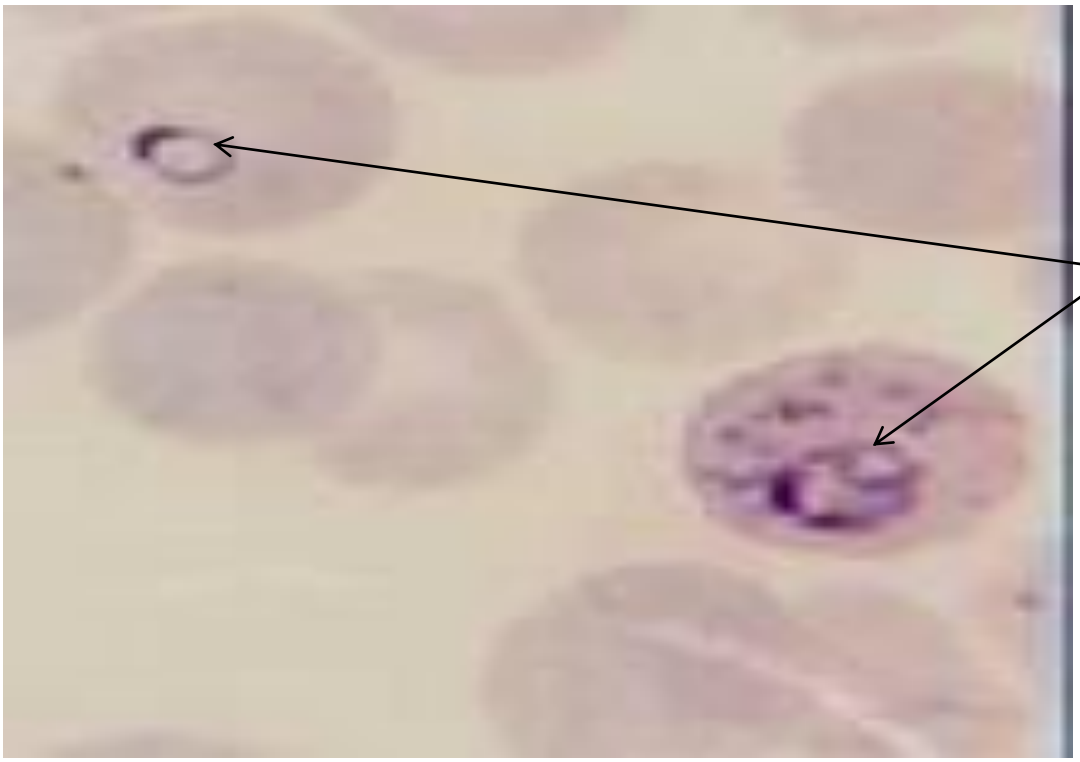

Plate XIX. Microscopic view of *Plasmodium* early ring form trophozoites X100 magnifications.

TABLE 16: Prevalence and distribution of malaria infections amongst nomads in selected bush encampments in Ebonyi state, Nigeria.

BUSH ENCAMPMENTS	NUMBER EXAMINED	NUMBER INFECTED	% PREVALENCE
1	104	8	7.8
2	79	6	7.6
3	53	7	13.2
4	91	5	5.5
5	96	19	19.8
6	68	8	11.8
7	82	8	9.8
Total	**573**	**61**	**10.6%**

Table 17: Sex-related prevalence of malaria amongst nomads in selected bush encampment in Ebonyi State Nigeria.

	MALE		FEMALE		TOTAL	
BUSH ENCAMPMENTS (SITES)	NO. EXAMINED	NO (%) INFECTED	NO. EXAMINED	NO (%) INFECTED	NO. EXAMINED	NO (%) INFECTED
1	22	5(22.7)	33	3(9.0)	55	8(14.5)
2	33	4(12.1)	48	2(4.2)	81	6(7.4)
3	92	4(4.3)	89	3(3.4)	181	7(3.9)
4	46	3(6.5)	44	2(4.5)	90	5(5.6)
5	53	6(11.3)	57	5(8.8)	110	9(8.2)
6	12	6(0.5)	13	2(15.4)	25	8(32.0)
7	9	6(66.7)	22	2(9.1)	31	8(25.8)
Total	**267**	**42 (15.7)**	**306**	**19(6.2)**	**573**	**61(10.6)**

TABLE 18: Age-related prevalence of malaria amongst Fulani herdsmen in Ebonyi State Nigeria

AGE GROUP (IN YEARS)	NO. EXAMINED	NO. INFECTED	% PREVALENCE
1 – 5	25	2	8.0
6 – 10	34	11	32.4
11 – 15	96	14	14.6
16 – 20	102	10	9.8
21 – 25	116	11	9.5
26 – 30	52	3	5.8
31 – 35	41	3	7.3
36 – 40	34	3	8.8
41 – 45	30	2	6.7
46+	43	2	4.7
TOTAL	**573**	**61**	**10.6**

TABLE 19: Sex related intensity of Malaria infection amongst nomads sampled in selected bush encampments in Ebonyi State

PARASITE COUNT/MM^3	MALE		FEMALE		TOTAL	
	NEGATIVE	POSITIVE	NEGATIVE	POSITIVE	NEGATIVE	POSITIVE
POSITIVE	267	-	306	-	573	-
<100	-	6	-	1	-	7
101 – 1000	-	8	-	4	-	12
1001 – 10000	-	9	-	6	-	15
10001 – 50000+	-	19	-	8	-	27
TOTAL	**267**	**42**	**306**	**19**	**573**	**61(10.6%)**

4.4.3 Prevalence of Blood Filarid Parasites in the Study

During this investigation, two major blood filarid parasites were isolated. These were *Wucheria bancrofti* and *Mansonella sp.*

4.4.3.1 Wuchereria

The prevalence and distribution of *Wuchereria bancrofti* infection amongst nomads in the various bush encampments in the study area is shown in Table 20. The highest prevalence of 9.8% was observed in site 7 bush encampment. This was followed by sites 1, 2 and 3 bush encampments with prevalences of 3.8% respectively. Site 4 bush encampment had the least prevalence of 2.2%. The overall prevalence for Wuchereria in the study is 14(2.4%)

The age-related prevalence of *W. bancrofti* infection amongst nomads in the study area is summarized in Table 21. Except the 1 – 5 years age group and 41- 45years group, infection was recorded in all the age groups sampled. Infection appeared to be di-phasic in distribution. *W. bancrofti* infection was significantly higher in adult 31 years and above than in subjects below this age category. The highest prevalence of 12.2% was observed in persons within 31 – 35 years age group. Out of the 573 nomads examined for *W. bancrofti*, 24 (4.2%) were infected. A total of 267 and 306 were males and females respectively.

Sex-related prevalence and distribution of *Wuchereria* sp is shown in Table 22. Sixteen (6.0%) males and eight (2.6%) females were infected. Infection was higher in males than in females. In the male category infection was significantly higher in site 7 than in other bush encampments in the study area ($P<0.05$). However, in the female category, the same was applicable where females in site 7 had the highest prevalence (13.6%). Sex-related prevalence and distribution of *Wucheria* sp is shown in Table 22.

Table 20: Prevalence and distribution of W*ucheria bancrofti* infection amongst nomads in selected bush encampments in Ebonyi state

BUSH ENCAMPMENTS (IN SITES)	NUMBER EXAMINED	NUMBER INFECTED	% PREVALENCE
1	104	1	0.9
2	79	3	3.8
3	53	2	3.8
4	91	1	1.1
5	96	3	3.1
6	68	1	1.5
7	82	3	3.7
TOTAL	**573**	**14**	**2.4**

Table 21: Age related prevalence of W*ucheria bancrofti* infection amongst nomads in Ebonyi State

AGE GROUP (IN YEARS)	NO. EXAMINED	NO. INFECTED	% PREVALENCE
1 – 5	25	0	0.0
6 – 10	34	1	2.9
11 – 15	96	2	2.1
16 – 20	102	2	2.0
21 – 25	116	1	0.9
26 – 30	52	2	3.8
31 – 35	41	3	7.3
36 – 40	34	1	2.9
41 – 45	30	0	0.0
46+	43	2	4.7
TOTAL	**573**	**14**	**2.4**

Table 22: Sex-related Prevalences of *Wuchereria bancrofti* amongst Fulani herdsmen in Ebonyi State, Nigeria.

	MALE		FEMALE		TOTAL	
BUSH ENCAMPMENTS (SITES)	**NO. EXAMINED**	**NO (%) INFECTED**	**NO. EXAMINED**	**NO (%) INFECTED**	**NO. EXAMINED**	**NO (%) INFECTED**
1	48	0(0.0)	56	1(1.8)	104	1(0.9)
2	33	3(9.0)	46	-(0.0)	79	3(3.7)
3	22	1(4.5)	31	1(3.2)	53	2(3.8)
4	47	1(2.1)	44	-(0.0)	91	1(1.1)
5	42	1(2.3)	54	2(3.7)	96	3(3.1)
6	30	1(6.7)	38	-(0.0)	68	1(1.5)
7	30	2(6.7)	52	1(1.9)	82	3(3.6)
TOTAL	**252**	**9(3.9)**	**321**	**5(1.9)**	**573**	**14(2.4)**

4.4.3.2 Mansonelliasis

A total of 573 nomads were examined for filarid nematodes, 32 were infected for *Mansonella perstans* microfilariae. This gave a prevalence of 5.6% infection which varied amongst nomads in various encampments in the area. Site 1 encampments had the highest prevalence of mansonelliasis (7.7%), followed by site 3 encampment (7.5%) with site 4 as the least (0.0%). Statistical analysis using chi-square test showed that there was slight significant variation amongst various encampments ($P<0.01$) as in Table 23. Statistical analysis of the age related prevalence of mansonelliasis infection amongst Fulani nomads in the area revealed that infection was aliphatic. Persons within the first 25 years of age had low prevalence rate. Infection was lower than subjects above 26 years of age. This is statistically significant ($P<0.05$) when tested on SPSS 16.0 soft ware. These are clearly shown in Table 24.

TABLE 23: Prevalence and distribution of *Mansonelliasis* amongst nomads in selected bush encampments in Ebonyi State

BUSH ENCAMPMENTS (IN SITES)	NUMBER EXAMINED	NUMBER INFECTED	% PREVALENCE
1	104	8	7.7
2	79	5	6.3
3	53	4	7.5
4	91	0	0.0
5	96	6	6.2
6	68	4	5.9
7	82	5	6.1
TOTAL	**573**	**32**	**5-6**

Table 24: **Age related prevalence of *Mansonelliasis* infection amongst Fulani herdsmen in Ebonyi State, Nigeria.**

AGE GROUP (YEARS)	NO. EXAMINED	NO. INFECTED	% PREVALENCE
1 – 5	25	0	0.0
6 – 10	34	3	8.8
11 – 15	96	4	4.2
16 – 20	102	0	0.0
21 – 25	116	4	3.4
26 – 30	52	7	13.5
31 – 35	41	6	14.6
36 – 40	34	5	14.7
41 – 45	30	3	10.0
46+	43	0	0.0
TOTAL	**573**	**32**	**5.6**

4.5 MICROBIOLOGICAL ANALYSIS OF SOIL, WATER AND AIR SAMPLES

4.5.1 Total Bacterial Counts for Soil Samples

The average total bacterial counts (TBC) of each soil sample ranged from 9.0 x 10^5 colony forming units (cfu) per gram of soil, 8.0 x 10^5 cfu/g of soil, 4.1 x 10^5 cfu/g of soil of WS, PG and MP respectively (Table 26). Although there were differences in the averages total bacterial counts of the different sampling locations, these differences were not statistically significant. However, highest counts were observed in WS, and lowest count was observed in MP.

4.5.2 Total Fungal Counts

The average total fungal counts (TFC) of each soil sample ranged from 4.0 x 10^3 cfu/g of soil, 2.5 x 10^3 cfu/g of soil, 1.3 x 10^3 cfu/g of soil of PG, WS and MP respectively. Highest counts were observed in PG, lowest counts were observed in MP (Table 27). Differences in the average total fungal counts of the sampling locations were not statistically significant. When tested on SPSS 11.0 software.

4.5.3 Soil pH

The pH values ranged from 6.90 – 7.40. The soil pH in PG was higher than WS and MP (Table 25). However, differences in the soil pH values of the different sampling locations were not observed to be statistically significant. These values are mean values determined by using two (2) independent measurements from each sampling point.

4.5.4 Spread in Bacteria Types in Sampling Locations

Cultures from the various locations show variations in the spread and abundance of bacteria. Throughout the sampling locations, several distinct strains of bacteria were recorded from PG (Play ground) with *Bacillus* genera being the most

dominant. Target organism were also recorded but were not dominant. In WS (Well side) similar trend was observed but *Enterococcus sp* showed significant presence (Table 28) as my target organisms. The bacteria cultural types in MP (Meeting Place) also had Bacillus showing dominant presence not among my target isolate. The number of target bacteria cultural types recorded were statistical significant when using SPSS 11.0 software ($P<0.01$) upon comparing each location against the other (PG vs WS, PG vs MP and WS vs MP).

Table 25: Soil pH of the sampling location

Sample	pH
PG	7.40
WS	7.08
MP	6.90

Key:

PG = PLAY GROUND

WS = WELL SIDE

MP = MEETING PLACE

Table 26: Total bacteria count of the soil in the sampling location

Location	Bacteria count in cfu/gm		
	Sample A	Sample B	Average
PG	$7.9x10^5$	$8.1x10^5$	$8.0x10^5$
WS	$9.2x10^5$	$8.8x10^5$	$9.0x10^5$
MP	$4.0x10^5$	$4.2x10^5$	$4.1x10^5$

PG, play ground soil: WS, Well side soil: MP, Meeting Place soil: Cfu/gm = colony forming unit per gram.

Table 27: Occurrence and abundance of bacteriafrom the soil in the sampling Location

Bacteria	Occurrence			Abundance		
	PG	WS	MP	PG	WS	MP
Staphylococcus *sp*						
Enterococcus *sp*	+	+	+	10	8	5
Escherichia coli	-	-	-	-	-	-
Enterobacter *sp*	-	+	-	-	5	-
Pseudomonas *sp*	+	+	+	5	6	2

Key: PG; play ground soil; WS, well side; MP, Meeting place soil. + = Presence. - = absence

Table 28: Total fungi count from the soil in sampling location

Location	Fungal count in cfu/gm		
	Sample A	Sample B	Average
PG	4.0×10^3	4.0×10^3	4.0×10^3
WS	2.5×10^3	2.0×10^3	$2. \times 10^3$
MP	1.0×10^3	1.6×10^3	1.3×10^3

Key: PG, play ground soil: WS, Well side soil: MP, Meeting Place soil: Cfu/gm = colony forming unit per gram

Table 29: Occurrence and abundance of fungi from the soil in sampling location

Fungi	Occurrence			Abundance		
	PG	WS	MP	PG	WS	MP
Aspergillus niger	+	+	+	10	5	6
Penecillium	+	+	+	4	3	4
Microsporum sp	+	+	+	6	3	4
Mucor	+	+	+	3	2	3
Trichophyton sp	+	+	+	8	5	2

Key: PG; play ground soil; WS, well side; MP, Meeting place soil. += Presence. - = absence.

Table 30. Target bacteria isolated from water sample from the Fulani settlement

Bacterial isolates	cfu/ml at 10^7
Pseudomonas *sp*	40
Enterobacter *sp*	105
Klebsiella *sp*	23
Escherichia coli	78
Enterococcus *sp*	285

Cfu/ml= Colony forming unit per milliliter

4.5.5 Variations in fungi cultural types in sampling locations

In all the different sampling locations a total of five (5) distinct types of fungi belonging to five (5) genera were recovered with *Aspergillus niger* being the most dominant. (Table 29) Trichophyton *sp* showed strong presence in Play ground soil (PG) and Well side soil (WS) but could not dominate either. Microsporum *sp* also was present in significant numbers respectively. In the 3 locations sampled, *A. niger* was the most dominant although it was not the target. The different distinct types of fungi isolated from the soil in the sample area were statistically significant ($P<0.01$) for PG vs WS, PG vs MP and WS vs MP when tested on SPSS 16.0 software.

4.6 KNOWLEDGE AND BELIEFS ABOUT MICROBIAL AND PARASITIC INFECTIONS

4.6.1 Knowledge of microbial and parasitic infections

The results of knowledge of microbial and parasitic infections among nomads shows that majority of respondents were aware of common illnesses and their preventive measures. The nomadic Fulanis strongly believe in the use of local herbs. They believe that western drugs are adulterated and the efficacy reduced when compared to their herbs, which they say is pure and natural. The attitude of most mothers towards medical services is positive and relies on the efficacy of the drug to protect against disease. There was a poor attitude towards western medical care among respondents who believe that it is against their belief and religion. Decision making on treatment of a child lies predominantly on the father; and if any drug was rejected it was because of rumours, frequency of administration, non-payment of charges, and the priority accorded to it in preference to more severe diseases. Most respondents could identify the most common infections and diseases but could hardly differentiate if they were caused by microorganism or they were act of Almighty Allah or evil spirit. They attributed their spread to factors such as bad food, bad water, weather conditions, poor

environmental sanitation, inadequate parental care, poor hygiene, mosquito bites and insufficient food intake. A severe lack of knowledge regarding the causative agent of some infections was observed, and in many cases respondents attributed this to evil spirits, Inna [a feminine spirit] or other unscientific phenomena. The proportion of respondents that had heard of infections caused by microorganism was low, ranging from 6.5% in bush encampment 3 to 28.9% in bush encampment 5. Others were in between encampment 3 and 5. Knowledge related to treatment of infections varied, and most believe that it is the father who has the final say when it comes to administering treatment to family members. In most instances, the fathers hang onto their religion, and low level of exposure to take rational decision concerning microbial infection and drug administration. Although some youth leaders had a contrary view concerning drug administration some agree that awareness and lack of proper information has made them think and believe the way they do. Ranging from 1.6% of respondents in encampment 1, 3.5%, 2.9%, 6.0%, 5.1%, 4.3% and 3.3% in ascending order They believe that if a drug is taken more than once, then it is not effective, and that when compared to their local herbs the efficacy of western drug is low that is why they take it more times with repeated doses. A substantial proportion of respondents in the entire encampment wrongfully believed that administering more doses of western drug is harmful to a child, ranging from 12.6% in encampment 3 to 32.2% in encampment 6.

CHAPTER FIVE
DISCUSSIONS

5.1 BACTERIOLOGY

This study is a confirmation that various microbial and parasitic infections afflict nomads .A total of 1218 nomads were sampled in the study. Out of this number, 677(55.6%) individuals harboured various bacterial organisms, with high occurrence level. *Enterococcus* sp (30.3%) being the most prevalent followed by *Neisseria* sp (23.3%), *Enterobacter* (20.0%) and *Staphylococcus* sp (14.2%), while *Acinetobacter* sp (0.3%) was the least prevalent bacterial infection among nomads. This data therefore, could be useful in the formulation of health policies to enhance the health status of the nomads. The high prevalence of *Enterococcus* sp is probably because they are part of the normal intestinal flora of humans and animals and could also be traced to poor hygiene among herdsmen, lack of portable drinking water in their various bush encampments and indiscriminate defaecation of animal and humans around the home environments in the rainforest region of Nigeria. Although very few reports are available on this group of people in the rainforest area ,for the purpose of comparison, 28.6% prevalence for enterococci is high (Jin *et al.,* 2004). The genus *Enterococcus* includes more than 17 species but only a few cause clinical infections in humans (Amyes, 2007). With increasing resistance to antibiotics, enterococci are now feared nosocomial pathogens that can be difficult to treat. Infections commonly caused by *Enterococci* includes urinary tract infections, endocarditis, bacteremia, catheter related infections, wound infections and intra-abdominal and pelvic infections (Guardador *et al.,* 2006). Many infections originate from patient's intestinal flora and can spread to cause urinary tract infection, pleural space infections, skin and soft tissue infections. In general, the virulence of enterococci is lower than that of other organisms such as

Staphylococcus aureus (Baker and Silverton, 1985). The high occurrence of *Neisseria* sp suggests presence of gonorrhea infection, which is a sexually transmissible disease. The presence of *Neisseria* sp to the magnitude of 23.3% occurrence is alarming and strongly suggests that herdsmen are promiscuous and reckless in their sexual habits. Since the disease does not instantly manifest its symptoms, which includes excessive anal itching, anal bleeding and excessive discharge from both male and female sex organs, the population could be at risk of a major outbreak if left uncontrolled. These herdsmen, therefore, need sex education on the use of condoms during sexual intercourse or awareness on forms of preventive practices. Religious and/or cultural restrictions, however, forbid them from using condoms. Most of them are not circumcised especially their male counterpart. A safe way to prevent the spread of the disease or contact with it amongst the herdsmen is to advise them to have only one sexual partner. This may, however, be difficult because their religious beliefs approve of polygamy.

It was observed that the bush encampments of relatively richer nomads, with large herd of cattle had lower bacterial infection rates than the camps inhabited by individual nomads that are seemingly poor, with small herds of cattle. This is probably due to the fact that the rich nomads kept a clean environment around their homes or camps and subsequently process by-product extracts such as milk from the cattle in a more hygienic way than the poor nomads with a dirty environment around their individual household camps. The number of individuals affected by bacterial infections does not differ significantly between male and female, probably due to similarities in habits and lifestyle. Mobile clinics should be positioned around the bush encampments. Free medical treatments should be given to this special group of people. Gradual but consistent health related awareness campaign is needed so as to encourage the

herdsmen to patronize approved medical centres and change their mindset of depending on local herbal treatments whose acclaimed potency to cure diseases is very much in doubt.

5.2 DERMATOLOGICAL INFECTIONS

Ringworm is a common dermatophyte infection that constitutes an important public health problem among the human population worldwide, including Nigeria. The present study revealed that 37.6% of nomads sampled in Ebonyi Local Government Area of Ebonyi State were infected with species of superficial dermatophytes. This finding agrees with the work of Ogbonna *et al.* (1986) who observed that most school children examined among the nomadic Fulani in northern Nigeria were infected by ringworms. Elsewhere, Somorin *et al*. (1977) and Egere and Gugnani (1980) reported similar observation amongst primary school pupils in Toro local government area, Bauchi state. One of the greatest problems hindering the eradication and prevention of this infection is the presence of healthy asymptomatic dermatophyte carriers. Majority of the nomads examined herein showed no physical symptom of infection, yet samples collected from some of these asymptomatic nomads yielded significant growth of dermatophytes. This observation corroborates with the findings of Figueroa (1997) who found out that symptomatic carriers of dermatophytes may be equal to symptomatic sufferers. This should keep both parents and teachers at alert so that adequate preventive measures would be taken to reduce the rate at which these infections spread. The prevalence rate (37.6%) of infection observed in the present study is relatively high compared with the report of Ajao and Akintunde (1985) amongst children in Ile-Ife, Nigeria (14.02%) or that of Omar (2000) in Alexandria (7.4%) as well as Fathi and Al-Samarai (2000) in Iraq children (2.7%). The difference in environmental and climatic conditions of the areas studied may be partly responsible. Gender related studies on the

prevalence of superficial dermatophytes by Ogbonna *et al*. (1986), showed that more females than males were infected although there was imbalance in the population size of both sexes studied. However, the higher prevalence amongst females than males may be attributed to the fact that male children usually carry low hair cut while the females plait their hairs. Furthermore, females who plait their hair usually do not wash them daily while bathing while most males wash their hair with soap while bathing. This finding suggests that ringworm infection is related to personal hygiene and its prevalence can be reduced by adequate health education and good personal hygiene practices. Further observation of the distribution and prevalence of the isolates shows that *Trichophyton mentagrophytes* had the highest prevalence of 42.3%, this may have a direct relationship with the environmental conditions as reported by Figueroa 1997.

Higher prevalence of infection was found amongst children under the age of 10 than older ones, suggesting that ringworm is mainly a pre-pubertal disease. Other researchers, Figueroa (1997) in South-Western Ethiopia, as well as Omar (2000) in Alexandria have made similar observations. This can be explained by poorer hygiene at this age as well as the absence of saturated fatty acids that provide a natural protective mechanism (Fischer and Cook., 1998). Also the frequent sharing of clothes, towels, comb, brushes and caps and visit to village barbers whose unhygienic practices may lead to the transmission of infection from person to person should be discouraged. The frequency and severity of ringworm infection is likely to be linked to personal cleanliness. It seems that unclean nomads are the prime targets of this infection and they serve as the major source of transmission. In this study, most of the affected nomads, based on their personal appearance and clothing looked unclean and dirty. This uncleanness is attributed to the scarcity of water since the pond which most of the population depends on is always dry in the dry season. When questions were asked

about their bathing habits, we noted that most infected nomads seldom bath after their day's activities and some at times do not even take their bath on daily basis.

Poor infrastructure/houses contribute a lot to the contact with these dermatophytes. The origin of these dermatophytes could be the Nigerian environment (Ogbonna *et al.*, 1986). Also, the playing habits of these nomads always bring them in constant contact with the soil. The habits of accompanying their parents to the farm also bring children in close contact with the soil. Amuyunzu (1982) in East Africa observed that the habit of playing with animals brings the possibility of contacting these infections from animals. It is stated that poor personal hygiene is a reflection of a low level of education within the family. A high level of parental education may be an important contributing factor in lowering the prevalence of ringworm infections. Most children examined seldom had bath and the fungal spores once deposited on the skin from the soil have ample chance of germinating and colonizing the skin. Daily activities carried out by these people include playing in the soil, working in the farm and playing with animals. Parents should encourage their children take their bath at least twice a day or before going to bed. This calls for the need for regular bathing by parents in order to pass the hygiene habit to their children. Lack of information about the infection contributes a lot in the transmission of the disease. Some parents do not even know when their children are infected, and the measures to take when one person is infected to avoid the transmission from one person to the other. It was observed that infected children still share clothes and as well as share the same pillow while sleeping together. Nomads were seen playing around with animal pets. Cow, goats, sheep, rats and dogs are also sources of infection (Fathi and Al Samarai, 2000 and Ogbonna *et al.*, 1986).

In conclusion, this study throws some light on ringworm (tinea capitis and tinea corporis) among the population at risk. Not only undetected cases of ringworm were considered, but also identified carriers. The children diagnosed with the infection and their parents were not aware of the presence of the disease, hence the prevalence of the infection is underestimated. Moreover, the infected children represent a persistent and hidden source of infection both to their community, schools and house hold contacts. From this survey, there is need for routine regular inspection of children on health hygiene. The promotion of health education at home, personal and community hygiene practices and provision of good infrastructures both in schools and homes would provide an unconducive environment for dermatophytes, to thrive in. This will help identify the risk group and enhance early monitoring of the disease pattern, so that preventive and control measures can be established and modified as necessary.

5.3 PARASITOLOGICAL RESULTS

This study shows that 14 different parasite infections among the nomadic Fulanis,. These include ascariasis, hookworm infections, strongyloidiasis, trichuriasis, schistosomiasis, wucheriasis, enterobiasis, entaemobiasis, trypanosomiasis, malaria and mansonelliasis. These parasitic infections have been reported in various parts of Nigeria (Okafor, 1984; Onwuliri *et al* 1990; Ofoeze *et al.*, 1991; Alo *et al*., 1993, Anosike *et al.*, 1992; 2004, 2005). The presence of 14 parasitic infections among the nomadic Fulanis in the study area, supports the earlier observations that parasitic infections constitute a major public health problem in the country (Udonsi, 1986); Abanobi *et al.*, 1993; Edungbola, 1988; Anosike *et al.*, 1992). This observation agrees with the earlier report of Gandiri *et al.*, (2001) who encountered 8 parasitic species among school age Fulani children in parts of Adamawa State, Northern Nigeria. The existence of some parasitic infections such as malaria, schistosomiasis,

trypanosomiasis, wuchereriasis as well as mansonelliasis among nomadic Fulanis could be attributed to the peculiar ecological nature of the study area. This, as well could be related to the favourable breeding sites found in the area for the breeding of the respective arthropod vectors. Two things are, therefore, possible for this observation. First, it could be that the disease vectors are available in this part of the country. Second, the Fulani's might have acquired the infections in other areas during their herding and seasonal movement. Furthermore, the herdsmen usually dress in their native attire. This also exposes most parts of their body to insect bites. This behavioural pattern as reported by Anosike *et al.* (2004) pre-disposes them easily to insect bites. On the other hand, recovery of some of the intestinal parasites in this work indicates the level of hygienic practices exhibited by the nomads since these do not need intermediate hosts, except for *S. mansoni*. It is interesting to note that both the level of personal hygiene as well as the environmental sanitary conditions in the studied bush encampments is rather low. Both the nomads and their animals' defaecate indiscriminately as earlier documented (Anosike *et al.*, 2004). In addition, the recovery of *S.haematobium* ova in the study is an indication of infection acquired in the water logged swampy areas or infested water bodies during herding, (Anosike *et al.,* 1992, Ugbomoiko, 2000).

Several factors are responsible for the various prevalence rates of parasitic infections noted in this study. The high prevalence of Schistosomiasis in the area could be due to the inability of the herdsmen to wear rubber boots while herding along the river valleys where water contact could easily be made with infested intermediate host (Anosike *et al*., 1992). Consistent intake of untreated (unsafe pond) water could lead to infection by intestinal parasites such as *Ascaris,* hookworms and *Strongyloides*. On the other hand, exposure to bites of mosquitoes, culicoides, Chrysops and *Glossina* while

herding, could explain the presence of parasitic infection such as malaria, mansonelliasis, wuchereriasis as well as trypanosomiasis.

Although, 45.9% prevalence of parasitic infections was observed in the present study, this is comparatively higher than those of either Gandiri *et al.* (2001) in Adamawa State of Northern Nigeria (33.3%) or Anosike *et al.* (1992) in Bauchi State, Nigeria (8.2%). Such variation could be related to the local environmental factors of the various areas or the behavioral practices of the nomads concerned (Green, 1979). Observation on the prevalence of mansonelliasis in the sampled population revealed a moderately low prevalence rate of 7.5%. This corroborates the earlier findings of mansonelliasis amongst various ethnic groups (Allsop *et al.,* 1992, Anosike, 1996, Anosike *et al*., 2004, 2005). However, observations made on the status of mansonelliasis amongst the Ibo ethnic groups of Imo and Abia States of Nigeria (Anosike *et al.,* 1992) gave a higher prevalence value. Since the herdsmen move from place to place according to the availability of pasturage or food supply, the present result may be an underestimate of the real prevalence of mansonelliasis in this group of people. In contrast, the lower prevalence rate of mansonelliasis recorded herein could be related to genetic factors as it has been seen in diseases like malaria where the Fulani ethnic group had low prevalence rate (Allsop *et al*., 1992). The variation in the prevalence of the disease in the different bush encampments is as a result of the uneven distribution of environmental factors that favours the breeding of Culicoide vectors as well as the migratory pattern of the study subjects. One thing that appeared very conspicuous in the living pattern of the nomadic Fulani herdsmen was the situation/location of the bush encampments in Ebonyi State, Nigeria. These encampments were always located within two kilometers radius of a non-seasonal water supply source. It could be pond water, stream or river. Their living near a water

source was to satisfy all their domestic water needs. In contrast such water sources could as well serve as a major breeding site for various disease vectors affecting them. The proportions of male nomads infected were higher than female nomads infected. The reason for the sex differential observed herein remains quite unclear since both are equally exposed to the bites of the infective intermediate host (Culicoides) in the field during herding. It is also plausible that the lower prevalence in females may be the result of some biological factors and/or the dress code for Moslem women which leave less exposed skin on women than men. Amuyunze (1997) reported a similarity in lymphatic filariasis where unexplained hormonal effects (in addition to other factors) result in lower prevalence in females than males. This calls for further studies (especially biological) to clarify the factors responsible for the disparity in infection rates among sexes in endemic areas.

5.3.1 Filarial Studies

Observations made in the age-related status of mansonelliasis showed a diphasic pattern. Infection was significantly lower in persons below 25 years of age than subjects above 26 years of age. This observation is in conformity with the finding of Wijeyaratue *et al.* (1982) among the Fulanis, Maguzawa and Hausas ethnic groups of Kaduna State; among the Ibos of Imo and Abia States as well as the nomadic Fulanis of Northern Nigeria (Anosike *et al.*, 1992). They attributed to the increased contact between the older nomads and the transmitting vectors as a result of exposure during herding (Green, 1979).

One interesting observation in this study is the low rate of clinical signs/symptoms of mansonelliasis amongst nomads in this part of Nigeria. Although *M. perstans* has been viewed by some authors as an insignificant filarial parasite, a

causal association between this parasite and various clinical illnesses has been documented (Green, 1979).

In Nigeria, Anosike (1996) examined 152 cases of *M. perstans* infections among African workers and observed that 39 of them had clinical symptoms, such as abdominal or pectoral pains, aching limbs, tiredness and periodic itching; seven cases among these were severe and had developed oedema of the lower limbs or scrotum.

Although several similar signs have been reported in different parts of Nigeria, (Anosike *et al.,* 1992, Udonsi , 1986), the present study inclined more towards asymptomatic cases of infection similar to those reported in parts of Bauchi State (Anosike *et al.,* 1992), and in the Niger Delta region of Nigeria (Udonsi, 1986). This could explain why only 6 persons had clinical signs. It is, therefore, possible that different parasitic strains of *M. perstans* could be a major factor in the existence of both symptomatic and asymptomatic cases of mansonellasis in different parts of Nigeria and even among various ethnic groups. There is need for further research on this subject. Inclusion of treatment of Fulani herdsmen in this area should be encouraged in future health plan package by the local, State and Federal Governments.

5.3.2 Malaria Infection

The overall prevalence of malaria observed herein is quite low (10.6%) compared with other studies in Nigeria where prevalence of over 65% - 90% have been documented (WHO, 1996). Even studies carried out in the same geographical zones showed higher prevalence levels (Eneanya, 1998, Eneanya and Nwazelu, 2003 and Ukaonu, 2003).

One would have expected high prevalence of malaria amongst the nomadic Fulani herdsmen due to their occupational disposition. It is interesting to note that earlier studies on malaria in different parts of Africa and amongst various ethnic groups

showed that there is lower susceptibility to *P. falciparum* malaria amongst Fulani of Burkina Faso, This is associated with low frequencies of classic malaria resistance genes (Modiano *et al.,* 1996), Same was applicable in Eastern Senegal and in the Gambia where Bare *et al.* (1990) and Allsop *et al.* (1992) observed inter-ethnic genetic differentiation in malaria infection. These could explain the very low prevalence rates observed for malaria herein. In addition, their high awareness and the consistent use of bed nets by the herdsmen may complement this observation.

In most studies in Nigeria, *P. falciparum* was the only species reported (Bertan *et al*., 1999; Nwoke and Anosike 2000). Nevertheless, in a few other studies in Aboh Mbaise of Imo State, Udi Enugu State and Abuja, Nigeria, infection of only *P. falciparum* and *P. malariae* were reported (Ajezee, 1999, Eneanya and Nwazelu, 2003). In the same rainforest region of South Eastern Nigeria, most of these *Plasmodium* species have been reported though in varying proportions (Nwoke and Anosike, 2000; Ilo, 2004).

Thus, differences exist in the prevalence of plasmodium parasites as well as species composition especially within the same geographical region. This could be related to rapid modification or changes in the environment which provides favourable breeding sites for the mosquito vectors around living environments. A factor of great epidemiological significance in malaria transmission in Nigeria as observed herein is transhuman (a nomadic approach to cattle rearing) a practice which has been imposed by a combination of factors including climatic, ecological and economic ones. Thus, though 75% of the cattle in Nigeria are reared by the Fulani in the far North, the severe effects of lack of rainfall on the vegetation during the dry season necessitates a downward migration southward in search of greener pastures as well as water,and to reach the consumer markets. By so doing, they are bitten *en-route* herding movements

by mosquito vectors. The recovery of all the four *Plasmodium* species from nomads in this part of Nigeria is of great concern to epidemiologists and should be seen in the light of emerging and re-emerging parasitic diseases. Considering the fact that these nomads move from one country to another, and even within the same country, they move from endemic area to perhaps non-endemic areas. It is likely that untreated nomads with malaria acquired in an endemic area, traveled to Ebonyi State and subsequently transmit the disease to others. This could explain the observations in parts of Imo State (Anosike *et al.,* 2005). They noted higher prevalence of *P. malariae, P. vivax* than of *P. falciparum*. There is indication of re-emerging of *Plasmodium* species in this part of Nigeria.

The effect of congenital parasitaemia on infant haemoglobin (Hb) concentration is unclear. Up to the age of about 6 months infants are thought to be protected against malaria infection and illness by maternal antibodies transferred to them in *Utero* (Schgal *et al.,* 1989). Low concentrations of para-aminobenzoic acid in breast milk consumed during the first months of life and the presence of foetal haemoglobin (Hbf) have also been thought to prevent the development of *P. falciparum* parasites and to protect the infant from malarial infection and illness (Pasvol *et al.,* 1977). This could explain the low prevalence of malaria observed amongst nomads within the 1 – 5 years age bracket with no infected child below 3 years of age is of epidemiological significance. It is possible that infected mothers took traditional anti-malaria drugs during pregnancy as confirmed by the Fulani nursing mothers. *Plasmodium* parasitaemia in females aged 8 – 16 years was considerably lower than that in males of the same age. Similar findings were reported from a comprehensive study in Garki, Federal Capital Territory, Nigeria amongst two ethnic groups as well as in Ghanaian school Children (Langraf *et al.,* 1994).

Mass Chemotherapy, use of bed nets and early diagnosis to eliminate malaria infections have been proposed for rapid intervention (Anosike *et al.*, 2005). However, findings in the present study and those of others (Modiano *et al.*, 2001) indicate that improvements in the surrounding physical environments and sanitary infrastructure may be necessary for permanent solution of malaria problem amongst nomads. Although nomads in the study area were familiar with malaria as a major health problem few could not understand its association with mosquito bite. Health education amongst nomads in various encampments in this area is needed to clarify these issues and to bring about the necessary changes in behaviour.

One aspect of great worry observed is that there is no nomadic education in these bush encampments studied. The nomads made it clear that their children would not attend the same school available in most of the communities near their encampments due to social and religious reasons. However, they should be advised properly to enroll their children in nearby schools owned by other ethnic groups. Presently, nomadic education is not yet working in Ebonyi State as opposed to the situation in northern and central Nigeria. This, therefore, calls for sensitization and proper mobilization of the nomads on the need for early education of their wards. Consistent and persistent health education on the biological transmission pattern and life cycle of malaria parasite, prevention and control of this disease should be part of the health care package. There should be a change in their mode of dressing so as to prevent mosquito (or other insects) bites. It is, therefore, being advocated that there should be a regular treatment schedule by the Health Department of every local Government Area, where these nomads encamp. This would cover not only malarial infection but also other parasitic infections affecting them. This would help in combating all other diseases that may be carried into this part of the country. There

should be more collaboration between the Federal, State and Local governments to actualize the various proposed intervention strategies that will address the health needs of Fulani herdsmens and their family members.

5.3.3 Soil, Water and Air

The results obtained for the total bacterial counts ranged from 10^5-10^7 cfu/g of soil, and fell within the range reported by earlier workers (Okoh et al., 1999). This has made the soil a primary suspected source, since most of the target isolates were recovered from the soil. Expectedly, the total bacterial counts were generally higher than those of fungi, irrespective of sampling locations. The predominance of bacteria over fungi observed throughout the sampling time has been reported by other workers (Ferando et al., 1994; Ingham et al., 1989; Okoh et al., 1999). Differences in bacterial counts between the different samples were not significant. This finding corroborates that of Amir and Pineau (1989) and Okoh et al. (1999). The fungal counts in this study were in the range of 10^3-10^5 cfu/g of soil. These values also fell within the range reported by other worker (Amir and Pineau, 1998). This further gives the confirmation that most of the fungal infections may have been contacted through the soil. Species of Trichophyton and Microsporum were target isolate and were recovered in abundance. The non-significance of the differences between total fungal counts of the different samples, irrespective of sampling locations supports the finding of Fernando et al 1994). Amir and Pineau, (1998) reported that, among the topsoil they investigated, species of *Actinomycetes* were the most dominant.

Bacteria isolates recovered from the water samples, shows the possibility of heavy feacal contaminations. Enterococcus *sp* comprising members from feacal streptococcus and other intestinal bacteria originating from feaces of warm blooded animals may have found its way into the water. They were found in dominating

abundance. Although the herdsmen boil the water before consumption, we cannot guaranty the possibility of their children or wives or any one drinking these water directly from the well. Therefore this contaminated well water becomes another easy source of these infections. The isolates recovered from the air were not target organisms and could not offer scientific lead.

The outcome of this study has been able to show the possible sources of infections while examining the health status of the mobile Fulani herdsmen in Ebonyi State. Diverse types of bacteria and fungi were isolated from the soil and water samples collected from the Fulani bush encampments. These isolates were also recovered from the initial samples collected from these herdsmen and their children. Although samples were collected from different locations, the distinct types of bacteria and fungi isolated were generally similar, though occurring at different locations during the period of the study. The abundance of bacteria and fungi in this study were typical of environment with high availability of different bacteria species as found in the tropical environment of Ebonyi State. In additions to the implications of the presence of the target microorganisms, the frequency of contact with bare soil is a serious cause of concern. During soil sampling, these herdsmen were found sleeping on bare ground just with a thatched roof above their head. Some put leaves or mats which is barely enough to cover the area they are sleeping on. Although the results of this study would not be considered to be exhaustive, as it was done within the limits of facilities available in the laboratory, an insight into the ecological dynamics and distribution of culturable aerobic bacteria and fungi diversity has been elucidated. This is without prejudice to the possible influence which a substantial proportion of bacteria and fungi that are not culturable *in vitro* could have on the overall picture of event in the context of this work. Since the primary target isolates were recovered in abundance, replication and further

insight may be required in a different context. It would also require more modern technology (nuclei acid probes) to obtain such detailed overview of microbial diversity. This should be a subject of extension of this investigation in future. However, the scientific lead is the presence in abundance of the target isolates at different locations in soil samples which could possibly be concluded that a greater percentage of the infections came from the soil and contaminated well water. It could not have been a coincidence that bacteria isolate recovered from these herdsmen are now recovered in abundance from soil and water around them. This is a call for further investigation on these groups of people most especially in the tropical region for comparism of research informations.

5.4 KNOWLEDGE AND BELIEFS ABOUT MICROBIAL AND PARASITIC INFECTIONS

The majority of respondents were aware of common illnesses and their preventive measures; this group of people called the nomadic Fulanis, strongly believe in the use of local herbs. They believe that western drugs are adulterated and the efficacy reduced when compared to their herbs, which they say is pure and natural. The attitude of most mothers towards medical services is positive and relies on the efficacy of the drug to protect against disease; but in the overall, there was a poor attitude towards western medical care among respondents who believe that it is against their belief and religion; decision making on treatment of a child lies predominantly on the father; and if any drug was rejected it was because of rumours, frequency of administration, non-payment of charges, and the priority accorded to it in preference to more severe diseases. These data were used to form a comprehensive list of recommendations, to guide and address specific key issues. Most respondents could identify the most common infections and diseases but could hardly differentiate if they

were caused by microorganism or they were act of Almighty Allah or evil spirit. They attributed their spread to factors such as bad food, bad water, weather conditions, poor environmental sanitation, inadequate parental care, poor hygiene, mosquito bites and insufficient food intake. A severe lack of knowledge regarding the causative agent of some infections was observed, and in many cases respondents attributed this to evil spirits, Inna [a feminine spirit] or other unscientific phenomena. The proportion of respondents that had heard of infections caused by microorganism was low, ranging from 6.5% in bush encampment 3 to 28.9% in bush encampment 5. Others were in between encampment 3 and 5. Knowledge related to treatment of infections varied, and most believe that it is the father who has the final say when it comes to administering treatment to family members. In most instances, the fathers hang onto their religion, and low level of exposure to take rational decision concerning microbial infection and drug administration. Although some youth leaders had a contrary view concerning drug administration some agree that awareness and lack of proper information has made them think and believe the way they do. Ranging from 1.6% of respondents in encampment 1, 3.5%, 2.9%, 6.0%, 5.1%, 4.3% and 3.3% in ascending order They believe that if a drug is taken more than once, then it is not effective, and that when compared to their local herbs the efficacy of western drug is low that is why they take it more times with repeated doses. A substantial proportion of respondents in the entire encampment wrongfully believed that administering more doses of western drug is harmful to a child, ranging from 12.6% in encampment 3 to 32.2% in encampment 6

There must be an awareness campaign for the education of the nomadic Fulani on preventable diseases using appropriate channels of communication including their languages.Public health education messages should include the causes of microbial

infection, risk factors, transmission/spread, preventive strategies, side effects and contraindications of orthodox drugs.

All components of treatment and drug administration to the nomadic Fulanis should be free, including the cost of needles and syringes. The Federal Ministry of Health should conduct periodic health research to identify hindrances to the effective delivery of routine health care at household and community levels.

Further work on this research will be on seasonal prevalence and the Ecological dynamics of Microorganism in the Fulani encampments within the study area.

5.5 CONCLUSION

The out come of this study has been able to showcase the various health challenges faced by the nomadic Fulani herdsmen. This is the first time this study is being carried out in Ebonyi State. More of these studies will be required in Ebonyi State. There was an initial difficulty of creating awareness and getting ethical permission, the study was successfully concluded according to research design. This particular huddle will be faced by futher researchers. The results obtained in the study gave a scientific lead for researchers to follow. Seasonal infection pattern will be required as an extension of this study. Although the results of this study would not be considered to be exhaustive, as it was done within the limits of facilities available in the laboratory, an insight into the ecological dynamics and distribution of culturable aerobic bacteria and fungi diversity has been elucidated.

5.6 RECOMMENDATIONS

In the light of the findings in this study, the following recommendations are proposed:

1. Adequate and quality health education should be mounted in the various bush settlements in Ebonyi state in particular and in the entire rainforest area of Nigeria.
2. Regular health and sanitory inspection should be carried out among the Fulani herdsmen to ensure that they imbibe the doctrine of personal hygiene.
3. Herdsmen should be advised to ensure that their children maintain both personal and environmental hygiene in their various settlements.
4. Children playing with animals should be discouraged, especially if such are not adequately immunized against some infectious diseases.
5. Government should bring health care facilities near the various bush settlements by provision of mobile clinics or construction of health centres in rural areas.
6. Government can put in place sanitation incentives specially packaged for the Fulani communities as a way of encouragement and morale booster for the herdsmen.

5.7 CONTRIBUTION TO KNOWLEGDE

1. This study has shown that Fulani herdsmen in Ebonyi State, South Eastern Nigeria are afflicted with various microbial and parasitic infections which hitherto were unknown. The study has added to efforts to create a detailed epidemiological picture of microbial and parasitic infections among nomads in Nigeria.
2. The study has also shown the knowledge, attitude and perception of Fulani herdsmen about microbial and parasitic disease in particular their treatment seeking behaviours.

REFERENCES

Abanobi, O.C., Anosike, J.C. and Edungbola, L.D. (1993). Observations on the deworming effect of Mectizan on gastro-intestinal helminthes during Onchoceriasis mass treatment in Imo State, Nigeria. *The Nigeria Journal of Parasitology 14, 11 – 20.*

Abanobi, O.C., Edungbola, L.D. and Nwoke, B.E.B. (1994). Validity of leopard skin manifestation in community diagnosis of human Onchoceriasis infection. *Applied Parasitology 35(1):* 8-11.

Abbey, S. D., (1995). *Foundation in Medical Mycology*. 1st edition. pp. 65 – 83.

Abdel–Wahab, M. Farid., Gomal Esmat., Iman Ramzy., Shaker Naroz., Emam Medhat., Mohammed Ibrahim., Yasser El: Boracy., Strickland Thomas, G. (2000). The epidemiology of schistosomiasis in Egypt: Fayourn Governor ratate, *American Journal of Tropical Medicine and Hygiene 62(2):* 55 – 64.

Abiose, A., (1998). Onchocercali eye disease and the impact of Mectizan treatment. *Annals of Tropical Medical Parasitology 92 (Suppl (1):* S11 – S22.

Agi, P.I. (1995). Vessical schistosomiasis at Odaie village in Ahoada Local Government Area, Rivers State, Nigeria. *West African Journal of Medicine 4(1):* 6 – 10.

Ajao, A.O. and Akintunde, C. (1985). Studies on the prevalence of *Tinea capitis* infection in Ile-Ife, Nigeria. *Mycopathologia et Mycologia applicata 89:* 43 – 48.

Ajello, L. (1974). Natural history of the dermatophytes and related fungi M*ycopathologia et Mycologia applicata 53:* 93-110.

Ajezee, G.L. (1999). Prevalence of malaria infections in Aboh Mbaise of Imo State. *Journal of Applied Parasitology*. *37(2):* 105-122

Akogun, O.B. (1991). Filariasis in Gongola State, Nigeria: Clinical and parasitological studies in Mutum – Biyu District. *Angew Parasitology, 33:* 125 – 131

Akogun, O.B., Sambo, E.O. and Dakiru, B. (1994). Schistosomiasis among school children at Agro-Industrial Estate of Adamawa State, Nigeria. Abstract. *Nigeria Journal of Parasitology, 6:* 33

Akogun, O.B., Chessed, G. and Akaffi, D.E. (2001). Prevalence of Bancroftian Filariasis in two communities in Zing local government area of Taraba State. *Nigeria Society of Parasitology. 25 Annual conferences Abstract. No. 10*

Akogun, O.B. (1991). Epidemiology and socio-economic studies of filariasis in rural communities of Gongola State Nigeria. *Ph.D Thesis University of Jos, Nigeria.*

Akpor, O.B., Okoh, A.I., Babalola, G.O. (2006). Cultural microbial population dynamic dur ing decomposition of *Theobroma cacao* leaf litters in a tropical soil setting. *Journal of Biological Science, 6(4):* 768-774.

Akwelley, A., Crompton, P.W.T., Walters, D.E. and Arnold S.E. (1985). An investigation of the prevalence of intestinal parasites in pre-school children in Ghana *Parasitology 92:* 209–2 17.

Alexander, M. (1977). Introduction to Soil Microbiology, 2nd Edition, John Wiley and Sons Inc: New York. pp. 19 – 43.

Aldoory, Y. and Katter A. (1967). Further studies of fungal flora of the air in San Antonio. *Journal of Allergy, 40(3):* 145-150.

Al-Dooy, Y. (1968). The isolation of keratinophilic fungi from African soils *Mycopathologia et Mycology Applied, 36:* 113 -116.

Allsop, C.E.M., Harding R.M., Tayloys, C., Buncem, Kwait Kowski, D., Anstey, N., Brewster, D.M.C., Michael Aj Greenwood, B.M. and Hill A.Y. (1992).

Interethnic genetic differential in Africa: HLA class/ Antigens in the Gambia. *AM Journal Human Genetics, 50:* 411 – 421.

Alo, E.B., Anosike, J.C. and Danburan, J.B. (1993). A survey of Intestinal helminthes among students of post-primary institution in Adamawa State, Nigeria, *Applied Parasitology 34:* 161 – 167.

Amir, H. and Pineau R. (1998). Influence of plants and cropping on microbiological characteristics of some new Caledonian Ultramafic soils. *Australian Journal for Soil Research, 36(3): 457 – 470.*

Amuyunzu, M. (1997). Community perception regarding chronic filarial swelling. A case study of Daruma of coastal Kenya. *East African Medical Journal, 74:* 411 -415.

Amyes, S.G. (2007). *Enterococci* and *Streptococci .Int. J. Antimicrobial agent. 29(3):* 543-552.

Anderson, R.M. (1982). Transmission dynamics of *Ascaris lumbricoides* and the impact of chemotherapy in *Ascaris* and its prevention and control: *Parasitology*. *106:* 253 – 273.

Anderson, R.M. (1986). The population dynamics and epidemiology of intestinal nematode infections: Transactions of the *Royal Society of Tropical Medicine and Hygiene, 80:* 686 -689.

Anderson, R.M. (1989). The population dynamics and control of hookworm and roundworm infections. In: R.M. Anderson (Ed). Population dynamics of infectious diseases chapman and Hall. London, pp. 67 – 106.

Anderson, R.M. and May, R.M. (1985). Helminthes infections of Lumina. Mathematical models population dynamics, and control. *Advances in Parasitology 24:* 1 – 99.

Anderson, R.M. and Medley, G.F. (1989). Community control of Helminth Infections of many by mass selective chemotherapy. *Parasitology*. *80:* 629 – 660.

Anderson, T.J.C., Romero Abal, M.E. and Jacnike, I. (1993). Genetic structure and Epidemology of *Ascaris* population. Pattern of host affiliation in Guatemala. *Journal of Parasitology 107(3):* 319 – 334.

Ankri S, Stolarsky, T. and Mirelman D. (1998). Antisense inhibition of expression of cysteine proteinases does not affect Entemoeba histolytica cytopathic or heamphytic activity but inhibits phagolytosis. *Molecular Microbiology* .28: 777–785.

Anosike J.C., Nwoke B. E. B., Ajayi E.G., Onwuliri C.O.E., Okoro, O.U. and Oku, E.E. (2005). Lymphatic filariasis among the Ezza people of Ebonyi State, Eastern Nigeria, Agriculture Environmental and Medical Journal. *12:* 181 – 186.

Anosike J.C., Nwoke, B.E.B., Onwuliri C.O.E., Obukwu C.E., Owu A.F., Nwachukwu M.I., Ukagu, C.N., Uwaezuoke J.C., Udujrh O.S., Amajuoyi O.U., Nkem B.I. (2004). Prevalence of parasitic Diseases among nomadic Fulani of South-Eastern Nigeria. *Annal Agriculture Environment Medical 11:* 221-225.

Anosike J.C., Onwuliri, C.O.E., and Onwuliri, V.A. (2003). Human filariasis in Dass Local Government Area of Bauchi State Nigeria. *Tropical Ecology 44(2):* 215 – 225.

Anosike, J.C. (1988). Studies on epidemiology of human filariasis in parts of Bauchi State, Nigeria *M. Sc. Thesis Department of Zoology, University of Jos,* Nigeria 106pp.

Anosike, J. C. (1994a). The status of human filariasis in Northwestern zone of Bauchi State, Nigeria *Applied Parasitology, 35(2):* 133-140

Anosike, J.C. (1994b). Studies on human filariasis in Bauchi State, Nigeria. V. The distribution and prevalence of mansonelliasis with special reference to clinical signs. *Applied Parasitology*. *35(3):* 189 – 192.

Anosike, J.C. (1996). Studies on filariasis in some local Government Areas of Bauchi State, Nigeria; *PhD Thesis, Department of Zoology,* University of Jos, Nigeria, 327pp.

Anosike, J.C., Payne V.K., Amuta E.U., Akogun O.B., Adeiyongo, C.M., and Nwoke B. E. B. (1992). Observations on Mansonelliasis among the Ibos of Abia and Imo States, *A new Parasitology, 33:* 235 -241.

Anosike, J.C., Azoro, V.A., Nwoke, B.E.B., Keke, I.R., Okere A.N., Oku, E.E., Tony Njoku, R. F., Okoro O.U. and Nwosu, D.C. (2002). Drancunculiasis in the North Eastern border of Ebonyi State, South Eastern Nigeria.*International Journal for Hygiene and Environmental Health, 205 -217.*

Anosike, J.C., Nwoke B.E.B., Onwuliri, C.O.E., Duru, A.F., Nwachukwu M. I., Ukaga C. N., Uwaezuoke J.C., Udujih O. U. and Nkem, B.I. (2005). Prevalence of parasitic diseases among nomadic Fulanis South eastern Nigeria. *Agriculture Environmental and Medical Journal*. *11:* 221- 225.

Anosike, J.C., Nwoke, B.E.B., Njoku, A.J., Ogbulie, J.N., Alozie J.I. (1999). Endemicity of urinary schstosomiasis in North Central Zone of Abia State, Nigeria, Abstract. *Nigerian Journal of Parasitology*, *20:*126.

Anosike, J.C., Nwoko, B.E.B., Dozie, I.N.S., Thofem, U.A.R., Okere, A.N., Tony – Njoku R, Nwosu, D.C., Oguwuike, U.T., Ajayi E.G. (2003). Control of endemic dracunculiasis in Ebonyi State, South Eastern Nigeria, *International Journal for Hygiene and Environmental Health*. *206:* 1-6.

Anosike, J.C., Okafor, F.C. and Onwuliri,C.O.E. (1992). Urinary Schistosomiasis in Toro Local Government Area of Bauchi State, Nigeria, *Helminthologia 29:* 177 – 179.

Anosike, J.C., Dozie I.N.S., Onwuliri, C.O.E., Nwoke B.E.B. and Onwuliri V.A. (2004). Prevalence of *mansonella perstans* infections among the nomadic Fulani of Northern Nigeria. *Journal Community Health 16(2):* 40-47.

Anosike, J.C., Dozie I.N.S., Onwuliri, C.O.E., Nwoke B.E.B. and Onwuliri V.A. (2005). Prevalence of *mansonella perstans* infections amongs the nomadic Fulanis of Northern Nigeria. *Agriculture Environmental and Medical Journal 12:* 35 – 39.

Arene, F.O.I., Atu, F.N. (1986). *Mansonella perstans* microfilaria among the Bori community in Niger Delta area of Nigeria. *Annals Tropical Medicine Parasitology, 50:* 535 – 536.

Arene, F.O.I., Ukeibo, E.T. and Nwanze, E.A. (1989). Studies on schistosomiasis in the Niger Delta, *Schistosomia intecalatum* in the urban city of Port-Harcourt, Nigeria *Public Health Journal*, *103*: 295 – 301.

Aristizabal, H., Acevedo, J., and Botero, M. (1991). Fulminant amebic colitis, *World Journal Surgery*, *15:* 216 – 221

Armad Laboratories BIOTECH Patent News Publication. November 2000. Armad Laboratories Inc. Ca, USA

Awadzi, K., Opoku, N. O., Addy, E.T. (1995). The chemotherapy of Onchocerciasis XIX: The clinical and laboratory tolerance of high dose. *Tropical Medical Parasitology*. *46 (2):* 131 –13 7

Badaki, J.A. and Akogun, O.B. (2001). Acute lymphatic filariasis morbidity in central Nigeria. *Nigerian Society Parasitology 24th Annual Conference Abstracts.* No 3.

Baker, D.J.P. and Gilles, H.M. (1981). Epidemiology of infection, worldwide water and food borne infection. *International Medical Journal 1: 27.*

Baker, D.J.P. and Gilles, H.M. (1981). Epidemiology of infection. World wide water and food borne infection. *International Medical Journal. 92(1):* 74-78.

Baker, F.J. and Silverton, R.E. (1985). Introduction to Medical Laboratory Technology (6th ed.) Butterwort London, pp 906.

Baker, F.J. and Silverton, R.E. (1985). *Introduction to Medical Laboratory Technology (6th ed.) Butterwoths London. 616*pp.

Barnes, P.F., Decock, K.M., Reynolds, T. N. and Ralls, P.W. (1987). A comparison of amebic and pyogenic abscess of the liver. *Journal of Medicine 66:* 472- 483.

Basch, P.F. (1976). Intermediate host specificity in *Schistosoma mansonic, Experimental Parasitology Journal, 39:* 150 - 169.

Beaver, P.C. (1975). Biology of soil transmitted Helminths. The massive infection. *Talan University School of Public Health and Tropical Medicine, 4:117-155*

Beaver, P.C. (1970). Filariasis within microfilaraemia, *American Journal of Tropical Medicine and Hygiene, 19:* 181-189.

Behinke, J.M., Paul V. and Ragasekariah, G. (1986). The growth and migration of *Nector Americanus* following infection of neonatal hamsters *Trans Royal Society for Tropical Medicine and Hygiene, 80:* 146 – 169.

Belidi Mengue Rosa N., Ratard, R.C., Alessaridro, J, Rice., Belidi Mengue, Robert, Kouemeni, LT., Cline B.L. (1992). The impact of *schistosoma* infection and of

prariquantel treatment on the growth of primary school children in Bertona Cameroon, *Journal of Tropical Medicine and Hygiene 95: 401 – 409.*.

Bentan, W.P.M., Betten Hauser., V., Wunderlich, F., Van VLICH, E. and Moss Mann, H. (1991). Testosterone – induced abrogation of self-healing of malaria in Bio mice. Mediation by spleen cells. *Infection Immunology*. *59:* 4486 – 4490.

Bertan, L.C., Siani, A.C., and Krochta, J.M. (1999). The influence of inhibitory substances on treatment of Plasmodium related infections. *Royal Society of Tropical Medicine and Hygiene*. *107(3):* 48-60.

Blare, M, Sanchez – Mazas A., van B/yen Bargh, N.H., Sevin, A., Pison, G. and Langangy, A. (1990). Interethrive genetic differentiation, G.M polymorphism in Eastern Senegal *American Journal of Human Genetics 46: 383 – 392.*

Braga, L.L., Nnomiya. H., Mccoyjj. (1992). Inhibition of the complement members attach complex by the galactose –specific adhesion of *Entemoeba histolytica*. *Journal for clinical medicine, 90:* 1131 –1137

Braide, E.I., Ikpeme, B., Edet E., Atting, I., Ekpo, U.F, Adie, H. and Esu, B. (2000). Preliminary investigation of occurrence of lymphatic filariasis in Cross River State, Nigeria, *Nigeria Society Parasitology, 25th Annual Conference Abstract*. No.19.

Brown, K.R.and Shannon, A. (1998). Changes in the use of profile of Mectizan: 1987–1997. *Annals Tropical Medical parasitology 92* (Supplementary I): 561–564.

Bruce-Chwatt, L.J. (1958). Parasite Density index in Malaria. *Trans Royal Society for Tropical Medicine and Hygiene. 52: 389.*

Chai, W.G. (1993). Specificities of malaria parasite infections. Conference report: Joint meeting of the Society-for-glycobiology and Japanese-Society-for-carbohydrate research *14:* 1102-1108.

Chandler, A.C. and Read, C.P. (1961). Introduction to parasitology, 10th ed. Black well Scientific Publications Oxford, p. 946.

Cheesbrough, M. (1984). Medical laboratory Manual for Tropical Countries, Butter worth and Co. Ltd., *Vol. 2;* 604pp.

Cheesbrough, M. (1987). Revised Medical Laboratory Manual for Tropical Countries, Butter worth and Co. Ltd, *Vol. 3*. 715pp.

Cheesbrough, M. (2002). District Laboratory Practice in Tropical Countries, Butterworth and Company Limited pp 193-204.

Cook, R.G. (1990). Birds and parasites. *Journal of Experimental Psychology 18(1):* 354-363.

Cowan, S.T. and Steel K.J. (1974). Manual for the Identification of Medical Bacteria. (2^{nd} edition.) Publ. Cambridge University press, 465pp.

Eberhard, M.L. and Lammie, P.J. (1991). Influence of infection with non-filarial helminths on the specificity of serological assays. *Royal Society of Tropical Medicine and Hygiene*. *97(1):* 88-90.

Edungbola, L.A. (1988). Editional Parasitologists and the Challenges of the decade. The Nigerian *Journal of Parasitology 9 –11:* 1 – 2.

Egere, J.U. and Gugnani, H.G. (1980). Etiology of dermatophytosis in Eastern Nigeria. *Journal of Mycology*, *25:* 178 -181.

Ejezie G.C., Ezedinachi Enu., Usanga E.A., Gemade, E.I.I., Kpah, N.W. and Alaibe, A.A.A. (1991). Malaria and its treatment in rural villages of Aboh Mbaise, Imo State, Nigeria. *Acta Tropical 48:* 17 – 24.

Ejezie, G. C., (1979). The pattern of parasitic infection in villages of Lagos State, Nigeria. *Tropical Geography Medicine, 31:* 503 – 508.

Ejezie, G.C. (1981). The parasitic disease of School Children in Lagos State *Journal of Parasitology, 38:* 78 – 84.

Ejezie, G.C. (1991). The epidemiology and control of schistosomiasis in Africa. *The Nigeria Journal of Medicine 1:* 29 – 30.

Ekanem, E.E., Ejezie G.C. and Ecoma E.E. (1997). Diagnosis of schistosoma haematobium by Reagent strip among children with low intensity of infection in an endemic area, Nigeria. *Medical Journal 32(1):* 7 – 9.

Elowski, B.E. and Hary, R.J. (1996). International summit on coetaneous antifungal therapy focus on *Tinea Capitis*, Boston, Massachusett *Pediatric Dermatology Journal 13:* 69 – 77.

Eneanya, C.I. and Nwazelu M.C. (2003). Mapping response of *Plasmodium falciparum* to some anti – malarial drugs in Anambra State, Nigeria, *The Nigeria Journal Parasitology 24:* 47 – 52.

Eneanya, C.I. (1998). Seasonal variation in Malaria episodes among residents of Udi, a Semi-urban community in South-east, Nigeria. *The Nigeria Journal Parasitology*. *19:* 39 – 43

Ezeomah, C.A. (1983). The education of Nomadic people. *Journal of Negro Education, 52:* 43-51

Fathi, H.I. and AL-Samarai, A.G.M. (2000). Prevalence of *Tinea Capitis* among school children in Iraq. *Eastern Mediterranean Health Journal 6: 128 – 137.*

Fay, J., Ruiz, A., Sandchez–Vega, J. T., Romero – Gabello, R., Robert, L. and Becerril, M.A. (1995). Intestinal helminthiasis in the Mexican Republic, *Bolk-chi-Parasitology, 50(1-02): 10 – 16.*

Ferando, H.C., Amanda V., Wright, J.S. (1994). Tropical forest litter decomposition under seasonal drought nutrient release, fungi and bacteria. Oikos, *(70):* 183 – 190.

Figueroa, J.I. (1997). *Tinea Capitis* in south western Ethiopia: a study of risk factors for infection and carriage *International Journal of Dermatology 36: 661 – 666.*

Fisher, F. and Cook. N.B. (1998). Fundamentals of diagnostic mycology. *Mycopathologia*, *144 (2)*: 169.

Frey, D. (1970). Isolation of *Trichophyton soudanense* in Australia. *Australasian Journal of Dermatology, 11:* 50 – 57

Fuller, L.C., Child, F.J., Midgely, G., Hay, R.J., Haggins, E.M. (1997). A practical method for mycological diagnosis of *Tinea capitis* validation of the toothbrush technique. *Journal European Academic Dermatology, 9: 209.*

Gandiri, M.A., Kwalagbe, B.T., Gandiri, E.A. and Gadly, C. (2001). Prevalence of parasitic infections among school age Fulani children in Guduson, Gire Local Government Area of Adamawa State, Nigeria. The Nigerian *Society for Parasitology, 25th Annual Conference, Sept. 2nd, 5th 2001, Abstract No. 9.*

Gobar, S. Nabil; Tarek, Ahammad; Anwa orieby Eglal Shawkyi Mahmood A. Khahab; Strickland and Thomas G. (2000). Epidemiology of schistosomiasis in Egypt. MINYO Governorate. *American Journal of Tropical Medicine and Hygience. 62(2): 65 – 75.*

Green,R.F. (1979). Taking Western medicine to a nomadic people. *Transactions of the Royal Society for Tropical Medicine and Hygiene, 73(4): 361 – 364.*

Greenwood, R., Slack, P. (1998). Medical Microbiology*: A guide to microbial infections pathogenesis, immunity, laboratory, diagnosis and control. 15th edition, ELSB, 559 – 563.*

Guardado, R., Asensi, V., Torres, J.M. (2006). Post-surgical enterococcal meningitis; Clinical and epidemiological study of 20 cases, *Scand Journal of Infectious diseases, 38(8):* 584-588.

Haraldson, S.S.R. (1975). Socio-medical problems of nomad peoples in W. Hobson (ed*) Theory and practice of public health. Oxford University Press, London UN Toronto,* pp. 531 – 542.

Hay, R.J., Clayton, Y.M. De Silva, Midgley, G., Rosser, E. (1996). *Tinea capitis* in South Eastern London, a new pattern of infection with public health implication *British Journal Dermatology*. *311:* 60-84

Higgins, E.M., Fuller, L.C. and Smith, C.H. (2000). Guidelines for the management of *Tinea capitis*. *British Association of Dermatologists. 12:* 2-5.

Huston C.D. and Petri, W.A. Jr. (1998). The host pathogen interaction in Amebiasis is a vaccine feasible European *Journal Clinical Microbiology Infections. Discovery. 17:* 601 – 641.

Huston, C.D. and Petri W.A. Jr. (2006). Amebiasis in Rakel RE, ed. Conns current therapy, New York WB Saunders. pp 321-344

Iloh, B. (2004). Anaemia due to different species of *Plasmodium PhD Thesis, Imo State University, Owerri, Nigeria. 59-116*

Ingham E.R., Coleman D.C., Moore J.C. (1989). An analysis of food–web structure and function in a short grass prairie, a mountain meadow and a loge pole pine forest. *Biol. Ferti. Soils (8):* 29 –37.

Jin, G., Jeng, H.W., Bradford, H., Englande, A.J. (2004). Comparison of *E. coli*, *Enterococci* and feacal coliforms as indicators of brackish water quality assessment. *Water Environ Journal*. *76(3)*: 245-55.

Kate, B. (1982). *Trichuris trichuria* and its medical implications. *Journal of Tropical Medicine. 130(3):* 115-129.

Langraf, B., Kollanitech, Wiedermann, G., Wernsdorfer W. H. (1994). Parasite density of *Plasmodium falciparum* malaria in Ghanaian school children: evidence for influence of sex hormones .*Trans Royal Society for Tropical Medicine and Hygiene. 85:* 73 – 74.

Leaver, A.G. (1975). Vertebrate hard tissue. *British Journal of Oral Surgery*. *13(2):* 480-484.

Leeming, J.G. and Elliot, T.S.J. (1995). The emergence of *Trichophyton tonsurans, Tinea capitis* in Birmingham, *U.K. British Journal Dermatology, 133:* 929 – 931.

Lie, Becker A. and Stanley, S. L. (1988). Use of Chinese hamster ovary cells with altered glycosylation patterns to define the carbonhydrate specificity of *Entamoeba histolytica* adhesions. *Journal of Experimental Medicine, 167: 1725 – 1730.*

Loverde, P.I. and Clien, L. (1991). Schistosome female reproductive development. *Parasitology Today 7(3): 303 – 308*.

Mangesho, P.E., Mborera, L.E.G., Mali R.C. and Senkoro, K.P. (2005). Local knowledge, attitude, practice and behaviour on malaria among pastoral communities of ngorongoro crater Northern Tanzania. 20th Annual Joint Scientific Conference and Silver Jubilee of Tanzania *national institute for*

medical research Arusha International Conference Centre Abstract 25 March 1-4, 2005.

Modiano, D., Petrarca V., Siruma B.S., Nebie I., Diallo D., Esposisto F. and Colluzzi M. (1996). Different response to *Plasmodium falciparum* malaria in West African sympatric ethnic group. *National Academy of Sciences of the United States of America, 93:* 13206 – 13211.

Ngere, L. O. and Ndiranga, C.N. (2007). Trypanosomiasis among nomadic Kenya pastoralist. *Tropical Journal of Animal Science*. *8:* 115-121.

Nwadiaro, P.O. (2003). Incidence of dermatophyte infections among some occupational and selected groups in Jos. *African Journal of Clinical and Experimental Microbiology, 4:* 11-17.

Nwoke, B. E. B. (2004). Our Environment and emerging and re-emerging parasitic and infectious diseases. *Supreme publishers, Owerri Nigeria. 355pp.*

Nwoke, B.E.B. and Anosike, J.C. (2000). Lake abadaba parasitic disease project(1). A pre-development malaria survey. *Trans Royal Society Tropical Medicine Hygiene. 42: 99-104.*

Nwosu, A.B.C and Anya, A.O. (1981). Nutritional aspects of infections. *Royal Society of Tropical Medicine and Hygiene*. *80(5):* 697-705.

Ofoeze, I. E., Imoboe, A.M.A., Balogun, M.O., Ogunkoya, O.O. and Asaolu, S.O. (1991) A study of an outbreak of *schistosomiasis* in two resettlement villages near Abeokuta, Ogun State, Nigeria. *Journal of Helminths 65: 95 – 102.*

Ogbe, G.M. (1995). *Schistosoma haematobium*; A review of the relationship between prevalence, intensity and age. *The Nigeria Journal of Parasitology. 16: 39 – 46.*

Ogbonna, C.I.C., Enweani, I.B. and Ogun, S.C. (1986). The distribution of ringworm infections among Nigeria nomadic Fulani herdsmen. *Mycopatholigia 96:* 45 – 51.

Ogbule, J.N., Uwaezuoke, J.C. and Ogiehor S.I. (1998). Introductory Microbiology Practical 1st edition *Spring Field Publication, Owerri Nigeria,* 301pp.

Okafor, F.C., (1984). The Ecophysiology and Biology of the snail hosts of the *Schistosoma haematobium* with observations of the epidemiology of the disease in Anambra State, Nigeria. *Ph.D. Thesis, Universisty of Nigeria, Nsukka,* 287pp.

Okeachilam,T.C., Kilama, W.L. and Raniju, B.D. (1972). The clinical significance of malaria parasitaemia in children. *East Africa Medical Journal 49: 962 – 967.*

Okoh, L.A., Badejo, M.A., Nathaniesl I.T., Tian G. (1999). Studies on the bacteria,fungi and springtails (collembola) of an agroforestry arboretum in Nigeria. *Pedobio. (43):* 18: - 27.

Omar, A. (2000). Ringworm of scalp in primary school children in Alexandria: Infection and carriage. *Eastern Medical and Health Journal 6: 961 – 967.*

Onubuogu, U.V. (1978). A survey of the incidence of intestinal parasites among government workers in Lagos Nigeria. *West African Medical Journal 10(1):* 148-157.

Onwuliri, C. O. E. and Anosike, J.C. (1989). Filariasis in some parts of Bauchi State of Nigeria. In proc. Int. Epidemiol Assoc. Afr. Reg. Conf. WHO/TDR WORKSHOP, Zimbabwe, August, 1989.

Onwuliri, C.O.E., Akoh J.I., and Anosike, J.C. (1990). *Mansonella perstans* infection in the middle Hawai valley, Nigeria, *Nigerian Journal of Parasitology, 9-11:* 83 – 85.

Onwuliri, C.O.E., Nwoke, B.E.B., Lawal A.I. and Iwuala, M.O.E. (1989). Onchocereasis in Plateau State of Nigeria . The prevalence among residents, around the Assob River area. *Annal Medical Parasitology. 81:* 49 – 52.

Onwuliri, F. C., (1996). Mouth microorganism in Plateau State. Their Ecology and Physiology. PhD Thesis, Dept of Botany, University of Jos.

Onwuliri, F.C., Ogbonna, C.C. and Onwuliri, V.A. (1994). Isolation and identification of bacteria associated with deep seated abscess in patients within Jos metropolis Nigeria. *Journal of Innovations in Life science*, *14(1):* 187.

Pasvol, G., Weatherah, D.J. and Wilson, R.J.M. (1977). Effects of fetal hemoglobin on susceptibility of red cells to *Plasmodium falciparum. Nature Journal, 270:* 171 – 173.

Pelczar, M.J., Chan, E.C.S., Krieg, N.R. (1993). Microbiology: *Concept and Application* International edition McGraw-Hill, USA. pp 281-324.

Petri, D, Delgaty, K., Bhatt, R. and Garber, G. (1988). Clinical and Microbiological aspects of *Trichomonas vaginalis. Clinical Microbiological Review 11(2):* 200 – 317.

Quinn, T.C., Jacobs, R.F., Mertz, G.J., Hook, III and Locksley, R.M. (1982). Cogenital malaria: A report of four cases and review *Journal of Pediatrics 10: 101-120*

Schgal, V.M., Siddigm, W.A. and Alpers, M.P. (1989). A sero epidemiological study to evaluate the role of passive maternal immunity to malaria in infants *Transof the Royal Society Tropical Medicine and Hygiene. 88:* 105 – 106.

Seeley, H. W. and Van Demark, P.J. (1981). *Microbes in action. A laboratory manual of Microbiology.* 3rd EditionW.H Freeman and Company, U.S.A p. 350.

Service, M.W. (1980). *A Guide to medical Entomology, Basingstoke Macmillan Press London.* 405pp

Shulman, T.A., Satena, S., Nelson, J.M. and Furmanski, M. (1984). Neonatal exchange transfusion malaria. *Journal of Tropical Pediatrics 73:* 330 – 332.

Somorin, A.O., Nwabudike, I., Adetosoye, A. I. and Hunponusu, D.O. (1977). Dermatophytosis in school children. *Nigerian Journal of Paediatrics, 4: 38 – 42.*

Stephenson, L. S., Crompton, D.W.T., Katehem, M.C., Schulpen, T.W.T., Nesheim, M.C. and Jasen, A. A. J. (1980). Relationship between Ascaris infection and growth of Malnourished pre-school children in Kenya, *American Journal of Clinical Nutrition 33:* 1165 – 1172.

Stepheson, L. S., Lathan, M.C., Kuez, K.W., Kinoti, S.W. and Oduori, M.L. (1985). Urinary Iron loss and physical fitness of Kenyan children with Urinary Schistosomiasis. *American Journal of Tropical Medicine and Hygiene 34:* 322 – 330.

Taylor, K. L. (1995). Ascariasis of the kidney. *Pediatrics Pathology and Laboratory Medicine. 15(4):* 609 – 615.

Taylor, P., Chandiwana, S.K. and Matanhire, D. (1990). Evaluation of the reagent strip test for haematuria in the control of *Schistosoma haematobium infection in School Children Acta Tropical , 47:* 91 – 100.

Udonsi, J. K. (1984). Studies on the co-occurrence of two species of human hookworm in a riverine community in Nigeria, *Tropical Medicine and Parasitology 35*: 37 – 40.

Udonsi, J.K. (1985a). Determinants of endemic status of Hookworm infection in rural communities in Niger Delta, *Nigeria Journal of Parasitology, 6(2):* 113 – 120.

Udonsi, J.K. (1985b). Features of multiple intestinal nematodes infection in endemic area of the Niger Delta, *Nigerian Journal of Parasitology, 6 (1 and 2): 29 – 36.*

Udonsi, J.K. (1986). The status of filariasis in relation to clinical signs in endemic area of the Niger Delta, *Annals of Tropical Medical Parasitology, 80:* 425 – 432

Ugbomoiko, U.S. (2000). The prevalence, incidence and distribution of human urinary *Schistosmiasis* in Edo State, Nigeria. *Nigerian Journal of Parasitology. 21:* 3 – 14.

Ukaonu, G. (2003). Prevalence of malaria amongst newly admitted students of Imo State University Owerri, Nigeria, *M. Sc. Thesis Imo State University, Owerri, Nigeria 75pp.*

Uko, E.K., Emeribe, A.O. and Ejezie, G.C. (1997). Pattern of malaria parasitaemia in pregnancy in Calabar. *Journal of Medical Laboratory Sciences. 6:* 14-20.

Ukoli, F.M. A. and Asumu, D.I. (1979). Fresh water snails of the the proposed Federal Capital Territory in Nigeria, *Nigerian Journal Natural Science. 1(1):* 49 – 58.

Ukoli, N.M. (1992). Out from the river. *African Health Journal 14(1):* 27-35.

Villanizar, E., Mendez, M., Bonilla, E., Veron, H. and De-Onatra S., (1996). *Ascaris lumbricoides* infestation as a cause of intestinal obstruction, *Parasitology Journal 8:* 13-21.

Waite, J.H. and Nelson, I.L. (1995). The effects of hookworm disease on mental development of North Queensland School children 1919 (Classical article) *Journal of Nutrition 11 (1):* 59 – 61.

Wang, D.N., Warne, A and Serest, M. (2001). Microscopy and characterization of plasmodium species. *Journal of Biochemistry*. *469(1):* 105-115.

WHO (1973). Study group on the prevention of Blindness. *World Health Organization Technical Report Serv. No 518.*

WHO (1984). *Lymphatic Filariasis Technical Report Series. 702: 112 pp.*

WHO (1985). *WHO expert committee on the Control of Schistosomiasis, WHO Technical Report Series. 728: 1-113.*

WHO *(1986). WHO expert committee on Malaria Technical Report Series 735.*

WHO (1988). *Malaria diagnosis WHO (5) 575 – 594.*

WHO (1990a). *Practical Chemotherapy of malaria: Report of a WHO scientific group. Technical Report Series. 805 WHO (1992): Bench Aids for diagnosis of intestinal helminthes, World Health Organisation. 55: 807 – 818.*

WHO (1990b). *Tropical Disease:Progress in programmes,WHO, International research, 1988 – 1990 9th programme Report of the UNDP/World Bank, WHO special programme for research and Training in Tropical Diseases (TDR) 27 – 33.*

WHO (1991). *Basic Malaria Microscopy Geneva; World Health Organization* pp. 67 – 68.

WHO (1992). Lymphatic Filariasis: *Disease and its control. 5th Report of the World Health Organization export committee on filariasis Technical Report Series. 821.*

WHO (1993). *Implementation of the Global Malaria Control Strategy. Report of a WHO study group on the implementation study group on the implementation of the Global plan of Action for Malaria Control 1993 – 2000. WHO, Technical Report 839.*

WHO (1994). Lymphatic Filariasis*: Infection and Disease control strategy. Reports of a consultative meeting held at the University of Sains Malaysia.*

WHO (1996). *Vector Control for malaria and other mosquito –borne diseases. Report of a WHO Study Group. WHO Technical Report Series 857.*

Wijeyaratue, P.M., Verma, O.P., Singha, P., Oshor, P.C, Motha B., Saha, A.L., Slotboom, A.B., Peleion, A. and Bandipo, A.B. (1982). Epidemiology of filariasis in Malumfashi district of Northern Nigeria *Indian Journal of Medical Research. 76:* 534 -544.

APPENDIX A

TYPE AND COMPOSITION OF MEDIUM USED

1. Sabouraud Dextrose Agar composition.

(i)	Peptone	-	10g/l
(ii)	Glucose	-	40g/l
(iii)	Agar	-	15g/l

3. MacConkey Agar composition.

(i)	Peptone	-	17g/l
(ii)	Proteose peptone	-	3g/l
(iii)	Lactose	-	10g/l
(iv)	Bile salts	-	1.5g/l
(v)	Sodium chloride	-	5g/l
(vi)	Neutral red	-	0.03g/l
(vii)	Agar	-	13.5g/l

4. Plate Count Agar

(i)	Casein peptone	-	5g/l
(ii)	Yeast Extract	-	2.5g/l
(iii)	Glucose	-	1g/l
(iv)	Agar	-	15g/l

5. Cystein Lactose Electrolyte Deficiency Agar

(i)	Peptone	-	4g/l
(ii)	Lab lemco' powder	-	3g/l
(iii)	Tryptone	-	4g/l
(iv)	Lactose	-	10g/l
(v)	L- cystine	-	128g/l

(vi) Bromothymol blue - 20g/l

(vii) Agar no.1 - 15g/l

6. Nutrient Agar

(i) Peptone - 5g/l

(ii) Beef extract - 1.5g/l

(iii) Yeast extract - 1.5g/l

(iv) Agar - 15g/l

(v) Nacl - 5g/l

7. Blood Agar

(i) Proteose peotone - 15g/l

(ii) Liver extract - 2.5g/l

(iii) Yeast extract - 5g/l

(iv) Sodium chloride - 5g/l

(v) Agar - 15g/l

8. Chocolate Agar

(i) Pancreatic digest of casein 10g/l

(ii) Soy peptone - 3g/l

(iii) Animal tissue - 10g/l

(iv) Dextrose - 1g/l

(v) Yeast extract - 2g/l

(vi) Sodium chloride - 5g/l

(vii) Sodium bisulfate - 0.1g/l

(viii) Agar - 15g/l

(ix) Cofactor - 10mls

(x) Sheep blood - 45.5mls

APPENDIX B

QUESTIONNAIRE FOR KAP SURVEY

Questionnaires on Knowledge, Attitude and Perception (KAP) of Microbial Infections

(A)

Camp No:……
Sex :…….

Age:……

(B)

Have you heard of Microbial infections before? YES NO

Have you ever suffered any form of infections? YES NO

How old were you when you notice the infection?.....

How did you know that it was an infection?.....

……
Where you taken to the hospital for treatment? If Yes, why? If No, why?

……
Did you accept the diagnosis and medication from the hospital? If Yes, why? If No why?

……

(C)

What do you think are the possible causes of these infections?.....

What types of treatment do you accept for this infection? (a) Local (b) Hospital

If local treatment, why?

……

Have you ever taken prescribed medication from the hospital?.....

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Abstract	Over the years, nomadic Fulani herdsmen have established different settlement camps outside the traditional villages of their indigenous host communities in Ebonyi State. With increasing concerns about the health condition of the nomads, this study was undertaken to investigate the prevalence and distribution of some microbial and parasitic infections amongst the spartially distributed population of the nomadic Fulani herdsmen in Ebonyi State. This investigation was carried out between June 2005 and June 2007 using standard bacteriological, mycological and parasitological techniques. In addition, the knowledge, attitudes and perception of Fulani herdsmen about microbial and parasitic infections was studied using questionnaires. Out of 1218 samples taken from 7 bush encampments, 677 (55.6%) had various bacterial organisms with Enterococcus spp (21.3%) and Nesseria spp (19.5%) being predominant followed by Enterobacter sp (14.6%) Staphylococci (10.6%) while the least was Acinetobacter sp (0.14%). Out of 280 persons examined for dermatophytes infections, 59(21.1%) were infected with ringworm of the scalp being most predominant. Although the prevalence varied amongst age and sex, both male and female within age bracket of 11-15 years were significantly infected than other age categories ($P<0.05$). *Microsporum spp* and *Trichophyton* spp were the most predominant isolates. Two (2) species of *Microsporum*, namely *M. audouinii*, (35.1%) and *M. canis* (28.0%) and four (4) species of *Trichophyton*, namely *T. mentagrophytes, T. quickenum, T. soudanense and T. schoenleini* were isolated. Infections decreased with increase in age. Out of 573 samples examined for parasitic infections a total of 263 were positive with an overall prevalence of 45.9%. *Plasmodium sp* 61(10.6%) and *Schistosoma haematobium* 48(8.4%) showed the highest prevalence; the least prevalent was *Trypanosoma* sp (0.7%). Distribution of these infections varied significantly amongst bush encampments, sex and age group. Out of the four (4) human *Plasmodium* species encountered, *P. falciparum* was significantly higher than others ($P<0.05$). The results of filarial studies showed *Onchocerca volvulus* (3.8%), *Mansonella* sp (2.8%) and *Wuchereria bancrofti* (2.4%) in decending order of prevalence.Among the nomads that participated in the Knowledge, attitude and perception survey, 82% displayed total lack of knowledge about the cause of microbial infection. The proportion that accepted western medication was very low (6.5%). Poor infrastructures, lifestyle

	and beliefs, low personal hygiene by the Fulani's are contributing factors to the high frequency and severity of these infections in the area. Adequate and quality education campaign should be carried out in the various bush encampments in Ebonyi State.