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DERMATOPHYTE INFECTIONS AMONG PRIMARY SCHOOL CHILDREN IN KIBERA, NAIROBI, KENYA.

BY

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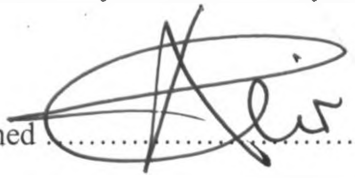
DECLARATION

I, Angeline Chepchirchir, hereby declare that all the work submitted is original except where otherwise acknowledged and it has not been presented either wholly or in part to this or any other university for the award of any degree.



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APPROVAL BY SUPERVISORS

This is to certify that this is bonafide research work carried out independently by Angeline Chepchirchir under our guidance and supervision.

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This is to certify that this study was registered and carried out under the department of medical microbiology. The results have been analyzed and document forwarded as proof of work done leading to an award of a master's degree.

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DEDICATION

This work is dedicated to my family: Gideon and our children; Allan and Daisy for their patience and encouragement during the course of this work.

Also, to my parents Magdalena and Martha who endeavored to educate me in my formative years and for not giving up even in the most trying moments.

May the Almighty God bless you all.

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LIST OF ABBREVIATIONS.

E	Epidermophyton
KEMRI	Kenya Medical Research Institute
KOH	Potassium hydroxide
M	Microsporum
SDA	Saboraouds Dextrose Agar.
T	Trichophyton.

OPERATIONAL DEFINITIONS.

Hyphae: Thread like structures which plays active uptake of nourishment from host's environment.

Mycelia: A collective weft of hyphae

Kerion: Suppurative ringworm lesion

Onychomycosis: Fungal infection of the toe nails

Tinea capitis: Fungal infection of the scalp

Tinea unguium: Fungal infection of finger nails.

Tinea cruris: Fungal infection of perineal areas.

Tinea barbae: Fungal infection of the beard.

Tinea corporis: Fungal infection of the body excluding beard and cruris.

Epidermophyton: A genus of dermatophyte characterized by thick walled and stout macro conidia only. It does not posses micro conidia.

Microsporum: A genus of dermatophyte which possesses both macro and micro conidia. Its macro conidia have rough surfaces.

Trichophyton: A genus of dermatophyte which possesses both macro and micro conidia. Its macro conidia have smooth walls.

Dermatophyte: A specialized type of pathogenic fungi that infects the keratinized tissues of the body.

Conidia reproductive form of dermatophyte

Alopecia: loss of hair especially of the scalp resulting in baldedness.

Abstract

Study objective was to determine the prevalence and etiology of dermatophyte infections and establish the relationship between type of infection and age and gender of the primary school children in Kibera during the period between September 2006 and January 2007.

Study design, was a cross- sectional descriptive study that focused on the prevalence, distribution and species differentiation of the causative agents of dermatophytosis in city council sponsored primary schools in Kibera, Nairobi.

The setting. The study was conducted in Kibera, the largest of the informal settlements within the capital city, Nairobi which is home to between 700-1,000,000 inhabitants.

Subjects. The study targeted primary school children from the ages of 5 years to 15 years from four government sponsored primary schools namely Olympic, Kibera, Ayany and Mbagathi Way. A sample of 424 pupils was selected from a population of 8904 pupils in the four schools.

Materials and Methods. The pupils responded to questions from a structured questionnaire that was prepared to elicit socio economic and demographic data from the participants. Physical examination was carried out on every participant to determine presence of skin infection. Photography was done for those with skin lesions and specimens collected from the infected sites. The specimens were processed in the mycology laboratory to determine the etiological agents of the skin infections.

Results. From the participants, 11.2% had ringworm infection with *tinea capitis* being the commonest type while the grey patch type was the dominant clinical manifestation.

The distribution of ringworm among schools was statistically significant with Olympic primary school registering the highest ratio of those infected to those not infected.

(P=0.001).

Both male and female pupils within the age bracket of 6-8 years were significantly infected than other age categories. Infection rate decreased with increase in age.
(P= 0.002)

Gender related prevalence was statistically significant with girls registering more infections than boys in their categories. (P=0.033)
All the three genera of fungi associated with dermatophytes were isolated with a number of species namely *T. violecium* (35), *T. mentagrophytes*(3), *T.* terestre(3), *T. schoenleinii*(2), and *T.interdigitale*(1), *M.canis*(2), *M .equinum*(1), *E. flocossum*(1).
T. violecium was the predominant species isolated, at (35)71% followed by *T. mentagrophytes and T. terrestre* at (3)6% each.

Conclusion: The study shows a high prevalence of 11.2% dermatophyte infection among the school children in this locality. Contributing factors to the high frequency and chronic occurrences of ring worm in this area include poor living environment, children interaction patterns and poor health seeking behaviour. There is need for health education to create awareness among the communities in urban informal settlements to seek treatment and improve on hygiene to reduce the prevalence of these infections.

CHAPTER ONE

1.1 Introduction.

Dermatological problems manifesting as primary and secondary cutaneous complaints, constitute at least 30% of all outpatient visits to a pediatrician [1]. In pediatric dermatology, fungal infections of the skin and scalp represent a relatively common problem especially in the tropical and subtropical regions of the world where the warm and humid climates provide a favorable environment for fungi causing superficial mycoses [2]

Tinea capitis is the most common type of dermatophytosis among children aged between six months and pre-pubertal age. Some individuals' manifest with symptoms while others remain asymptomatic. The lack of symptoms in some cases means that the infected individual remain untreated and become reservoirs of infection in close association with the uninfected population.[3, 4]

Ringworm infection is not a notifiable disease but is a cause for concern because of its contagious nature. It can be transmitted through body contacts (person to person) especially in crowded settings or via inanimate objects like cloths, combs or hairdresser equipment.[5]

Children are vulnerable because of inadequate amounts of inhibitory fatty acids usually produced by an adult's skin. This makes them highly predisposed to dermatophyte infections. Children's interaction patterns too, increases the risks of acquiring the infections through contact. Poor living conditions marked by poor; sanitation, housing (congestion), limited water supply as well as limited economic power heightens the possibility of acquiring and harboring such infections. Children living in informal settlements are more at risk to such skin diseases spread through contact as a result of living environment and overcrowding both in school and at home.

Dermatophytosis inflicts a lot of psychosocial trauma due to attached social stigma, ulceration, and sometimes irritation which hampers pupil's attention in class as well as representing a potential source of secondary bacterial infection.

It is not generally appreciated how disabling a skin disease can be since an apparent trivial rash to the observer may be a source of intense discomfort to the sufferer. Children are more sensitive to scorning and stigma from others.[6]

Superficial mycoses have neither been the focus of intensive study nor of active control programs in the sub-Saharan Africa, including Kenya. The neglect is probably due to the fact that fungal diseases of healthy humans tend to be relatively benign[2]. Consequently, there is paucity of information on the epidemiology of superficial mycoses in Kenya and this lack of scientific information has negatively affected provision of adequate patient management, diagnosis, control programmes and antifungal drug resistance surveillance. Despite the socio-economical improvement in many parts of Kenya, and the efficacy of available antifungal treatment, superficial mycoses remain a common public health problem and a challenge in dermatological practice.

1.2 LITERATURE REVIEW.

Background Information

The skin is the interface between the human body and the environment and serves many functions crucial to survival such as protection against harmful elements and thermoregulation. The psychosocial roles the skin and its appendages play are crucial in ones appearance. Skin infections are becoming increasingly common with fungal infections leading with a prevalence of 81.1 per 1000 in united states.[7]

Ringworm infection medically known as dermatophytosis is caused by a highly specialized group of fungi that affects the keratinized tissues of the body including skin, hair and nails of both human and animals. It is the most common superficial type of infection worldwide. It occurs more commonly in children than adults. It is highly contagious and represents a significant public health problem among school children. [8,9]

Dermatophyte infection is only restricted within keratin layers of the skin because of the serum fungal inhibitory factor that protects living tissue against deep penetration of fungal elements.[10,11]

When dermatophytes invade the superficial layer of the skin, it elaborates an enzyme that enables them to digest keratin, causing the superficial skin to scale and disintegrate, the nails to crumble and the hairs to break off.[8,12,13]

The classic presentation of tinea infection, known as "ringworm," is one or many lesions with central clearing surrounded by an advancing, red, scaly, elevated border. Inflammation assists in colonization and may result in vesicles on the border of the affected area. Atopic persons and those infected with zoophilic fungi tend to have more inflammatory reactions [14]

Dermatophytes may become invasive in immune-compromised individuals causing what is known as majocchis granuloma following invasion into the dermis through a ruptured hair follicle.[13]

The vulnerability of certain topographical regions or certain structures of the skin to various fungi has resulted in clinical classification of superficial fungal diseases i.e. tinea capitis (scalp), tinea corporis (smooth skin), tinea pedis (feet), tinea manuum (hands), onychomycosis (nails), tinea cruris (groin) and tinea barbae (male beard).[14]

The three genera responsible for dermatophytoses are Microsporum, Trichophyton and Epidermophyton. Epidermophyton infects the nails but not the hairs. Microsporum seldom invades the nails while Trichophyton affects skin, nails and hairs.[15]

There are many species of dermatophytes within the three genera which are divided epidemiologically into three groups i.e. anthropophilic, zoophilic and geophilic.[15]
Each species of dermatophytes tends to produce its own clinical manifestations, although several species may provoke similar clinical condition. Sometimes the

clinical manifestation is so distinctively typical and characteristic that the species may be identified from the clinical findings.[10,14,16]

Although the distribution of dermatophytes throughout the world varies from one region to another, this is a dynamic process subject to change, as one species tends to disappear from an area to be supplanted by another.[15]

In the host tissue, the filamentous hyphae of dermatophytes segment into chains of contagious arthrospores which are responsible for contagion and the spread of infections. On infecting the tissue, the spores germinate into hyphae, spreading along the outer epidermis invading hair follicles. Some species have the ability to penetrate the hair shaft within the follicle and spread down against the directions of hair growth until the living tissue of hair bulb arrests further penetration. In an anagen follicle, the fungus may invade newly formed hair indefinitely, perpetuating the infection until the follicle goes into the telogen or resting phase. Subsequently shedding off the telogen hair spontaneously "Cures" the infection in the follicle.[9]

Growth of the hair in an infected follicle passively carries the fungus back to the skin surface and beyond. If the infected shaft is weakened, it may break, providing a source of potentially infectious material. In some species, the arthrospores are formed outside the hair shaft in the infected follicle (ectothrix infection) while others form inside the hair shaft (endothrix infection).[9,15]

Dermatophytes produce spores both sexually and asexually which are rarely seen readily in the infected skin scrapings, hair or nails unless after specimen has been treated with KOH which digests the keratin and loosens the spores if present.[17]

Invasive dermatophyte infections present with fluctuant and non fluctuant dusky, hemorrhagic nodules. The lesions may be tender and found in areas where infections usually occur; the feet, the lower legs and buttocks. Most patients with invasive tinea have onychomycosis.[13]

Recurrent acute infections can lead to chronic infection. Infected toe nails are difficult to treat since the focus is difficult to eradicate. The species of fungus influences the response to therapy.[11]

In the tropics, multiple fungal infections in the same patient are extremely common. The finding of one clinical variety should prompt a search in other parts of the body which are often involved.[15]

Poor nutrition and hygiene, tropical climate, debilitating diseases and contact with infected animals, persons or fomites all increase the likelihood of acquiring a fungal infection. No known protective immunity following primary infection has been documented.[10]

Chronic cutaneous fungal infection occurs in approximately 20% of the population, with more than 90% of the male population being afflicted by one type of fungal infection at least at some point in life.[15]

Superficial diseases of the skin, hair, nails and the mucus membranes are the most common of all fungal infections with a worldwide distribution though some are endemic to specific geographical regions due to climatic conditions.

The three genera of dermatophytes are recognized by the nature of their macro and micro conidia (asexual spores). There are about forty species recognized whose mycological

classifications is as follows: [18]

Anthropophilic ;

- T. *rubrum* (most common in New Zealand)
- T. *interdigitale*
- T. *tonsurans* (very common in the USA)
- T. *violaceum*
- T. *schoenleinii*
- T. *megninii*

- T. *soudanense*
- T. *yaoundei*
- M. *audouinii*
- M. *ferrugineum*

Zoophilic;

- T. *equinum* (associated with horses)
- T. *erinacei* (associated with hedgehogs and other animals)
- T. *mentagrophytes*(associated with rodents)
- T. *verrucosum* (associated with cattle)
- M. *nanum* (associated with pigs)
- M. *distortum* (a variant of *M. canis*).
- M. *canis* (associated with cats and dogs)

Geophilic;

- M. *gypseum*
- M. *fulvum*
- M. *boullardi*

Reservoirs of dermatophytes include man and animals like dogs, cats, cattle as well as soil. Incubation period for scalp and body infections is 10-14 and 4-10 days respectively. The period of contagion is marked by the presence of lesions and viable spores that persist on contaminated materials.[19]

Dermatophyte infections are classified according to the affected body site, such as tinea capitis (scalp), tinea barbae (beard area), tinea corporis (skin other than bearded area, scalp, groin, hands or feet*), tinea cruris* (groin and perinea areas), tinea pedis (feet), tinea manuum (hands) and tinea unguium (nails)[20]

Tinea capitis is the most common dermatophyte infection in children with a higher incidence among urban African children. Approximately 95% of cases occur in pre-adolescent children similar to occurrence of tinea corporis.[21]

Different factors play a role in higher incidence of dermatophytosis in the tropics and sub tropics. The predisposing factors are poor nutrition, debilitating diseases, overcrowding, deficient hygienic facilities and in rural areas the

proximity to infected animals. Poor living conditions commonly found in developing countries are often favorable to fungal infection.[22]

Improvements in the standard of living resulting from the industrialization of Britain were accompanied by a fall in the incidence of most infectious diseases brought about by better nutrition, improved living conditions and hygienic measures. Because of poor standards of living, most forms of infectious diseases including those of the skin are now more common in the third world than in western countries.[22]

The incidence of superficial mycoses is related directly to factors that affect the degree of exposure to the causal fungi e.g. living conditions, animal contacts and recreational activities. Infections are spread through direct or indirect contact with an infected individual or animal.

Pathophysiology of dermatophytes infections

Dermatophytes invade keratin by enzymatic digestion and mechanical pressure producing lesions which vary according to the site of the infection and species of fungus involved. Sometimes there is only dry scaling (hyperkeratosis) but commonly there is irritation, erythema, edema and some vesiculation. Sporadic inflammatory lesions with weeping vesicles, pustules and ulceration are usually caused by zoophilic species.[18]

Following infection by spores, the dermatophyte proliferates in the stratum corneum. For tinea capitis, hyphae penetrate the surrounding hair follicles and infect the keratinized portion of the hair shaft, causing shaft weakening and breakage. The residual fragment of hair may be seen as a black dot.[21]

Clinical presentation varies with the type of the infecting agent. Some will produce well circumscribed, single patches of scaly alopecia while others present with diffuse fine scaling which may be difficult to detect unless scalp is gently scratched. Strong inflammatory response results in development of perifolicullar pustules or a kerion which is a boggy, tender, inflammatory mass.[18]

Tinea capitis may be accompanied by a pruritic, papular eruption on the face, neck and trunk known as an id reaction which represents hypersensitivity to fungal allergens

Differential diagnoses for tinea capitis include dandruff, seborrheic dermatitis and atopic dermatitis.

Glabrous skin dermatomycoses presents with one or more circumscribed, erythematous, annular plagues. A tinea corporis lesion starts as a small papule or plague that expands outwardly with a raised ring of scale at the leading edge. Differential diagnoses include eczema, psoriasis, atopic dermatitis and *pityriasis rosea*; these lesions may be extensive in immune compromised people.[18]

Tinea faciei occur in children of all ages including infants. Sources of infection include the mother's breast in a nursing child. It is also associated with tinea capitis.

Tinea pedis is not common in young children but occurs increasingly after puberty. It may be asymptomatic or pruritic. Scaling and erythema in lateral toe web space is common. Another form caused by *T. rubrum* is characterized by dry hyperkeratotic erythematous scaling of dorsal and lateral aspects of the feet often referred to as moccasin type tinea pedis.[21]

Tinea cruris is less common on children before puberty. It occurs relatively frequently among adolescent boys. It presents with symmetric, erythematous scaling on the upper inner thighs and in the inguinal creases. The scaling is more prominent along the peripheral border. Associated tinea pedis should be sought. Chronic onychomycosis can serve as a reservoir for infection.[21]

Tinea unguium becomes common after puberty. The most common pattern involves the thickening and yellowing of the distal aspect of the finger or toe nail.[21]

Treatment of Superficial Fungal Infections[23]

Localized ringworm of the body or flexures is treated with topical antifungal creams Clotrimazole, Miconazole, Terbinafine or Amonifine applied three times daily for 1 to 2 weeks.

Widespread infection requires oral antifungal therapy. Itraconazole (100 mg daily) and terbinafine (250 mg daily) are the most effective drugs used for periods of 1 to 2 weeks but currently licensed for adults only.

Systemic antifungal therapy is required for *tinea capitis* since topical agents are not adequate. Micro size griseofulvin is given in a dose of 20-25 mg/kg/day orally twice daily for 6-8 weeks.

A shampoo with an antifungal agent may be used in cleaning the hair twice to three times in a week so as to reduce the communicability of the infection.

Tinea unguium of the toe nails is the most resistant to treatment. It is associated with longstanding fungal infection of the feet. It is treated with griseofulvin for six months to one year or Itraconazole 100mg daily, or 200mg twice daily for 1 week per month pulsed therapy or terbinafine (250mg daily) given for three months will cure up to 80% of the cases.[24]

If a fungal skin infection has secondary bacterial infection then the patient requires systemic antibiotics added to antifungal treatment.[25]

Infected areas should be kept clean and dry so as to thwart further fungal growth and promote skin healing. [25]However recurrence rate remains high. [26]

Complications of dermatophyte infections.

Complications of dermatophytoses are rare if infection is diagnosed early and treated. Kerion formation may result following chronic untreated scalp infection. Secondary bacterial infection may also result and eventually permanent scarring is seen on recovery. Dermatophyte infection of the scalp may spread to other body parts if it remains untreated.

Epidemics may arise in schools if infected pupils are not treated to contain the infection.

Destruction of the nail matrix in chronic infections may result in permanent loss of the finger and toe nails.[13]

Control and preventive measures

There are several control measures of dermatophyte infections .[19] which include:

1. Investigation of contacts and source of infection.
2. Children should be assessed for dermatophyte infections before being enrolled into class .suspected cases should be treated to curb spread of the infection.
3. Education of the public, especially parents on the danger of acquiring infection from children infected and from animals.
4. Isolation of infected children from using public facilities i.e. swimming pools that predispose others to infection.
5. Specific treatment for the type of infection.
6. Proper laundering of towels and clothing.

Overview of other epidemiological studies.

Europe:

In a study carried out in Greece during 1996-2000 period, 1045 children less than 13 years old were examined for suspected dermatophytoses. In 611 cases fungi were isolated. Male children were mainly affected on the scalp and body area. Girls were more affected in the location of the arms and legs. There were a greater proportion of cases in the age range 2-12 years. The most prominent fungal agent was *M. canis* (515 cases) followed by *T. rubrum* (34). Tinea capitis (280 cases) mainly caused by *M. canis* (276 cases) was the most common clinical form. Tinea corporis (109 cases) mainly caused by *M. canis* (88 cases), while *T. rubrum* (seven cases) was the second most frequent clinical form.[26]

In Spain, 1997, a prospective study aimed at detecting dermatophytes on the scalp was undertaken in 5000 unselected school children aged between 3 and 16 years (mean age 8.34 years, SD +/- 3.83). Thirty-two (0.64%) had dermatophytes in the scalp, 22. (0.44%) had tinea capitis and 10 were asymptomatic scalp carriers. Approximately 33% of the patients with tinea capitis and 60% of the asymptomatic scalp carriers also had ringworm in other body sites. There were a significantly higher proportion of cases of tinea capitis

(P < 0.001) particularly due to *T. tonsurans*, (P < 0.001) and of cases of asymptomatic scalp carriers (P < 0.05) (particularly due to *T. tonsurans*, (P < 0.001) in the immigrant population of African origin. In all the child index cases with positive scalp cultures (tinea capitis and carriers), the household members were studied clinically and mycological. One child had tinea corporis caused by *M. canis*. Twelve adults had positive cultures with dermatophytosis (one with tinea capitis and eleven with tinea corporis). Three adult patients were also carriers of dermatophytes in other body sites.[27]

In 2005, a study to identify the prevalence of tinea in school children in the area with the highest immigrant population, showed that 36(2.8%) children had tinea pedis and 3 (0.23%) had tinea capitis. One child had tinea capitis and tinea pedis, caused by different species (tinea capitis caused by *T. mentagrophytes* and tinea pedis caused by *T. rubrum*). In 39 positive cases for dermatophytes, the etiologic agent in 18 (46.1%) was *T. mentagrophytes*, 17 (43.5%) *T. rubrum*, 2 (5.5%) *E. floccosum* and 2 (5.5%) *T. tonsurans*.[28]

Asia:

In Tehran, Iran, a total of 1568 patients (children) with suspected tinea capitis were examined for causative fungal agents between 1994 and 2001. Laboratory examination confirmed tinea capitis in 209 patients. Males were affected more frequently (67.5%) than females (32.5%) and in both sexes, those who were 3-11 years were more affected. *T. violaceum* was the most common etiological agent (37.3%) followed by *T. schoenleinii* (21.5%), *M. canis* (18.6%), *T. veruccosum* (14.8%), *T. tonsurans* (5.3%), *T. rubrum* (1%), *M. gypseum* (1%) and *T. mentagrophytes* (0.5%). A higher incidence of the disease was found to be correlated with larger family and class size. [29]

In a study undertaken to identify the etiological agents and to determine the clinical-etiological correlation of tinea capitis in eastern Nepal, sixty-nine clinically diagnosed cases of tinea capitis were enrolled in the study. Tinea capitis accounted for 4.6% of all dermatophyte infections: 68.1% occurred in patients below the age of 11 years with a male to female ratio of 1: 1.9. "Gray patch" was the most common clinical type (52.2%), followed by "black dot"

(17.4%)., seborrhoeic dermatitis (13%), alopecia areata (11.6%) and pustular (4.3%). Direct microscopy of hair was positive in 62.3% of patients. Culture positive was found in 56.7% of patients. Common isolated organisms were *T. violaceum* (48.71%), *T. mentagrophytes* (15.38%), *T. tonsurans* (12.82%), *M. canis* (7.69%), *T. rubrum* and *M. gypseum* (5.12% each), and *M. audouinii* and *M. nanum* (2.56% each).[6]

Investigation of the etiologic agents and clinical correlation of tinea capitis in Lahore, Pakistan, involving 100 clinically suspected cases 95% being children below 12 years of age revealed non-inflammatory and inflammatory lesions in 56.4% and 43.6%, respectively. *T. violaceum* was the most common etiologic agent, responsible for 82% of infection, followed by *T. tonsurans* (8%), *T. verrucosum* (5%), and *T. mentagrophytes* (5%). *T. violaceum* is the predominant pathogen causing tinea capitis in this part of the world with varied clinical picture.[30]

Analysis of 325 patients (182 males, 143 females) with mycological proven tinea capitis seen over a period of two years (from January 2001 to December 2002) in the Farwaniya region of Kuwait, revealed positive family history and contact with pets in 22% and 36.7% of the cases respectively. The age range was 8 months to 17 years. Peak incidence was observed in the 3-14 year age group (79.6%). The non-inflammatory 'gray patch' variety was the most common clinical type, seen in 163 (50.2%) children, followed by the black-dot variant in 100 (30.2%) patients. A significant proportion of the cases (16.6%) had the uncommonly reported seborrheic dermatitis or dandruff like pattern. Highly inflammatory kerion was encountered infrequently (2.5%). Seven species of dermatophytes were isolated; *T. violaceum* in 135 (41.5%), followed by *M. canis* in 89 (27.4%), *M. audouinii* in 48 (14.8%), *T. mentagrophytes* var. *mentagrophytes* in 31 (9.5%), *T. verrucosum* in 15 (4.6%), *T. tonsurans* in 6 (1.9%) and *M. gypseum* in 1 (0.3%) patient. *T. violaceum* was noted to be the most common fungus responsible for the black-dot variety (89/100) and kerion (4/8) patients. Three cases of kerion (33.3%) grew *T. verrucosum. M. canis* was the most common species isolated from the 'gray patch' cases (79/163; 48.5%) followed by almost equal prevalence of T. *violaceum* (16.6%), *M. audouinii*

(15.3%), and *T. mentagrophytes* var. *mentagrophytes* (12.3%). Among the seborrheic type of cases, *M. audouinii* was the most common fungus isolated in 20/54 (37%) followed by *T. violaceum* in 15 (27.8%), *T. mentagrophytes* var. *mentagrophytes* in 9 (16.7%), *M. cannas* in 8 (14.8%) and *T. verrucosum* and *T. tonsurans* in one (0.3%) patient each.[31]

Africa:

In a study involving a total of 510 children from a primary school in Alexandria examined for tinea capitis, dermatophytes were isolated from 7.4% of scalp samples (2.9% confirmed cases, 4.5% carriers). A further 2% were suspected cases as they were negative for fungal investigation. Most of the children were under 10 years and none was aware of having the infection. All isolates were identified as T. *violaceum*.[32]

A total of 1842 school children examined for the occurrence of common transmissible skin infections in a rural area in North-West Ethiopia showed a prevalence rate of 49.2% with tinea capitis being the most common.[33]

In Ekpoma, Edo State, Nigeria, 1400 pupils from two public primary schools screened for dermatophyte infection showed that 188 (13.4%) were infected. The causative agents isolated included *M. audouinii* in 88 (46.8%), *T. mentagrophytes* in 48 (25.5%), *T. rubrum* in 40 (21.3%), *T. tonsurans* in four (2.1%) and *E. floccosum* in eight (4.3%). There were significant differences in the rate of infection between male and female school children as well as between children from different socioeconomic backgrounds.[34]

One hundred and ninety six patients with tinea capitis enrolled in a study to determine the prevalence, clinical types, and causative species of tinea capitis in Benghazi, Libya, showed that the gray patch type was the most common clinical variety (53.6%) followed by black dots, seborrhoid type, and kerion (25.5%, 10.2%, and 8.2%), respectively. Four patients with a clinical picture of alopecia areata-like lesion and one patient with a favus-type lesion were seen. Species identification revealed that *T. violaceum* was the most common causative agent, responsible for 49.4% of infection, followed by *M. canis*

(38.6%) and *T. verrucosum* (7.8%). From seven patients it was mixed infection with *T. violaceum* and *M. canis.*[35]

The findings of a study conducted over a 1-year period to determine the demography, etiology, and clinical patterns of tinea capitis involving 100 children in South Africa with a male: female ratio of 1.4:1 and a mean age of 4.6 years (range 1-11 years) showed that *T. violaceum* was isolated in 90% of positive cultures. Wood light was positive in one patient with *M. gypseum*. The most common clinical variety was the "black dot" type, seen in 50% of patients. Twenty percent of the children presented with more than one clinical type. It was noted that the most common cause of tinea capitis in
a South African child is *T. violaceum*. The presentation is variable.[36]

Tanzania

A study carried out in a rural village in southern area of Tanzania involving 120 heads of households were interviewed to determine the factors that influence the families health seeking behaviour found out that 34.7% of 800 villagers had one or more skin diseases, the most common of which were tinea capitis, tinea corporis, scabies, acne and eczema.[37]

Uganda.

A 15 year old HIV-positive Ugandan boy suffered from several dry and hyperkeratotic lesions of his left hand and forearm with circinated, erythematous and scaly morphology caused by *microsporum gypseum.* Species differentiation was confirmed and specified by sequence analysis of the internal transcribed spacer of the ribosomal DNA.[38]

Kenya:

In a study to determine the prevalence and etiology of tinea capitis in primary school children attending a school in Eldoret, involving Sixty eight subjects in classes 1 to 5, 60.9% and 39.1% being males and females respectively; prevalence was found to be 33.3%. Peak age of infection was 10 years. Ratio

of infected males to females was 2:1. There was a growth on culture in 76.1% of the cases all of which were endothrix. *T. tonsurans* was isolated in 77.8% and *T. rubrum* in 4% of the cases.[39]

A survey of 5780 children from 13 schools in rural Kisumu District (western Kenya) in 1993 showed a prevalence rate of dermatophytoses of 10.1%. Three-quarters of the affected children suffered from tinea capitis (prevalence rate 7.8%), caused by *M. audouinii var. langeronii*, *T. violaceum* and *M. canis*.[40]

Dermatophytoses is of significant magnitude and public health problem in informal settlements due to overcrowding and poor environmental sanitation and hence the focus of this study. This report presents the findings of a cross-sectional study of the prevalence of dermatophyte infections among primary school children in Kibera. The public health significance of results and the implications for superficial mycoses control are discussed as they affect primary health care delivery in Kenya and other parts of the sub-Saharan Africa with similar setting.

1.3 STATEMENT OF THE PROBLEM.

Dermatophytoses represent a significant public health problem and accounts for almost 19% of skin diseases affecting school going children in Kenya and especially those from poor socioeconomic settings.[41] Although the disease remains a significant public health problem in Kenya, there is limited information on the spectrum and type of infecting dermatophytes. Dermatophytosis although is a communicable disease it is a preventable disease if proper measures are put in place. The research objective was an attempt to determine the prevalence and causative agents of dermatophytoses for the basis of designing appropriate control measures and for development of management policies.

1.4 STUDY JUSTIFICATION.

There are limited reports on this topic hence this study aims at providing information on prevalence and causative agents which can be used to guide decision making on management and control.

1.5 RESEARCH HYPOTHESIS.

1. The prevalence of common clinical type of dermatophyte infection (tinea capitis) among primary school children in Kibera is 10%.
2. There is no relationship between dermatophyte infection occurrence and child's age.
3. There sex of the child has no relationship with prevalence of dermatophyte infection.

1.6 OBJECTIVES

Broad objective.

To determine the prevalence and etiology of different fungal dermatological conditions in relation to age and sex among primary school children in Kibera.

Specific objectives.

1. To determine the prevalence and type of dermatophytoses among primary school children in Kibera.
2. To isolate and identify the dermatophytes associated with the infections.
3. To determine the correlation between the type of dermatophyte infection with age and sex.

CHAPTER TWO: METHODOLOGY

2.0 MATERIALS AND METHODS

2.1. STUDY DESIGN.

The study was a cross sectional- descriptive study.

2.2. STUDY AREA

Kibera is one of the largest slum settlements in Africa with estimated 700,000 to 1 million residents. It is situated 10km south west of Nairobi within Langa'ta division. Informal settlements like Kibera are found in all divisions of Nairobi in varying sizes and densities.[42]

A larger proportion of population in the city live in informal settlements where environmental and health conditions are very poor predisposing the children to communicable diseases like dermatophytoses due to overcrowding both in school and at home.[42]

Essential services like health and education are provided by the government through Nairobi city council, Non-Governmental Organizations, private and faith based organizations.

Most slum houses have small household space whereby on average a room of ten by ten feet is used as a sleeping room, sitting room, bathing room as well as kitchen by at least five household members. Basic amenities like toilets, bathrooms and toilets are limited, unsuitable and communally shared. Water sources are limited with water kiosks being the main source of water where a 20 liter jerrican sells for kshs.3.00. Poor waste disposal creates habitat for rodents and other mammals that are reservoirs to some fungal causative agents. [42,47]

Kibera has 5 primary schools within its locality run by the city council of Nairobi among other privately sponsored schools. City council sponsored schools are affordable for the poor majority compared to the latter whose cost of fees payable is high. Thus these affordable schools are faced with the problem of overcrowding due to over enrollment.

2.3 STUDY POPULATION.

Four city council primary schools, namely; Olympic, Ayany, Kibera and Mbagathi-way with a population of 8176 pupils[44]constituted the study population. The fifth school, Shadrack Kimalel was used in pilot testing of the study tools. All the schools used for this study were public schools with crowded classrooms and inadequate facilities. Majority of the pupils in these schools are drawn from the expansive Kibera slum and its environs.

2.4. SAMPLE SIZE.

A total of 422 pupils were selected for the study as estimated using the formula by Fisher et al 1998[45]on sample size calculation.

$$N=z^2pq/d^2$$

Where z=1.96

N is the desired sample size.

P is the prevalence of dermatophytoses estimated at 50%.

D is the confidence limit of the prevalence at 95% confidence interval which is 0.05. This represented the desired confidence interval for the study.

Sample size calculation was based on prevalence rate of 50% assumption taken by the researcher since there were no current studies showing data on the occurrence rate of dermatophyte infections in the study population. Studies done in rural settings in Kenya have shown a prevalence rate of between 10% and 15%. The prevalence in urban slum area is expected to be much higher, therefore a higher prevalence was assumed for this setting.

2.5. SAMPLING METHOD.

Purposive sampling was used to select the 4 city council run primary schools within Kibera. Systematic random sampling method was then used to select the subjects. The desired sample size (n) was 384 while the study population (p)

was 8176[44]. The interval of study subjects' selection was given by p /n (8176/385) which was 21. Every 21st pupil was selected. Sampling from each school was done considering the total pupil population: Kibera 116, Ayany 95, Olympic 111 and Mbagathi Way 62.

2.6 INCLUSION CRITERIA.

1. All the pupils who were enrolled in school during the period of study (September to November 2006).
2. All the pupils whose parents gave written consent. Consent forms in sealed envelopes were sent to the parents/ guardians through the selected pupils who in turn returned them back to the respective class teachers. Consent forms were translated into Kiswahili to ensure ease of communication.
3. Those pupils who assented to take part in the study.

2.7 EXCLUSION CRITERIA.

1. All the pupils who were away during the period of study.
2. All the pupils whose parents/ guardians did not consent to participate in the study.
3. Pupils who did not assent to take part in the study.

2.8 DATA COLLECTION TOOLS.

2.8.1 Structured questionnaire.

Structured questionnaire (appendix 1), was administered to collect demographic and qualitative data from study subjects. Systematic sampling of pupils in the named schools was carried out using the fraction ratio of 1 in 21. A total of 424 questionnaires were administered as follows: 124 in Ayany, 119 in Olympic, 56 in Mbagathi- way and 124 in Kibera.

Three research assistants (graduate nurse interns) carried out the administration of the questionnaires after undergoing one day training. They translated the information in questionnaires into Kiswahili where necessary.

2.8.2 Physical assessment profile form

All the subjects underwent head to toe examination mainly by observation to assess their skin condition and find out if there were any clinical signs of dermatophyte infections. The examination took place at a designated room in each of the selected schools. The sex of each child was recorded while age and number of occupants per bedroom in each child's home, were obtained by interview. All the boys wore short hair while some girls plaited their hair in line with the regulation of the schools. To maximize the sense of comfort, female participants were examined by the female member of the research team.

The skin of scalp, eyebrows, and eyelashes of each child was carefully examined for characteristic features of Tinea capitis as described previously [46]These included (I) lesions manifesting as red papules to grayish ring-formed patches containing perifollicular papules, (ii) pustules with inflamed crusts, exudates, matted hairs, and debris, (iii) black dot with fracture of the hair, leaving the dark stubs visible in the follicular orifices and, (iv) Keri on celsi manifesting as a patchy or diffuse distribution and severe hair loss with scarring alopecia.

Those who were found or suspected to have clinical signs of dermatophytoses, proceeded to the next phase as noted below.

2.8.3 Digital camera

Photographs of the infected sites were taken as evidence of the various clinical forms of dermatophyte infections and their extent of severity.

2.8.4 .Specimen collection

Affected areas were cleansed with 70% v/v ethanol, allowed to dry and light scrapings (skin scales, crusts, hair pieces) were taken from the active edge of lesion using a blunt sterile scalpel blade [47]. Pieces of hair stumps were collected in the case of tinea capitis while scrapings from the edges of the lesions were taken in tinea corporis. An isolation rate for a dermatophyte is affected by the amount of specimen collected and site of infection. Causal agents of tinea capitis are easy to

isolate owing to ease of removal of scrapings and hair from the head compared to Tinea corporis cases which easily bleed on scaling the site.

The specimens were placed in clean white envelopes with each participant's code well labeled. Specimens were transported to the Kenya Medical Research Institute's Mycology laboratory for analysis.

2.9 LABORATORY PROCEDURES.

2.9.1 Direct microscopy.

The specimens were examined for presence of characteristics of dermatophyte infection; hyphae or spores, by adding 20% potassium hydroxide (KOH) and leaving it for 30 minutes. The digestion of keratinous material would release hyphae and /or spores if present. Diagnosis of dermatophytes in the skin scales and crusts was predicted on visualization through direct microscopy of branching septate hyphae with angular or spherical arthroconidia (arthrospores), usually in chains. Dermatophytes diagnosis in the hair pieces was predicted on visualization of anthroconidia arranged along the length of the hair in chains or in masses around the hair (ectothrix infection) or in the hair substance (endothrix infection[48]

2.9.2 Culture.

The isolation media of choice for dermatophytes is SDA agar (PH 5.6) that contains chloramphenical with or without cycloheximide. Both types were used in this study. Chloramphenical inhibits the growth of bacterial contaminants while cycloheximide suppresses saprophytic fungi.

Cultures were read weekly to capture pathogens as per their rate of growth. A culture plate was kept for a maximum of eight weeks before being regarded negative for growth.

Identification of dermatophyte species from positive cultures was based on colony characteristics in pure culture and microscopic morphology which

includes; the presence of conidia, (macro and micro), and microscopic appearance of the said conidia.

Photographs of positive cultures were taken as evidence of fungus isolation and for comparative analysis.

2.9.3 Physiological tests.

A few physiological tests were done to aid in species differentiation within a given genus since some share same characteristics. They include Urea hydrolysis for *Trichophyton equinum* which doesn't hydrolyse urea, in vitro hair perforation for *T. mentagrophytes* which gives a positive result and incubation at 36°c for *T. terestre* which grows better at this temperature.

2.10. Data management.

The completed questionnaires were examined for completeness and only properly completed questionnaires had information entered into a computer and stored in soft copy awaiting laboratory data where applicable before analyzing using SPSS package.

2.11. Data analysis

A computer based file was developed using SPSS. The results were then presented in descriptive statistics using frequency tables, cross tabulation and bar charts. Univariate analysis was used to analyze each variable while bivariate analysis was used to compare dichotomous variables. Frequencies of various parameters were obtained. Chi-square test for significance was used and the level of significance set at 0.05.

2.12 Minimizing of errors and biases

Subjects were selected randomly while the research assistants were trained on the contents of the questionnaire, aim of the study and how to fill questionnaires before the study commenced as the principal investigator supervised the collection of data.

Laboratory data was generated using the proper protocol and standards to ensure effectiveness. Coding of data was done accurately.

2.13 Ethical Issues

Informed consent was obtained from the guardians as well as individual assent from participants before recruiting them into the study. Approval to carry out the study was obtained from the Kenyatta National Hospital Research and Ethical Committee, and the City Council of Nairobi's Directorate of Education (Appendix VI)

The approval was on the agreement that participants anonymity must be maintained, good laboratory practice/quality control ensured, and that every finding would be treated with utmost confidentiality and for the purpose of this research only. Those found to have evidence of dermatophytosis were given advice and health education on treatment.

2.14 Study Limitations

- Some guardians refused to let their children participate in the study while some pupils had difficulties in expressing information. The researcher and field assistants made all the efforts to assist the pupils to understand the questions asked and answer them appropriately.
- Braided hair in some pupils concealed the scalp especially with dandruffs increasing suspicion of infection or overlook on existing infection.
- The researcher would have liked to expand the study area to include school children in other informal settlements in Nairobi but due to limited time and resources, this was not possible during the period of study.

CHAPTER THREE: RESULTS

Introduction

A total of 424 pupils were enrolled from the four schools surveyed and physical assessment was carried out to investigate for presence of dermatophytes infections. Mycological analysis of 160 specimens from suspected infected sites of participants was carried out at the Center for Microbiology research, Kenya Medical Research Institute, Nairobi.

3.1 Prevalence of skin infection

General skin infections (not exclusively dermatophytoses), were observed in 209/419(49.9%) of all the pupils investigated as shown in the table below. Questionnaires from five participants were rejected due to incompletion.

Table 1. General skin infection among participants. N=419

	Skin infection		
School of participant	Yes	No	Total
Kibera	46	77	123
Olympic	78	41	119
Ayany	58	64	122
Mbagathi	26	28	54
Total	209	210	419

3.2 Prevalence of confirmed dermatophytosis

Obtained prevalence of actual dermatophytosis by school is as given in the table below while the overall prevalence was 11.3%. Olympic primary school had the highest percentage of dermatophytoses among pupils followed by Mbagathi Way and Ayany respectively. Kibera primary school had the least prevalence. There was statistical significant difference in the number of infected pupils and the different schools studied (P= 0.0001).

Table 2: Prevalence of dermatophytosis by school. N=48

School	Frequency of confirmed dermatophyte infections	School prevalence%
Kibera	6	4.8
Olympic	27	22.6
Ayany	10	8
Mbagathi way	5	8.9

3.3 Prevalence of skin infection in different age groups

Age range of infected participants was 5-14 years. The findings indicate the modal age group of the respondents was 6-8years, the youngest being 5 years and the oldest 14 years. The age category with the highest (44%) infection rate was 6-8 years followed by (35.4%) in the 9-11years group. There was a significant statistical differences (P= 0.002) between age and the presence of skin fungal infections as shown in the table below.

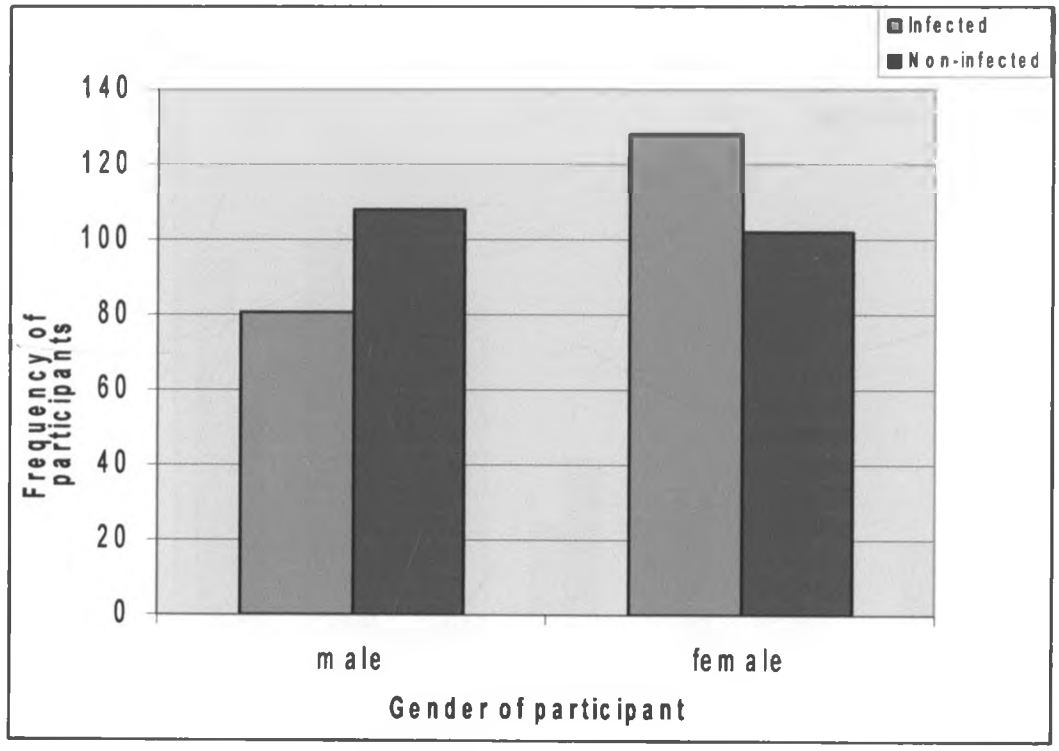
Table 3. Prevalence of skin infection by age. N=422

	No. of participants	No. infected	% of infected within the category
6-8 yrs	188	114	44
9-11yrs	150	67	35.4
12-14yrs	74	23	17.5
<6yrs	8	2	25
>14yrs	2	0	0
Total	422	206	

3.4. Prevalence of skin infection by participant's gender

Of the total number of study population 230/419 (54.89%) of the total respondents were girls while boys were 189/419(45.11%). Among the girls 12.6% had dermatophyte infection in comparison to 10.1 % infection rate in boys. Comparatively more girls were infected than the boys (p=0.033).

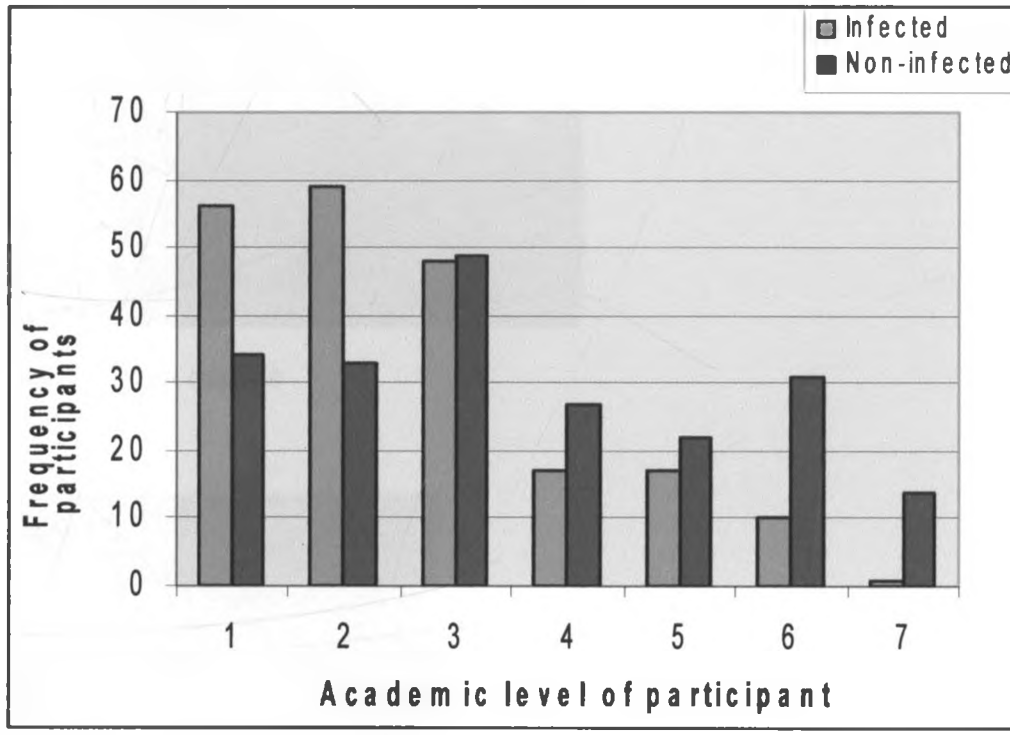
Fig 2: Gender of participants



3.5 Prevalence of skin infection by academic level participants

Most respondents came from the lower classes; 284/424, (66.9%) of total respondents were from classes one to three. The rate of infection declines gradually as one progresses from class one to seven with the highest rate at class one. There was a statistically significant difference between the presence of infection and the academic class of the pupil with the p value for trend of infection as one progresses being 0.033.

Fig 3: Infected and non-infected participants in different academic levels.



3.6 Sites of dermatophyte infections encountered

A total of 199 participants were found to have suspected fungal lesions; 94% on the head, 4% on the body and 2% on both sites. Tinea capitis was the most common form of dermatophytoses encountered among the pupils investigated, with significant grey patch type of clinical manifestation (P= 0.000)(Picture 1 below.) followed by tinea corporis with the circumferential type of lesions(picture 2 below) . Co-infection of both head and body was the least encountered.

Picture 1: ***Tinea capitis***

Picture 2: ***Tinea corporis***

3.7 Socio-demographic factors of participants.

Several factors were analyzed in relation to the presence of skin infection among participants and their significance obtained as shown in the table below.

Table 4. Demographic and Socio-economic characteristics of study participants

	No. of participants	No. with skin infection	% of total participants infected	P value
Age				
• 6-8yrs	188	114	60.6	0.039
• 9-11yrs	150	67	44.7	
• 12-14yrs	74	23	31.1	
• <6yrs	8	5	62.5	
• >14yrs	2	-	-	
Sex				
• Male	189	81	42.9	0.059
• female	230	128	55.7	
Next of kin				
• Parents	398	198	49.7	
• Relatives	21	11	52.4	0.181
Occupation of parent/guardian				
• Small-scale business	151	65	43.0	0.644
• Casual jobs	130	69	53.1	
• Permanent salaried	75	35	46.7	
Educational background of guardian/parent				

• Primary • Secondary • Tertiary/college	78 198 48	42 93 23	53.8 47.0 47.9	0.944
Type of living structure • Cemented walls and floors • Cemented floors and earthen walls • Mud walled with earthen floors	213 22 162	100 12 78	46.9 54.5 48.1	0.305
No. of living rooms in house • 1-2rooms • 3-4 rooms • >4 rooms	357 54 10	180 24 4	50.4 44.4 40	0.318
No. of adults in house • One • Two • >two	62 298 63	34 140 34	54.8 47 54	0.753
No. of children in the house • 1-2 • 3-4 • >5	112 211 101	56 111 42	50 52.6 41.6	0.148
Sharing of beddings				

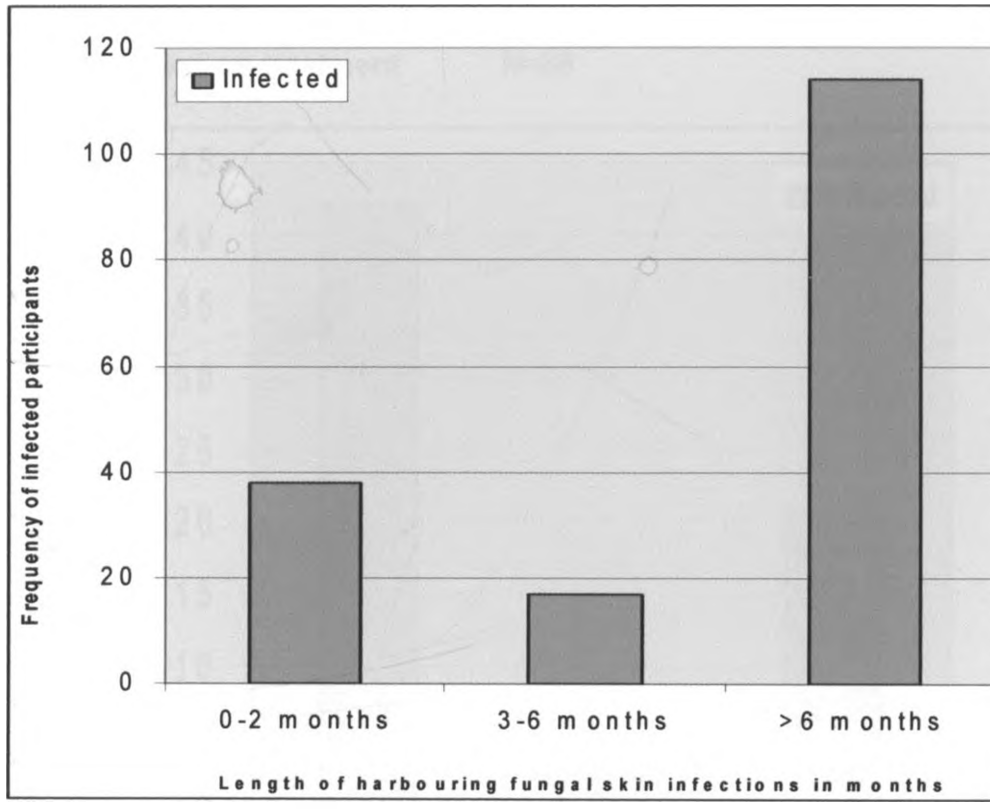
• Yes • No	333 91	174 35	52.3 38.5	0.062
No. sharing bed/ beddings With participant. • 1 • 2 • >2	24 228 83	13 112 49	54.2 49.1 59.0	0.410
Source of water for domestic use. • Piped • Borehole/dam /pond • Stored rain water in tanks	372 4 48	178 3 28	47.8 75 58.3	0.164
Participants' bathing frequency • At least once daily • Twice daily • Occasionally	328 30 57	154 14 37	47.0 46.7 64.9	0.457
Sharing of combs Family • Yes • No Schoolmates • Yes • No	282 138 34 390	148 59 12 197	52.5 42.8 35.3 50.5	0.161 0.163
Size of academic class • <40 pupils • >40 pupils	55 369	29 180	52.7 48.8	0.878

Place of shaving hair				
• Home	49	17	34.7	0.001
• Barbers' shop	337	185	54.9	
Keeping of pets				
o Yes	132	66	50.0	0.856
o No	292	143	49.0	
Type of pet kept				
o Cat	33	17	51.5	0.959
o Dog	95	47	49.5	
o Both	9	4	44.4	

3.8 Duration of infection

More than half 114(55.3%) of the participants had harbored infection for more than 6 months compared to 38 (18.4%) of those who had infection for >2 months. Only 17 (8.25%) had had the infection for between 3-6 months while 37(17.9%) could not recall how long they had had the infection. There was a statistical significance differences in the length and presence of the skin infection. (P=0.000)

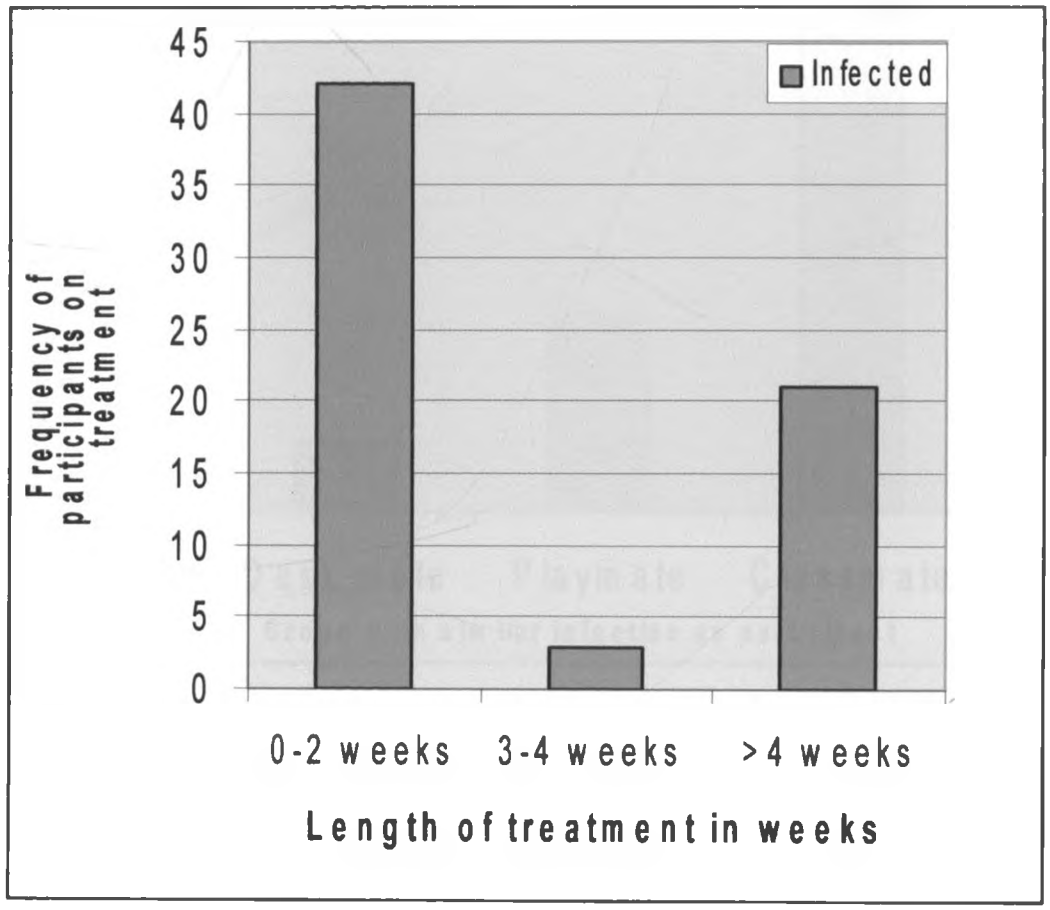
Fig.7 Duration of infection **N=206**



3.9 Treatment seeking behavior and duration by participants.

About half 112(53.8%) of participants with skin infection had sought for treatment against 96(46.2%) who had not. One participant gave no response regarding treatment. Only 66 participants with identified skin infection responded about the length of treatment and 64% had treatment ≤0-2 weeks while 31.8 % had treatment for more than 4 weeks while 4.5 % had treatment for the period between 3-4 weeks. The length of treatment was statistically significant to the presence of an infection in the respondent. (P= 0.000)

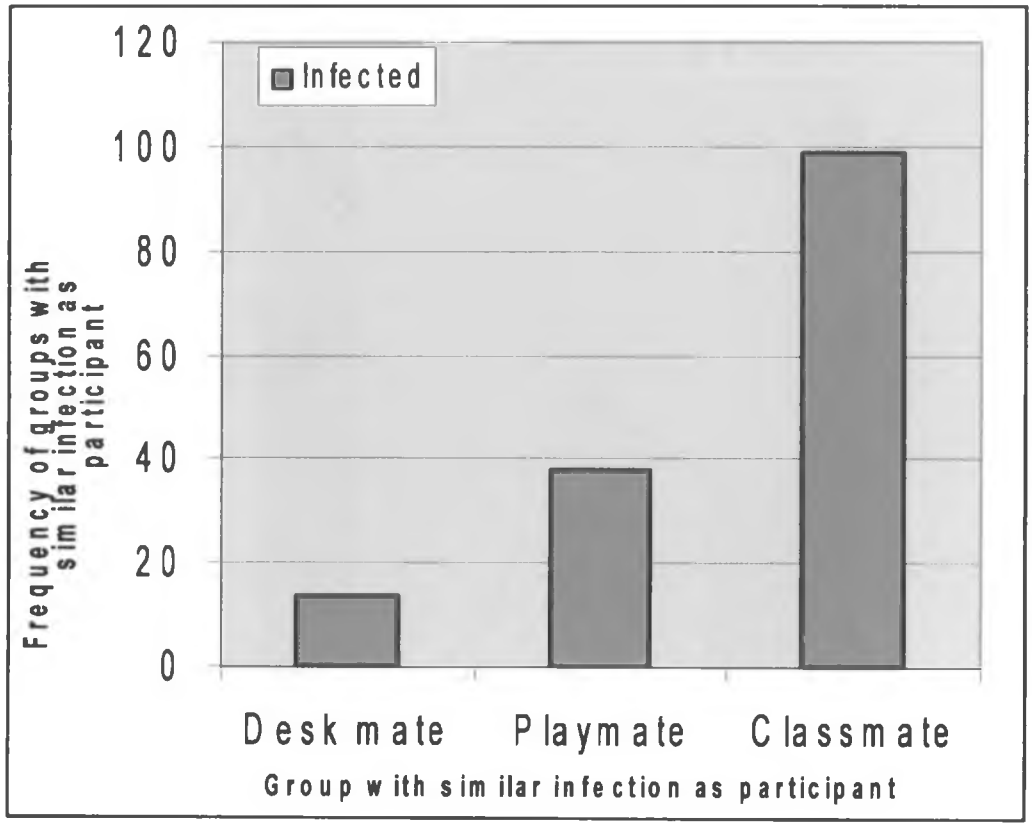
Fig. 9 Duration on treatment N=66



3.10 Knowledge of similar infection in school among infected participants.

Out of 154(85%) of those infected were aware of similar infections in the school compared to 27(15%) of those who were not aware of similar infections in the school. About 99(55.9%) of those who were aware of similar skin infections were with classmates, playmates 38(21.46%) or desk mates at 14(7.9%).

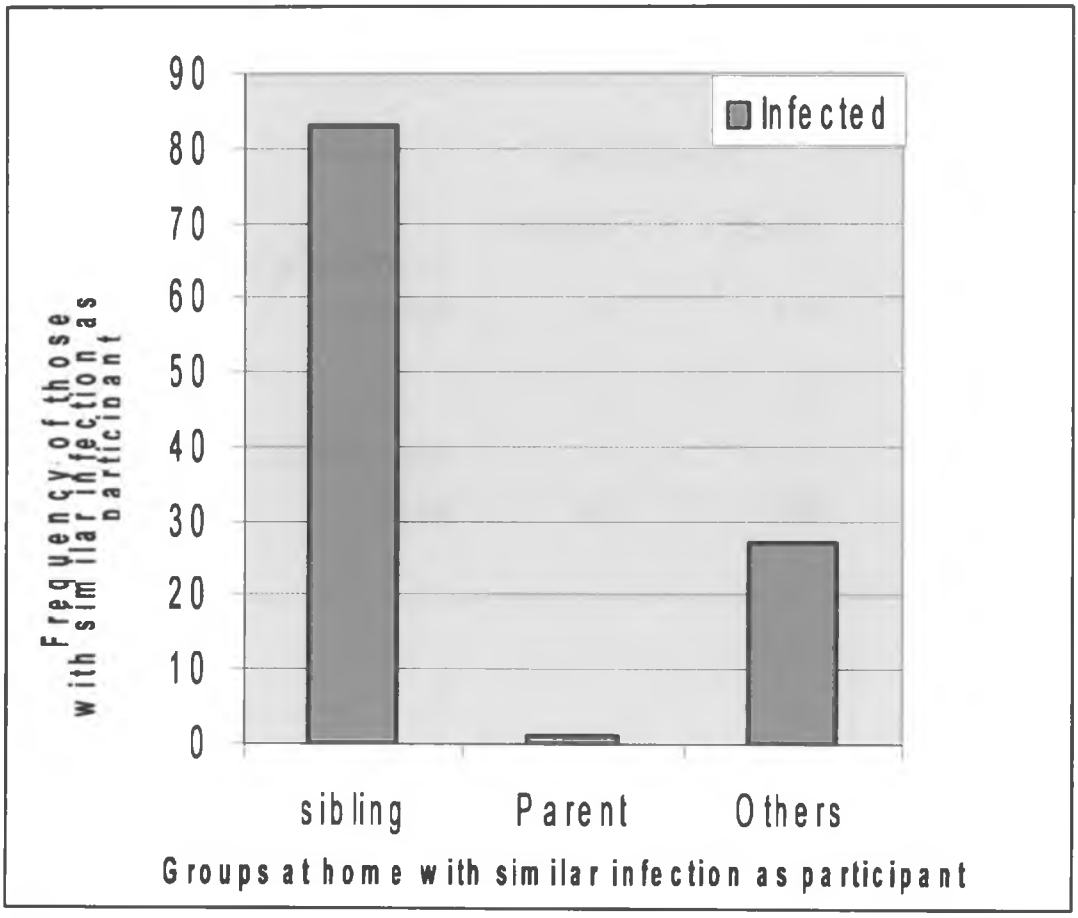
Fig.10.Group with similar infection(s) in school N=177



3.11 Knowledge of participant on similar infection(s) at home.

Most 83(82.1%) of participants who indicated presence of infection among family members pointed at sister or brother cases while 27(26.7%) indicated presence of infection in the category 'others' at home. Only 1 participant pointed at presence of infection in a parent.

Fig. 11 similar infection(s) at home N=101



3.12 Discrimination among participants.

Cases of discrimination among children in their interaction patterns were heightened in those with skin infections. In those infected, 32(15.5%) faced one form of discrimination or the other compared to only 13(6.8%) of those without skin infections. This had a statistical significance in the sense that the proportion of those discriminated at increases when there is infection. (p=0.001)

Table 5. Discrimination among participants

	Discrimination		
Presence of skin infection	Present	Absent	***Total***
Infected	32	174	**206**
Non infected	13	177	**190**
Total	**45**	**355**	**396**

3.13 Forms of discrimination among participants.

There were varied types of discrimination in social life that those infected faced with; Out of the 32 participants who had skin infection and faced discrimination, 27(84.3%) experienced general isolation followed by 3(9.3%) of those who experienced refusal to play with. Majority of those discriminated upon experienced general isolation even in the non- infected group.

Table 6. Forms of discrimination among participants.

Form of discrimination	No.	Frequency(%)
Refusal to sit with	1	3.22
Refusal to play with	3	9.67
Nick-naming	1	3.22
General isolation	27	84.1
Total	31	100

3.14 Academic performance among participants

In this study, 88(42.1%) versus 81(38.7%) scored very good in end term examination in infected and none infected respectively. Only 16(7.6%) and 15(7.14%) of infected and non-infected respectively were below average in academic performance.

Table 7. Academic performance of participants

Academic performance	Infected		Non infected	
	No.	%	No	%
Very good	88	49.4%	81	43.7%
Good	43	24.2%	56	30.3%
Average	31	18.1%	33	17.8%
Below average	16	8.9%	15	8.1%
Total	178	100%	185	100%

3.15 Hygiene of participants.

193(45.8%) of the participants had fair/average hygiene followed by 191(45.3%) with good hygiene and finally 36(8.9%) with poor hygiene. This was based on individualized physical assessment. A higher proportion of those who had poor hygiene had skin infection 28(77.7%) compared to 59(30.8%) of those with good hygiene. The hygiene status of a pupil is a significant factor in the presence of skin fungal infection. (P= 0.000)

Table 8: Hygiene of participants

General hygiene status of participants	Presence of dermatophytoses			
	Yes		No	
	No	%	No	%
Good	59	28.5%	132	66.7%
Fair	120	57.9%	68	34.3%
Poor	28	13.5%	8	4.0%
Total	207	100%	198	100%

3.17 Mycology results

3.17.1 KOH treatment and microscopy

Up to 98% of specimens which were positive at microscopy for spores in 20% KOH were positive on culture. While 50% of those negative for spores on KOH turned out to be positive on culture.

Table 9. KOH treatment and microscopy

		Results of culture		
		Positive	Negative	Total
Presence of spores in 20% KOH	Positive	28	2	30
	Negative	71	78	149
	Total	99	80	179

3.17.2 Mycological culture

All specimens were subjected to mycological culture regardless of the KOH microscopic results. Three possible outcomes were realized for every specimen cultured; positive growth of a dermatophyte or non dermatophyte or no growth. The non dermatophytes included opportunistic fungi i.e. aspergillus's species, penicillium species and other moulds as well as yeasts and bacteria. The findings were similar with both types of media used for isolation; SDA with chloramphenical and Mycosel. From this study comparison on the use of either SDA with chloramphenicol or Mycosel for isolation of dermatophytes yielded no significance difference (P=0.112).

Table 10.Sabourauds dextrose agar and Mycosel

		Mycosel			
		dermatophyte	Non dermatophyte	No growth	Total
SDA	No growth	17	10	34	61
	Non dermatophyte	21	22	41	84
	dermatophyte	8	1	6	15
	Total	46	33	81	160

3.18 Genus of dermatophytes isolated

Based on morphological characteristics of the colonies on culture plates, the rate of growth, ability to produce pigments and specialized physiologic tests, 48 (%) specimens were positive for culture. Dermatophytes belonging to all the three genera namely *Trichophyton*, *Microsporum* and *Epidermophyton* were isolated. Below are some of the representative photographs of the isolated dermatophytes (photo 3, 4, 5, 6, 7, and 8).

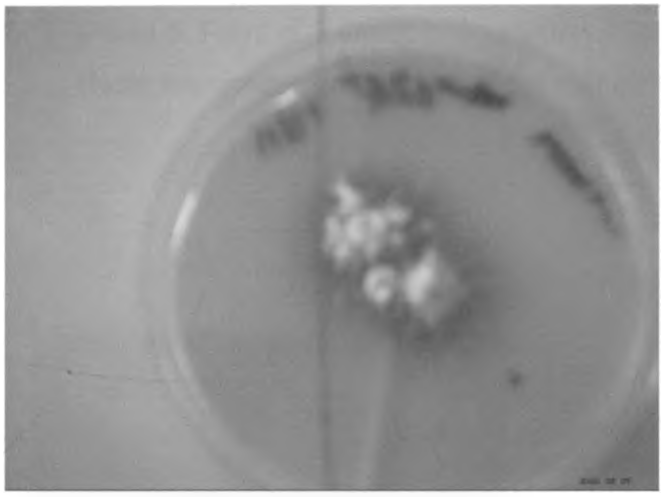


Photo 3. Front appearance of *M. canis* on Mycosel

(Note the yellow-brown diffusing pigment)

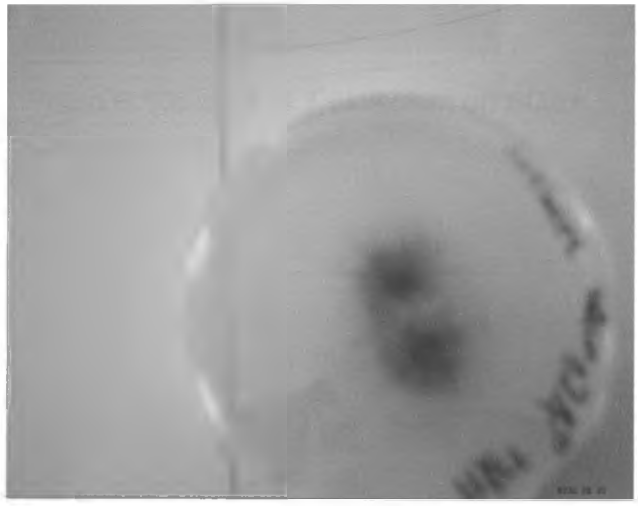


Photo 4. Reverse appearance of *M.canis* on mycosel.

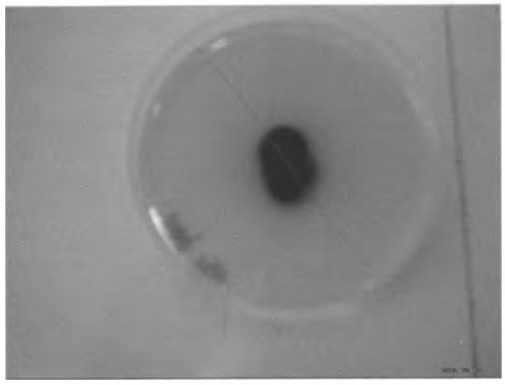


Photo 5. Front of *T.violecium* on SDA+
(Note the violet pigmentation of the culture)

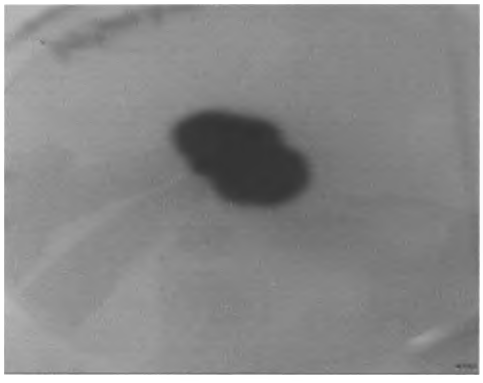


Photo 6. Reverse of *T.violecium* on SDA+

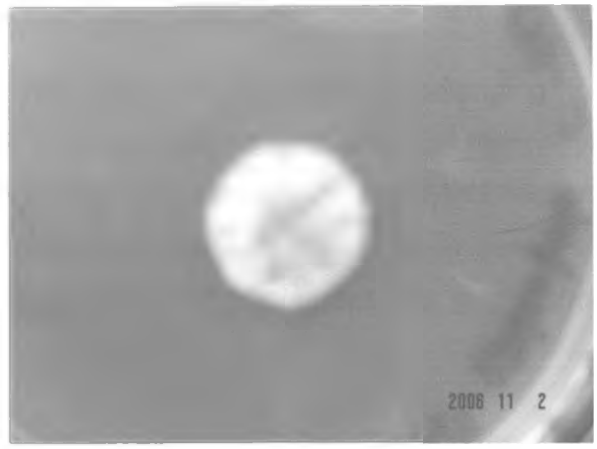


Photo 7. Front appearance of *T. schoenleinii*
(Note the white sandy appearance)

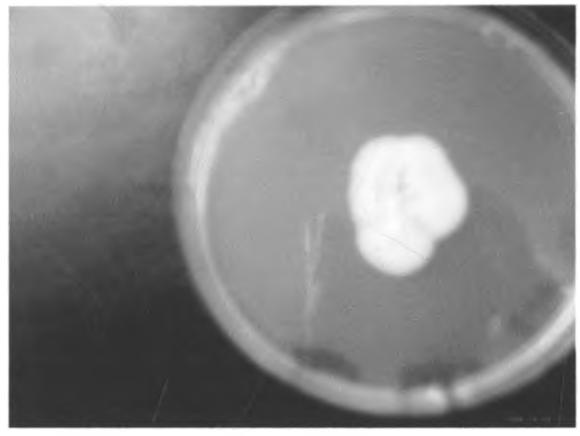


Photo 8. Reverse culture of *T. shoenleinii*

3.19 Species of dermatophytes isolated.

Forty-eight dermatophytes comprising 9 species belonging to the three geni; *Trichophyton* (93.7%), *Microsporum* (4.2%) and *Epidermophyton* (2.1%) were isolated. There was one case of multiple dermatophyte infection by *Trichophyton schoenleinii* and *Trichophyton violecium*. *T. violecium* species was the highest isolated with 35(71%) followed by *T.mentagrophytes and T.shoenleinii* both *with* 3(6.3 %).

Table 11: Species of dermatophytes isolated.

Genus	Species	Frequency	
		No	%
Trichophyton	*violecium*	35	72.9%
,,	*shoenleinii*	3	6.25%
,,	*interdigitale*	1	2.1%
,,	*mentagrophytes*	3	6.25%
,,	*concentricum*	1	2.1%
,,	*terrestre*	2	4.2%
	Sub-total	**45**	**93.8%**
Microsporum	*canis*	1	2.1%
,,	*equinum*	1	2.1%
	Sub-total	**2**	**4.2%**
Epidermophyton	*flocossum*	1	2.1%
	Sub-total	**1**	**2.1%**
	Total	**48**	**100%**

CHAPTER FOUR: DISCUSSION.

The study revealed that 11.2% of primary school going children in Kibera were infected by dermatophytes. These findings correlate with those of a study done in a rural school in Kisumu but fell far below the prevalence as per a study done in an urban school in Eldoret with estimated prevalence of 33.3%.[39, 40.] The age range in this study was 6-11 years with the highest number of participants in the 6-8 years group. There was statistically significant difference in the prevalence of infection and the age category of the participant (p=0.002). The variation seen in comparison with the study in Eldoret could be attributed to socio-economic as well as environmental conditions of the participants.

Tinea capitis was the most common type of ringworm seen in the participants. This finding tally's with those of other studies done in Kenya, Europe, Asia.[27, 30, and 33,36,39,41]. This could be attributed to the exposed nature of the head/scalp compared to other body areas and hence easy transmission and acquisition of infection. Shaving of hair at a barber's shop is a common phenomenon in urban settings and featured as a significant factor in the study. A significant number 337(86.6%) of the participants shave their hair at the barbers shop while 49(11.5%) shave their hair at home. The proportion of those who shave at the barbers shop and were infected was higher than those who shaved at home (54% versus 34%). In this study, there was a statistical significance difference between the presence of fungal infections and the place of shaving a pupil's hair. (P=0.001).The practice of communal shaving contributes to the transmission of scalp infections especially in children due to poor hygiene and improper disinfection of gadgets used increasing the carriage and spread of dermatophytes.

No case of Onychomycosis was found. This compares with literature finding that this infection is rare in children.[22]

Genus *Trichophyton* formed the majority of the isolates with 45(94%) while *Epidermophyton* had the least 1(2.1%). This finding compares with studies done in

other developing countries in African continent and parts of Asia [31, 33, 36, 39] .In our study, *T. violecium* was the most common dermatophyte species isolated with 35(72.9%) followed by *T. mentagrophytes* at 3(6.3%), *M. canis* 1(2.1%), *M. equinum* 1(2.1%), *T. interdigitale* 1(2.1%), *T. terrestre* 2(4.2%), E. *flocossum* 1(2.1%), T. *schoenleinii* 3(6.3%), and *T. concentricum* 1(2.1%). These are anthropophilic species significantly transmitted in overcrowded human settings. This situation is unlike Europe where most of the dermatophytes are of zoophilic type owing to the high preference of keeping pets. [27, 28, 29]

Studies elsewhere have shown that rearing and close proximity to domestic pets is a significant risk factor to the development of dermatophytoses.[20] According to this study only a small percentage of households' rear pets as a result of limited space and resources in urban informal settlements. This may be an explanation for the small percentage of zoophilic type of dermatophytes isolated in this study especially those associated with domestic pets like *M. catis* and *M. canis*.

Poor garbage disposal has been associated with the presence of zoophilic type of dermatophytes owing to the presence of rodents' i.e. rats.[23] This is a common phenomenon in slum areas with scattered heaps of garbage around living houses. Rodents scavenging into living houses in such of food may spread fungal pathogens to man. Such mammals harbor dermatophytes like *T. mentagrophytes* which was isolated in this study. *T. mentagrophytes* was the second commonest species isolated. No geophilic type of dermatophyte was isolated in the study. Although this could not be clearly explained, this could be attributed to increased hygiene standards and universal dressing which limits the body's contact with the contaminated soil.

Most of the infected were children below the age of 10 years affirming the observation that a ringworm infection is predominantly a pre-pubertal disease. This is confounded by poor hygiene at this age as well as the absence of saturated fatty acids that provide a natural protective mechanism against dermatophytoses. Besides this natural predisposition, the degree of exposure to etiological agents

plays a major role. Children brought up in clean environments with less crowding and reliable water supply tend to suffer less from dermatophytes.[25]

A similar prevalence rate of infection among girls and boys was noted in the study contradictory to other studies elsewhere showing that boys are more vulnerable. This may be taken as an isolated finding but is an eye opener for possible change in the social behaviors of the participants.[39, 40]

There was no major complication of dermatophytosis in the infected population except for two cases who had superimposed bacterial infections marked by suppurative lesions on the scalp. The bacterial agents in this infection were staphylococcus dermatidis. Complications are commonly seen with zoophilic type of dermatophytes which were significantly few in this study.

The study found out that most children put up with their biological parents which contradicts the report on population and health dynamics in Nairobi's informal settlements which indicates that a higher proportion of resident children under the age of 15 years are not the biological offspring of the head of household implying a higher fostering rate.[47]

The parents and guardian's level of education had no significance with the presence of dermatophyte infection in children in this study. Most parents are educated to secondary level of education. This enables them have a good understanding of good public health practices. The spread of ringworm infection and its carriage is dependent on the interaction patterns and nature of the living conditions. Most parents in these settings cannot afford less crowded schools for their children nor afford decent living conditions due to underlying economic constraints. The form of employment too had no significance in this study because most parents had low paying jobs regardless of they being on permanent or casual basis. The economic power determines where one lives in and in turn the living environment dictates the potential exposure to fungal agents.

The study found out that most of the participants' accessed piped water through water kiosks and sometimes from vendors whenever there is some shortage. This

finding concurs well with the report that slum residents distinctively lack basic amenities like electricity, proper sanitation and access to piped water.[47]

Most of the participants' living structures were semi- permanent with cemented floors and mud walls. The type of living structure had no significance to the spread of dermatophyte infections among children in these settings. This is attributed to fairly good hygiene standards despite the limited space. This was a positive observation unlike that of rural settings.

Hygiene status of an individual's skin has been cited as one of the associated factors with the acquisition of dermatophyte infections. The poorer the hygiene, the higher the chances of acquiring infection. Over 75% of the participants reported bathing at least once daily. High frequency of bathing reduces rate of colonization of the skin by the fungal agents following contact with infective agents.

Sharing in school is very negligible although much dermatophyte transmission occurs due to the children's interaction patterns compounded by overcrowding. Classmates come out clearly as the highest category with similar skin infections as the respondents and this could be a result of the proximity among the pupils within the classroom. It has statistical significance at (P= 0.000).

Sharing of beddings and toiletries was a common practice in participant's homes. On average two people in the participants homes shared beds. This indicates that sharing is a common experience in most homes in informal settlements. Over 282(66.5%) of participants shares bath towels and combs with family members while 138(32.5%) did not. More 333(78.5%) participants shared beds and beddings at home while 91(21.5%) did not. 228(68.5%) of the participants shared beds with 2 bedmates while 27(8.1%) shared with 3 bedmates. There was no statistical significant difference between the number of family members sharing and occurrence of skin infections (p=0.161).

Low rates of infections were noted in homes compared to school probably due to the fact that human pressure in homes is less than in school with an average of

two children and adults in a homestead. It is also attributed to better hygiene standards of the urban poor in their living houses compared to that of rural areas

Over enrollment of pupils in the schools under study was an important observation. On average each class had over 40 pupils with as high a number as 79. This is a positive factor in the spread of fungal skin infections among the pupils. Most infections were therefore likely to be acquired in school than at home where transmission is more likely due to congestion. Teachers should be involved in primary control of dermatophytoses. They are likely to be the ones to identify those children with infections at the early onset and therefore advice them on treatment in the nearest health facility therefore reducing carriage and transmission.

Skin infections are said to affect ones' perception of self and hence interfere with individuals' performance despite adequate potential to excel. The presence of dermatological condition had no statistical significance on the participant's performance in examinations. This is only applicable at the point in time but differences may arise if effect is measured between two points in time (P=0.821)

General discrimination against those with dermatophyte infections affected 54% of the respondents. However discrimination had no significant influence on academic performance of the infected. This may be due to more efforts projected on academics with limited time on socialization as well as children's ability to forgive and forget. Although discrimination was not significant academically, it is significant from a social perspective in terms of the individuals' self regard and social development which might be affected irreversibly.

In the study, most pupils had had the infection for over 6 months and a larger percentage of those who sought treatment used it for less than 2 weeks. These two scenarios increased the carriage of dermatophytes. Most of the participants reported having used topical antifungal agents. These may not be effective in the course of widespread infection and especially in treatment of endothrix type of

infection. Oral systemic antifungal agents like Griseofulvin are recommended for widespread and chronic dermatophytosis.

Prompt and lengthy period of treatment is paramount in management of fungal infections of the skin. Only 54% of infected respondents had sought for treatment. Of these number 22% had had treatment for the recommended period of 3-4 weeks. The rest had had treatment for 0-2 weeks. Seeking for treatment alone is not adequate but rather how the prescribed mode and frequency of treatment is adhered to. Shorter treatment period contributes to re emergence of similar infections and promotes development of fungal resistance.

One of the greatest problems hindering prevention and eradication of dermatophytoses is the presence of health asymptomatic carriers. This is compounded by inadequate treatment marked by shorter periods of topical antifungal use as well negligible use of oral treatment. This approach results in disappearance of symptoms but the infection persists. Recurrence rate is increased while carriage is prolonged. Parents/ guardians may not be having proper information on the importance of completing prescribed doses of drugs.

KOH's reliability as a diagnostic investigation for dermatophytes is low but acts as a supportive preliminary investigation. The presence of spores on KOH preparation is quite significant in determining the presence of dermatophyte infection and outcome on culture. (P= 0.0001).

There was no difference in the effectiveness of the use of either Mycosel or SDA plus in isolation of dermatophytes. SDA incorporated with chloramphenical had sensitivity of 61.9% and specificity of 9.4% while Mycosel had sensitivity of 41.9% and specificity of 28.8%. The latter is selective for dermatophytes but highly inhibitory to environmental contaminants and therefore ideal for dermatophyte isolation. However growth is slow hence it requires longer periods of incubation of between 6-8 weeks compared to the former which requires between 3-4 weeks for dermatophytes to grow.

CONCLUSION

- The prevalence of dermatophyte infections among children was 1.2% higher than the supposed rate of 10% with tinea capitis being the commonest clinical type at 91%. This strongly reflects the contribution of communal shaving in its spread.
- No variation in infection burden was observed between boys and girls. The null hypothesis was not rejected.
- Variation in infection burden was observed with the younger age groups being more affected than the older age groups. The null hypothesis was therefore rejected.

RECOMMENDATIONS.

- School health programmes should be enhanced as part of routine surveillance which ensures professional assessment, advice and treatment of the affected children.
- Public health education on the importance of seeking treatment and completion of the recommended dosage, use of communal shavings targeting both the consumer and the service provider and proper garbage disposal.
- Emphasis on culture methods in routine diagnosis of dermatophytes.

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APPENDIX 1: RESEARCH PARTICIPATION CONSENT FORM.

My name is Angeline Chepchirchir, a postgraduate student at the University of Nairobi. I am carrying out a research study entitled *'Prevalence of dermatophyte infections among primary school children in Kibera*' as part of the requirement of my studies.

It involves physical examination of pupil's skin. No invasive or painful procedures will be involved. Those who will be found or suspected to have a fungal disease will have some specimen collected from the site by gently scrapping and taken to the laboratory for diagnosis upon which preliminary treatment will be given as well as referral and health education on preventive measures. Confidentiality will be maintained. Participation in the research is voluntary. A child can drop out at any stage without any prejudice. You may choose to *accept* or *reject* to volunteer your child to participate in the study. *Read carefully the summary below and circle appropriately against any of the two options.*

The nature, duration, method and purpose of the study and implications of my child participating in the above research, have been highlighted. I have been assured that confidentiality shall be maintained of any information that my child will give in this study. I also understand that my child at any time during the course of this study may revoke my consent and withdraw from the study without any penalty, benefit or victimization.
I hereby *accept*/ *reject* my child to volunteer to participate in the above study.

Parent's/ Guardian's Name_____

Signature _____

Date_____

My contact addresses are as follows:
Department of Medical Microbiology,
P.O Box. 19676, 00200, Nairobi.
Tel.02726300 ext. 43390
E-mail chepangeline@yahoo.com.

APPENDIX 2: QUESTIONNAIRE

A STUDY ON DERMATOPHYTE INFECTIONS AMONG PRIMARY SCHOOL CHILDREN IN KIBERA.

COLLEGE OF HEALTH SCIENCES

DEPARTMENT OF MEDICAL MICROBIOLOGY

UNIVERSITY OF NAIROBI

Instructions:

1. One questionnaire should be filled for each child.

2. This questionnaire comprises of 3 sections: A, B, & C.

3. The information given shall be accorded due confidentiality and used only for the purpose stated above.

SECTION A-PERSONAL PARTICULARS

a) Age in completed years.....

b) Sex.....M. ( ).....F. ( ).....

c) Class.....

SECTION B-SOCIO-ECONOMIC VARIABLES

(Tick against the appropriate answer)

a) Relation of child to guardian.
   i. Son/daughter
   ii. Niece/nephew
   iii. Others(specify)

b) Employment status of the guardian.
   i. Casual
   ii. Business
   iii. Permanent
   iv. Others(specify)

c) Level of education of the guardian.

i. Primary
ii. Secondary
iii. College
iv. Others(specify)

d) Structure of living house
   i. Permanent(cemented)
   ii. Semi-permanent(wooden)
   iii. Temporary(earthen)
   iv. Others(specify)

e) Number of rooms in the living house(specify)----------

f) Number of persons in the living house

Adults' _____

i. Children _____

g) Do you share a bed or beddings?_____

If yes above, with how many people?

i. 1
ii. 2
iii. 3
iv. ›3

h) What is the source water for your household use?
   i. Piped
   ii. Pond water/borehole water/dam water
   iii. Stream
   iv. Others(specify)

i) How often do you take a bath?
   i. Once daily
   ii. Twice daily
   iii. Occasionally
   iv. Others(specify)

j) Do you share towels and combs with all the family members?
   i. Yes
   ii. No
   iii. Don't know

k) Do you share combs with other pupils in school?

i. Yes
ii. No
iii. Don't know

a) How many pupils are there in your class?

l) Where do you shave your hair?

i. Home
ii. Barber shop
iii. School
iv. Others(specify

m) Do you keep pets in your home?

i. Yes
ii. No

If yes above, specify

i. Dogs
ii. Cats
iii. Others(specify)

SECTION C_HISTORY ON SKIN CONDITIONS

Do you have any skin disease problem on your body?

i. Yes
ii. No
iii. Not aware

b. If yes above, how long have you had the infection?

i. 0-2 months
ii. 3-6months
iii. more than 6 months
iv. not sure

c. Have you had any treatment?

i. yes
ii. No

If yes above, for how long?

d. Does anyone at school have similar skin condition?

i. Yes
ii. No
iii. Not sure

If yes above, specify

i. Desk mate
ii. Playmate
iii. Classmate
iv. Others(specify)

e. Does anyone at home have similar skin condition?

i, Sister/brother
ii. Parent
iii. Others(specify)

f. Do you experience any form of discrimination from other pupils?

i. Yes
ii. No
iii. Not sure

If yes above, give brief account---------- ----------

What position were you in the last end term examination?

APPENDIX 3: PHYSICAL EXAMINATION & LAB. ANALYSIS

Physical assessment was carried out by the researcher and the three research assistants. The researcher carried out laboratory analysis of the specimens collected with the guidance of the supervisor at the KEMRI mycology lab.

a) Head to toe examination

General hygiene status.....

No. of times child baths in a fortnight.....

b) Diagnose fungal infection and specify the site.....

.....

c) Take a photograph of the infected or suspected site of infection.....

.....

d) Collect specimens for laboratory diagnosis as per protocol.

Pieces of hair .....

Nails (toe, finger).....

Skin scrapings.....

e) Prescribe for topical anti-fungal treatment and instruct the child to surrender to the guardian who will monitor its use.....

.....

f) Provide health education on prevention and control measures.....

.....

.....

.....

g) Transport the specimens to the laboratory for analysis and culture.....

.....

.....

.....

.....

Laboratory analysis

Presence of spores in 20%KOH.....

Description of spores in hair specimen.....

Results in culture .....

Dermatophyte isolated: genus.....

Species.....

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University of Nairobi

Dear Angeline

RESEARCH PROPOSAL: "DERMATOPHYTE INFECTIONS AMONG PRIMARY SCHOOL CHILDREN IN KIBERA, NAIROBI" (P110/5/2006)

This is to inform you that the Kenyatta National Hospital Ethics and Research Committee has reviewed and **approved revised** version of your above cited research proposal for the period 28th August 2006 – 27th August 2007.

You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given.

On behalf of the Committee, I wish you fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of database that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely

PROF A N GUANTAI
SECRETARY, KNH-ERC

c.c. Prof. K.M.Bhatt, Chairperson, KNH-ERC
The Deputy Director CS, KNH
The Dean, Faculty of Medicine, UON
The Chairman, Dept. of Medical Microbiology, UON
The Head, Medical Records, KNH
Supervisors: Prof. Ndinya-Achola, Dept. of Med. Microbiology, UON
Dr. Christine Bii, KEMRI

CITY COUNCIL OF NAIROBI

TELEGRAM "SCHOOLING"
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CITY HALL ANNEXE
P O BOX 30298 GPO
NAIROBI

CITY EDUCATION DEPARTMENT

GL/NC/141 VOL II/59

22nd August, 2006

All Headteachers
City Council Primary Schools
NAIROBI

RE: RESEARCH AUTHORITY

I write to certify that Chepchirchir Angeline of University of Nairobi Department of Microbiology is authorised to visit Council schools for the purpose of carrying out a research titled "Dematophyte infections among primary school children in Kibera".

Therefore you are requested to facilitate this important study in your schools.

F. L. SONGOLE
CHIEF ADVISER TO SCHOOLS
FOR: DIRECTOR OF CITY EDUCATION