EPIDEMIOLOGY OF SCHISTOSOMIASIS AND OTHER GASTROINTESTINAL PARASITES IN *KACHIA* LOCAL GOVERNMENT AREA OF KADUNA STATE, NIGERIA

BY
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DECLARATION

This is to certify that I, Mr. Joseph M.A. MBAWAH carried out the work reported in this thesis in the Department of Veterinary Parasitology and Entomology, Ahmadu Bello University, Zaria. The project was supervised by Dr. V.C. Ogbogu and Professor R.I.S. Agbede both of the Department of Parasitology and Entomology.

The works of other investigators in related areas are duely acknowledged by means of references. No part of this thesis has been submitted elsewhere for a degree or diploma.

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CERTIFICATION

This theseis by Joseph M. A. Mbawah entitled "Epidemiology of Schistosomiasis and other Gastrointestinal Parasites in Kachia Local Government Area of Kaduna State, Nigeria" meets the requirements for the award of the degree of Master of Science, Ahmadu Bello University, Zaria, and is approved for its contribution to Scientific knowledge and literary presentation.

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DEDICATION

This thesis is dedicated to my late brother Sandy Mbawah and parents.

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ABSTRACT

Two separate studies were conducted to determine the prevalence and intensity of Schistosomiasis in Kachia Local Government Area of Kaduna State Nigeria. Altogether, 800 urine and 820 faecal samples were examined from school children between the ages of 5 and 19. Equal number of urine samples were collected from the two sexes while 417 of the total stool samples were from boys and 403 from girls. Prevalence rates of 1.75% and 2.56% were recorded for *S. haematobium* and *S. mansoni* infections respectively. A prevalence rate of 0.50% was also recorded for urinary schistosomiasis, involving polymorphic-shaped eggs belonging to the *S. haematobium* hybrid range. This gives an overall prevalence of 2.25% for urinary schistosomiasis. There was no significant difference in prevalence rates between boys and girls (P>0.05). the intensities of infection were relatively low, with geometric mean egg output of 32 eggs/10ml of urine. There was no significant difference in egg output between the two sexes and between the different age groups (P>0.05). A five year retrospective study, using hospital records at the Kachia Health Centre from January 1987 to December 1991, was also done. On the whole, 3224 urine and 5018 stool samples were examined during this period. 1965(60.95%) of the urine samples were from males and 1259(39.05%) from females. Of the

total stool sample, 3026(60.34%) were from males and 1992(39.66%) from females. Prevalence rates of 1.74% and 3.05% were recorded for *S. haematobium* and *S. mansoni* infections respectively. There was no significant association between age, sex and prevalence of *S. mansoni* infection. The intensity of schistosomiasis recorded during this period could be described as light. Maximum egg output was less than 60 eggs/10ml of urine. Three species of fresh water snails were encountered in various water bodies in the area of study. These are: *Lymnaea natalensis*, *Biomphalaria pfeifferi* and *Bulinus globosus*. *Biomphalaria pfeifferi* shedded more brevifurcate cercariae and was found to be infected with *S. mansoni*. *Bulinus globosus* was found to be infected with *S. bovis* and some eggs recovered from mice resembled that of *S. haematobium*.

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the superior mesenteric veins. The pathologic lesions seen are mainly due to the reactions of the host to eggs lodged in the tissues (Edington and Gilles, 1976). *S. haematobium* causes the vesicular form of the disease or urinary schistosomiasis and *S. mansoni* causes the more lethal intestinal schistosomiasis (Odei, 1961). Depending on the severity of the infection, few symptoms are produced in urinary schistosomiasis namely, haematuria and dysuria. Established infections due to *S. mansoni* and *S. japonicum* cause recurring diarrhoea, blood and mucus stained stool, abdominal pains, enlargement of the liver and spleen and anaemia (Edington and Gilles, 1976). It has been observed that practically any system or organ in the body may be involved.

By rendering people less resistant to other infectious diseases and by weakening their ability to work, schistosomiasis reduces national output and thereby engenders poverty. It affects the development of the young and in some cases, has been known to cause death of its victims (Chandler, 1952; Ansari, 1973; Ejezie and Ade-Serrano, 1981).

The increased emphasis on water resource development and irrigated agriculture has created adequate environment for the proliferation of the snail intermediate hosts. This has brought about an increase in transmission around these areas (Sturrock, 1974; Scott *et al.*, 1982).

In Nigeria, a number of epidemiological studies have been carried out in certain parts of the country (Ramsay, 1934; Gilles et al., 1965; Pugh, 1979; Ejezie, 1984; Edungbola, 1988), but available information remains inadequate to give the true picture of the disease status in the country as a whole.

The objectives of this study are:

1. To determine the prevalence and intensity of Schistosomiasis among school children in Kachia Local Government Area of Kaduna State, Nigeria.
2. To determine the pattern of infection in the area over a five year period, using available hospital records.
3. To determine the occurrence and distribution of snail *intermediate hosts in the area.*

The results it is hoped will provide a baseline data on the status of the disease in the area.

CHAPTER 2

LITERATURE REVIEW

2.1 The Schistosomes

The Family Schistosomatidae are dioecious Digenetic parasites whose adults are found in the blood vascular system of vertebrates. Of the five genera within the family that are confined to mammals, only the genus *Schistosoma* contain species that are of medical and veterinary importance.

Theodore Bilharz (1851) discovered the first schistosome (*S. haematobium*) in the veins of a man at autopsy in Cairo and it was described in 1852. The schistosome life-cycle was not however elucidated until 1913 by Miyairi and Suzuki when they showed that *S. japonicum* develops in the hydrobid snail *Oncomelania huspensis nosophora.*

According to Rollinson and Southgate (1987), there are currently eighteen recognized species of *Schistosoma.* Table 1 gives their snail intermediate hosts, mammalian hosts, and broad geographical distribution. Five species are considered important parasites in man: *S. haematobium*, *S. mansoni* and *S. japonicum* are the most widely spread while the other two *S. intercalatum* and *S. mekongi* have localized distribution. Other species such as *S. mattheei* and *S. bovis* which naturally infect animals can occasionally infect man. Rollinson and

Southgate (1987) have considered the *Schistosome* species to belong to three groups or complexes which centres around *S. haematobium*, *S. mansoni* and *S. japonicum*. This division is based mainly on their snail hosts, egg morphology and the genera of the intermediate snail in which the parasite develops. Under this system, species with terminal-spine to their eggs are referred to as "terminal-spined" egg group which is synonymous with *S. haematobium* group. Similarly, those species with lateral spine eggs are placed with the *S. mansoni* group and those species with round minutely spined or spineless eggs are placed with the *S. japonicum* group. However, the difficulties encountered in the identification of schistosomes arise when distinctive morphological characters are lacking. This has been seen in the case of *S. haematobium* and *S. curassoni* which share similar egg morphologies and when species overlap in their distribution as in many parts of Africa. In such cases it is recommended that further reliable characterization be employed such as enzyme analysis and DNA studies.

2.1.1 Life-Cycle Pattern

From the standpoint of development and life history, the Digenea possesses by far the most complex of developmental cycles among all members of the Animal Kingdom.

Table 1 Details of *Schistosoma* species, distribution and their definitive mammalian hosts (Rollinson and Southgate, 1987).

Schistosoma Species	Snail host genus	Continental distribution	Mammalian orders containing important definitive hosts
***S. haematobium* Group**			
S. haematobium (Bilharz, 1852) Weinland, 1858	*Bulinus*[a]	Africa and adjacent regions	Primates
S. intercalatum Fisher, 1934	*Bulinus*	Africa	Primates
S. Mattheei Veglia and Le Roux, 1929	*Bulinus*	Africa	Artiodactyla
S. bovis (Sonsino, 1876) Blanchard, 1895	*Bulinus* *Planorbarius*	Africa and adjacent regions	Artiodactyla
S. Curassoni Brumpt 1931	*Bulinus*	Africa	Artiodactyla
S. margrebowei Le Roux, 1933	*Bulinus*	Africa	Artiodactyla
S. Leiperi Le Roux, 1955	*Bulinus*	Africa	Artiodactyla
***S. Mansoni* Group**			
S. mansoni Sambon, 1907	*Biomphalaria*	S. America Caribbean Africa Madagascar	Primates Rodentia
S. rodhani Brumpt, 1931	*Biomphalaria*	Africa	Rodentia Carnivora
S. edwardiense Thurston, 1964	*Biomphalaria*	Africa	Artiodactyla

Table 1 (continued)

Schistosoma Species	Snail host genus	Continental distribution	Mammalion orders containing important definitive hosts
S. hippopotami Thurston, 1963	?	Africa	Artiodactyla
***S. indicum* Group**			
S. indicum Montgomery, 1906	*Indoplanorbis*	India S.E. Asia Sri Lanka	Artiodactyla
S. spindale Montgomery, 1906	*Indoplanorbis*	India S.E. Asia Sri Lanka	Artiodactyla
S. nasale Rao, 1933	*Indoplanorbis*	India Sri Lanka	Artiodactyla
S. incognitum Chandler, 1926	*Lymnea Radix*	India S.E. Asia	Rodents, Carnivora Artiodactyla
***S. japonicum* Group**			
S. japonicum Katsurada, 1904	*Oncomelania*	China Japan Phillipines, Taiwan Indonesia	Primates Rodentia Carnivora Perissodactyla Artiodactyla
S. mekongi Voge, Bruckner and Bruce, 1978	*Tricula*	S.E. Asia	Primates Carnivora
S. sinensium Pao, 1959	*Tricula*	S.E. Asia	Rodentia

During the typical life cycle of Schistosome, the worm utilizes two hosts - one being the definitive host and the other, the intermediate host. The intermediate host is usually a fresh water snail. In each host, the parasite takes on one or more different forms. In the intermediate host, the parasite assumes various larval forms each of which develops asexually from the preceeding generation. It is only in the definitive host that sexual reproduction occurs.

The life cylce of the schistosomes starts when eggs laid by the adult female are passed out of the host in urine or faeces. When the eggs get in contact with water, the miracidium hatches out. The free swimming miracidium finds and penetrates a suitable snail host, and transforms into mother sporocyst. Daughter sporocysts are differentiated and these eventually produce large numbers of furcocercous cercariae. These escape from the snail and become free swimming. When the cercariae come in contact with a compatible host, they actively penetrate the skin. Once successful penetration occurs, the cercariae lose their tails and migrate in the host to their predilection sites where sexual maturity takes place.

A correlation exists between such variables as length of prepatent period, adult worm size, rate of progeny production and progeny size. The prepatent period in the mammalian host tends to be characteristic for the species, with marked

differences occurring in the minimum time required to reach patency (Loker, 1983). The prepatent period was observed to vary between geographical strains of species and could be much longer in unfavourable hosts.

The length of prepatent period in the molluscan host has been found to be highly dependent upon environmental temperature, the size and age of the snail, the number of miracidia penetrating, host environmental factors such as nutrition, crowding and overall compatibility between the schistosomes and snails (Loker, 1983). Marked differences have also been observed between schistosome species and strains of their intermediate host. Compatibility between parasite and snail intermediate host is largely determined by genetic factors (Rollinson and Southgate, 1985). The relationship between species and strains of parasite and their actual and potential intermediate snail hosts can result in marked differences in infection rate, duration of infection and snail mortality.

2.1.2 Intermediate Hosts of Schistosomes

In general *S. haematobium* in the Afrotropical region is transmitted by snails of the *Bulinus africanus* group; in the Mediterranean area and Southwest Africa by the tetraploid members of *B. truncatus/tropicus* complex and in Arabia and Mauritius by members of the *B. forskali* group.

In West Africa three of these snail groups are known to act as host for *S. haematobium* (Wright, 1966; Brown, 1980). A number of species of *Bulinus* have been implicated in the transmission of *S. haematobium* in Nigeria (Gills et al., 1965a, Betterton, 1984). This species of snail has also been reported in Ghana (Paperna, 1968; Chu et al., 1978), The Gambia and Sierra Leone (Odei, 1961). *B. rohlfsi* has also been reported in Nigeria (Cowper, 1963; Hira, 1969; Betterton, 1984), Cameroun and Ghana (Odei, 1961; Paperna, 1968; Chu *et al.*, 1978). Recently, *B. senegalensis* which occurs in Senegal, the Gambia and Mauritania (Webbe, 1982) has also been found in Nigeria (Betterton *et al.*, 1983; Ndifon, personal communication). *B. senegalensis* is known to be infected by two strains of *S. haematobium* in Nigeria (Bassey, 1988).

Twelve species of *Biomphalaria* have been recognised and all those that have been tested appear to show some compatibility with at least certain strains of *S. mansoni* (Brown, 1980). *B. pfeifferi* shows a broad compatibility and is an important intermediate host of *S. mansoni* (Wright, 1973; Brown, 1980). In West Africa *B. pfeifferi* is responsible for the transmission of *S. mansoni* in most territories. *B. pfeifferi* has been found in Cameroun, The Gambia, Ghana, Sierra Leone and Nigeria (Odei, 1961; Cowper, 1973; Wright, 1973; Brown, 1980; Bassey, 1988). Another potential snail

host of *S. mansoni*, *B. sudanica* has been found in shores of Lake Chad (Betterton et al., 1983; Fryer, 1986).

2.2 Hybridization of Schistosomes

Where two species of adult schistosomes develop in the definitive host, or the cercariae of one species penetrate and partially develop in the host, at least three types of interaction may occur; (a) hybridization, which is the result of interspecific pairing, successful mating and production of viable eggs; (b) interspecific pairing with the production of parthenogenetic eggs; and (c) heterologous immunity, where development or partial development of one species will confer at least some immunity upon the host against other species (Southgate and Rollinson, 1987).

2.2.1 Natural hybrids

There is ample evidence of the occurrence of natural hybrids of the cattle parasite *S. mattheei* and of the human parasite, *S. haematobium* in the Eastern Transvaal, South Africa (Pitchford, 1959, Pitchford, 1961). Pitchford (1961) demonstrated that *S. mattheei* is prevalent in man but apparently always occurs together with either or both of the human parasites *S. mansoni* and *S. haematobium* . He suggested hybridization when he observed eggs intermediate in shape in

individuals containing both *S. haematobium* and *S. mattheei*. Further confirmatory evidence of hybridization was obtained by passaging suspected hybrid miracidia from suspected hybrid eggs through laboratory snails and four rodent species and a calf as definitive hosts (Pitchford, 1961). Wright and Ross (1980) from experiments using *S. haematobium* and *S. mattheei* confirmed that hybridization does occur between these two species. As explained by Southgate and Rollinson (1987), prior to intensive livestock farming, the main definitive hosts for *S. mattheei* were probably wild bovines; the transmission foci of *S. mattheei* and *S. haematobium* were therefore to some extent geographically isolated. However, the introduction of intensive livestock farming has increased the definitive host-range of *S. mattheei* and coincidentally brought transmission foci of *S. mattheei* closer to *S. haematobium* in some parts of South Africa. This increased the chances of interaction between the two species in man.

Hybridization between two human schistosomes; *S. haematobium* and *S. intercalatum* has been observed in Cameroun. A survey demonstrated a clear correlation between the distribution of the snail hosts, *B. forskali* (for *S. intercalatum*) and *B. rohlfsi* (for *S. haematobium*) and the distribution of the schistosomes in human population (Southgate *et al.*, 1976). Burchard and Kern (1985) have also

suggested hybridization between *S. intercalatum* and *S. haematobium* based on the polymorphic-shaped eggs seen in urine samples in Western Gabon.

2.2.2 Laboratory Hybrids

Based on the observations of natural hybrids of schistosomes, several cross-mating of different species have been successfully carried out in the laboratory.

Le Roux (1954) described a successful cross-mating between *S. mansoni* and the closely related *S. rodhaini*. Taylor (1970) produced the first laboratory hybrids between different species/ strains of schistosomes belonging to the terminal-spined egg complex. Reciprocal hybrids of *S. bovis* (Iran strain), and *S. mattheei* (South Africa strain) were produced in these crosses. The cross of *S. mattheei* male and *S. bovis* female produced some viable eggs for three generations and the female worms of the F_1 generation produced eggs intermediate in shape between those of the parent species; but the cross of *S. bovis* male and *S. mattheei* female was less fertile. Viable crosses were produced between *S. haematobium* male (Nigeria strain) with *S. bovis* female and *S. mattheei* female, respectively; but a cross between *S. haematobium* male (Iran strain) and S. *bovis* female (Iran strain) was of very low viability. Taylor (1970) demonstrated

that the viability of the hybrids varied according to the parasite strain, and that even viable crosses of the same species were not always reciprocal. Wright and Southgate (1976) confirmed Taylor's observation that schistosomes varied according to the origin of the parent stock.

A series of crosses between *S. intercalatum* (Cameroun strain) and different isolates of *S. haematobium* have been produced. They found that the crosses between *S. haematobium* male and *S. intercalatum* female was not only viable but exhibit heterosis (hybrid vigour) in the F_1 generation. The hybrid was able to develop in both species of snails, being more infective to *B. rohlfsi* than *S. haematobium*, more infective to hamsters, matures more quickly in snails and hamsters and is more fecund than the parentals.

2.3 Diagnosis of Schistosomiasis

Epidemiological studies of human schistosomiasis infection depend upon examining faeces and urine preferrably using quantitative methods (WHO, 1983, a,b,c). It has been recommended that urine samples should be collected at the time of peak *S. haematobium* egg excretion which falls between 10.00 hrs and 14.00 hrs (Pugh, 1979).

Faeces are usually examined with the cellophane or glass sandwich thick-smear technique (Katze *et al.*, 1972; Sleigh *et al.*, 1985) to give the value for the number of ova per gram of

faeces (Wilkins, 1987). However, alternative concentration techniques (Knight *et al.*, 1976; Bell, 1963) could be used.

Teesdale *et al.*(1985), observed that there could be considerable variation in a subjects egg count and that at low intensities of infection there is inevitably an increased likelihood of "false negatives". Urine flow rates have also been found to influence the number of ova in a given volume of urine and the consistency of faeces has been shown to affect egg count (Teesdale, 1985). It had earlier on been recommended however, that replication of observations is the most obvious way of overcoming these difficulties (McCullough and Bradley, 1973; Warren *et al.*, 1978; Wilkins and Scott, 1978).

A number of immunodiagnostic techniques have been used in the diagnosis of schistosomiasis. These include: the intradermal test which although believed to be of value also give positive reaction to other animal schistisome and also continue to give positive results for years even after the patient has been cured; the complement fixation test, which has been widely used because of its high sensitivity especially in the acute phase of the disease; the cercarien hullen reaktion test (CHR); the cercarial fluorescent antibody test; the indirect haemaglutination test (Laughlin, 1986, Ukoli, 1990). Several recent studies have established that

the enzyme-linked immunosorbent assay (ELISA) is a potentially useful immunodiagnostic test for schistosomiasis (Abdel-Hafez *et al.*, 1983, 1984; Deelder *et al.*, 1989; Qian and Deelder. 1983). The chemical reagent strips which indicate semi-quantitative levels of blood and protein in urine have been widely used as an indirect diagostic test in urinary schistosomiasis (Feldmeier *et al.*, 1982a; Mott *et al.*, 1983; Pugh *et al.*, 1980b; Tanner *et al.*, 1983 and Wilkins *et al.*, 1979).

While immunodiagnosis may be useful in a clinical situation, it is said to be of less value in epidemiological studies, as tests convey limited information about intensity. These tests being highly specialized require the services of highly trained personnel. However, in some circumstances they may be easier to use than microscopy if the aim is to obtain an indication of the prevalence of infection. They can also be of value in assessing the incidence of infection after control measures (Wilkins, 1987).

2.4 Epidemiology of Schistosomiasis

Prevalence and intensity are interrelated and in general the higher the prevalence in a group, the greater is the mean egg count among the infected subjects (Jordan, 1972). However, there are reports suggesting geographical variation

in the relationship in *S. haematobium* infection. El Alamy and Cline (1977) and Zumstein (1983) observed surprisingly low *S. haematobium* egg counts to be associated with a moderate or high prevalence rates.

Current estimates of the prevalence of schistosomiasis put the figure at 200 million people in the world (WHO, 1990). The Western hemisphere (Brazil, Venezuela, Surrinam and Carribean Islands) has been found to have a widespread prevalence of *S. mansoni* infection (Webbe, 1982). Prevalence rates as high as 96% for *S. haematobium* have been reported in West Africa (Wen and Chu, 1984), but a generally low prevalence rate for *S. mansoni* infections have been recorded for most countries in this region. S. mansoni infections appear to be highly endemic in countries north of the Sahara both in irrigated and non-irrigated areas (Odei, 1961).

In Nigeria, the Northern parts of the country is considered to be the most endemic for *S. haematobium* infections and of medium endemicity for *S. mansoni* infections. Increased levels of prevalence rates (27-58.4%) of *S. haematobium* infections have been associated with construction of dams and extensive irrigation projects in Nigeria (Tayo *et al.*, 1980, Pugh *et al.*, 1980; Bassey, 1988).

The possible role of protective immunity in schistosomiasis infection had long been considered and it had

been suggested that some form of protective immunity may be responsible for the lower prevalence and intensity of infection in older subjects (Fisher, 1934). McCullough and Bradley (1973) applied the experimentally derived concept of concomitant immunity to the epidemiology of *S. haematobium* and suggested that the relative stability of egg output which they observed might represent the effect of concomitant immunity. They proposed that, if this were the case, then the relationship of *S. haematobium* infection to age could reflect the acquisition of solid concomitant immunity by the age of ten years after which established worm burdens were subject to constant mortality until the last worm was lost in the third or fourth decade of life and susceptibility regained. Warren (1973) however, presented an alternative view, that in many foci, the observed decline in prevalence and intensity of infection is due to diminished contact with water by adults in transmission sites where there are only small numbers of cercariae, with exposure to infection being the factor that limits worm burden rather than immunity. In a reinfection study in a *S. mansoni* focus, Butterworth *et al.* (1985) observed that the resistant children were significantly older than the susceptible ones suggesting a gradual acquisition of some degree of protective immunity. A more recent and similar observation was made by Wilkins et al. (1987) in a Gambian

community in which post treatment reinfection with *S. haematobium* was studied in a random sample of subjects of all ages. But according to Wilkins (1987), available evidence suggests that protective immunity may be more significant in *S. haematobium* and is more marked compared with the variability of pattern seen in *S. mansoni*. He further stated that the epidemiological importance of protective immunity in schistosome infection may be related to the intensity of transmission, with protective immunity being epidemiologically unimportant in foci of low prevalence and intensity of infection.

2.4.1 Variation in Prevalence of Schistosomiasis

2.4.1.1 Variation in space and time

It has been shown that considerable variation exist in the prevalence and intensity of schistosome infections over relatively short distances in endemic areas such as between one group of huts to another (Forsyth and Bradley, 1966) and between nearby villages (Pugh and Gilles, 1978; Polderman, 1979; Scott *et al.*, 1982; Polderman et al., 1985).

A marked variation in prevalence one or few kilometers apart was observed in The Gambia (Goll and Wilkins, 1984); and is believed to reflect the presence or absence of habitat suitable for the intermediate hosts and the individual characteristics of these habitats and their proximity to

villages (Wilkins, 1987). Both geomorphology and pattern of human activity and settlement appear to influence prevalence (Goll and Wilkins, 1984; Polderman *et al.*, 1985). In the Machakos district of Kenya, altitude has been found to be negatively correlated with *S. mansoni* infection (Nordbeck *et al.*, 1982).

de Lima eCosta *et al.* (1985) on the other hand found out that in urban communities, variation in prevalence between different districts of the same town was related to variation in socio-economic status and the provision of piped water.

Variation in prevalence and intensity also occurs in time as well as place, most obviously when new foci appear; such as man-made water bodies (Scott *et al.*, 1982). Water resource development and irrigated agriculture are responsible for much further spread of schistosomiasis, but according to Wilkins (1987), the two are not simply inevitably related. In Sierra Leone for example, transmission does not appear to be related to rice cultivation (White *et al.*, 1982) whereas in neighbouring Liberia such associations have been reported (Kazura *et al.*, 1985).

Variation between years in the pattern of rainfall has also been shown to be associated with marked variation in the incidence of infection in The Gambia (Goll and Wilkins, 1984).

2.4.1.2 Variation between subjects

The analysis of the distribution of egg counts in a group usually shows that it is over-dispersed with a variance greater than the mean (Wilkins, 1987). Bradley and May (1978) recommended the negative binomial distribution of counts in the analysis of egg count data as a more accurate description of the pattern of infection.

In an *S. mansoni* endemic community in Ethiopia, 50% of the eggs excreted were found to come from 5% of the community (Polderman, 1979), while in Brazil the same proportion came from 6% of the community (Lehman *et al.*, 1976). The possession of a high egg count is believed to be relatively persistent rather than a transient attribute. Studies of cohorts of children infected with *S. haematobium* in Tanzania (McCullough and Bradley, 1973) and in The Gambia (Wilkins and Scott, 1978) have shown that those with high egg counts at the beginning of the study tended to have high counts three years later. Sleigh et al. (1985) also reported the relative stability of *S. mansoni* egg counts over a three-year period.

A significant correlation has been found between children's egg output before treatment and after reinfection has taken place from studies in a Kenyan community endemic to *S. mansoni* (Bensted-Smith *et al.*, 1987). In areas where both *S. haematobium* and *S. mansoni* exist, the prevalence and

intensity of infection have been found to be higher in subjects with *S. mansoni* (Clarke, 1966; Kvalsvig and Schutte, 1986).

The prevalence and intensity of schistosomiasis is greatly dependent on age. Wilkins *et al.* (1979) stated from their observations that prevalence and intensity in *S. haematobium* infection rise to a peak early in the second decade of life after which they both fall to much lower values in the fourth decade and persist with little change into old age. Polderman (1979 observed a similar pattern for *S. mansoni* although *S. mansoni* infections showed greater variation between foci.

In Brazil it has been observed that egg counts are highest in the 10 to 14 year-old and falls markedly after this age while maximal prevalence is only reached in the 20 to 24 year old age group (Lehman *et al.*, 1976). Earlier studies Pesignan *et al.*, 1958) suggest that the relationship between age and the prevalence and intensity of *S. haematobium* infection resemble that shown by *S. mansoni*.

The prevalence of schistosomiasis in many foci is greater in males than in females (Farooq *et al.*, 1966; Pessignam *et al.*, 1958; Pugh and Gilles, 1978). In The Gambia however, Wilkins *et al.* (1984a) found the prevalence and intensity in the two sexes to be similar despite apparent differences in

exposure to infection. As White *et al.* (1982) observed, in the Mende community in Sierra Leone where fishing is a female occupation, the prevalence was higher in females. Farooq *et al.* (1966) had earlier shown that all groups with a high occupational contact with water, had a high prevalence of infection as did muslims in comparison with christians.

In the Machakos district of Kenya, Nordbeck *et al.* (1982) found lower *S. mansoni* egg counts in wealthier households and in those with better farms.

In the case of immigrants in endemic areas, Kloetzel and Da Silva (1967) have stated that the length of exposure and infection rather than a factor related to age such as water contact should be seen as determining the pattern.

2.4.1.3 Water contact and exposure to infection

Water contact activity is described as activity leading to both the exposure of the individuals to infected water bodies and contamination by the infected individuals of water bodies infested by potential snail hosts (WHO, 1979). Water contact activities may be broadly classified into domestic, recreational, religious and occupational. It has been established from a number of studies that the majority of contact is domestic and recreational and that children have more such contact than adults (Dalton, 1976; Dalton and Pole, 1978; Tayo *et al.*, 1980; Kvalsvig and Schutte, 1986; Bassey,

1988). Dalton and Pole (1978) showed that there was a correlation between age and water contact in relation to egg output of observed subects in Ghana. Barbour (1985) on the other hand thinks that only age and sex are the relevant significant factors in the studies of water contact patterns in the prevalence of *S. haematobium* infection. Dewolfe Miller (1981) noted in Egypt that the prevalence of *S. haematobium* and *S. mansoni* infections were lower when individuals obtained water for domestic use or recreational purposes from protected sources (water piped from a deep bore-hole or water treatment plant). As stated by Wilkins (1987), the analysis of data to assess individual exposure to infection and the importance of different activities is difficult and involves assumptions which can lead to ambiguity in interpretations. The critical factor however, in maintaining transmission and consequently, the prevalence of schistosomiasis with regards to water contact is the level of contamination through indiscriminate urination and pollution of water with faeces.

2.5 Control of Schistosomiasis

The objective of control in the past has been defined as interruption of transmission. This objective is said to have been infrequently attained in spite of extensive and intensive use of existing tools (Mott, 1987).

Currently, the main objective of schistosomiasis control is to achieve reduction of the disease. The current trend is to integrate control programmes into the general health delivery system in endemic countries.

Control of schistosomiasis include health education, environmental modification, sanitation and water supply, chemotherapy and snail control.

2.5.1 Health Education

Health education now ranks as the highest priority in schistosomiasis control programmes (Teesdale, 1986; WHO, 1985). The importance of community participation has been demonstrated by a number of workers including Ravaoalimalala (1986) and Tanner *et al.* (1986). All control programmes require the knowledge, attitude and practices of a community *in relation to personal hygiene, perception of schistosomiasis* and its diagnosis and treatment be understood before action is initiated (Tiglao, 1982). As Mott (1987), pointed out, the information component of schistosomiasis control now emphasizes the role of man in the cycle of infection. However, the emphasis of the health education message should be on the role of the individual spreading schistosomiasis to his family and community by lack of hygiene - indiscriminate urination and defaecation - as well as in contracting the

disease in contaminated water. Mobilization of mothers, community groups and school-teachers is believed to promote effective health education. The use of health education materials in national and local languages, use of radio, television and video tapes have enhanced communication of information about the importance of schistosomiasis and the role of human behaviour in the spread of the disease (Mott, 1987).

2.5.2 Habitat Modification

Habitat modification through drainage, land reclamation and good water management practices have been shown to be an effective means of eliminating the intermediate snail host of schistosomiasis. In an irrigated scheme in Iran, swamp drainage and proper design have been cited as important snail control measures (Herbert, 1978). In the Philippine (Santos, 1984; Makiya *et al.*, 1986) and in China (Mao, 1986) where amphibious *Oncomelania* snails transmit *S. japonicum*, a wide range of environmental modification has been employed. Small dam construction for reservoirs could be modified to reduce the risk of schistosomiasis transmission (Brinkmann and Steingruber, 1986). In irrigated schemes, canal lining, a free-draining system reduced reservoirs and proper water

scheduling is believed to contribute to effective control (Bolton and Drapper, 1986; Drapper and Bolton, 1986).

2.5.3 Sanitation and Water Supply

The aim of these two approaches is to reduce human water contact and contamination of water by infected individuals. The construction and use of latrines should be encouraged to improve the general standard of hygiene and to reduce the general incidence of other faecal-borne diseases as well.

The beneficial role of water supply in the control of schistosomiasis has now been recognized (Jordan *et al.*, 1982; McJunkin, 1983). A number of innovative types of water supply have been tested in endemic areas of Brazil (Sleigh *et al.*, 1986a,b) and Sudan (El Basit and Brown, 1986). The cost of water supply systems varies and must be adopted to local conditions (Werler, 1986a).

2.5.4 Chemotherapy

While other means of schistosome control merely reduce transmission without any direct effects on human worm load, chemotherapy reduces output of live eggs from the patients body and in doing so diminishes transmission. The use of chemotherpay in control requires a clear definition of aims, selection of the appropriate chemotherapeutic agent and

decision or the dosage and frequency of administration to be followed as well as on the organization of the delivery system (WHO, 1980).

The anti-schistosomial drugs available for field use are Oxamniquine, Metrifonate and Praziquantel (WHO, 1980). Reduction of morbidity after treatment has been validated with metrifonate for *S. haematobium* infection (Doehring *et al.*, 1984) and *S. japonicum* infections (Hadidjaja *et al.*, 1985). Praziquantel is now regarded as the drug of choice being effective against all three human schistosomes when administered orally. Tolerance to this drug has been observed to be good with only mild to moderate side effects which are mostly of short duration (WHO, 1980).

The timing of treatment varies between endemic areas according to the prevalence and intensity of infection prior to treatment. Retreatment may not be necessary for up to three years if the prevalence is initially low (Santos, 1984).

The approach in large scale use of these anti-schistosomal drugs could be any one of the following: Mass treatment, selective population chemotherapy or selected group treatment (WHO, 1985). According to Mott (1987) the decision to employ any of these approaches must be based on adequate epidemiological data which accurately estimate the proportion of the population that is infected. Mass treatment was used,

for example, in north east Brazil when the prevalence in the school-age population surveyed was greater than 20% thus indicating that the prevalence in adults was high (Machado, 1982).

Apart from the effectiveness of the drug, the cost of delivery and logistics are major considerations. While metrifonate is relatively cheap, the cost of repeated treatment by specialized team can be considerable (Saladin *et al.*, 1983; Korte *et al.*, 1986).

2.5.5 Snail Control

The use of molluscicides in snail control has always had a role in integrated schistosomiasis control programmes.

The focal use of molluscicides at epidemiologically important water contact sites is said to have reduced the cost of snail control. However, in order to be effective, mollusciciding requires repeated long-term application by highly skilled personnel (Mott, 1987).

The more common molluscicides used are Niclosamide, Trifenmorph, Sodium Penthachlorophenate, Copper Sulphate and Nicotinanilide (WHO, 1980). Snail control is based upon the identification of foci and seasonal variations in population of snail in an approach which can be applied in many endemic situations; and even in large impounded habitats, it may permit cost effective molluscicide regimens. However, such

delivery mechanisms will depend on surveillance procedures, and these may not be feasible in large irrigated areas where population density is high and human water-contact pattern are diffuse. In these areas wide chemical control based on water management procedures will offer the most cost effective approach (WHO, 1980).

A number of of molluscicides of plant origin have also been used. Endod, *Phytolacca dodecandra*, is believed to be the most thoroughly studied example. Being a Saponin, it is not target-specific. The use of molluscicides of plant origin obviate importation of synthetic chemicals (WHO, 1980).

In Nigeria a number of plants have been studied for molluscicidal activity. These include; *Tetraplenra tetraptera* (Adewumi *et al*; 1980), *Calliandra portoricensis* (Adewumi and Margins 1981, *Balanites aegyptica*, (Daziel and Mccullough, 1982), *Dichrostachys glomerata*, *Lophira alata* (Kloos and McCullough, 1983)and shells of *Anacardium occidentale* (Cashew nuts) (Sulivan *et al*, 1982).

A number of organisms, which serve as potential competitors, predators or parasites have been used in the biological control of snails. Species such as *Limnogeton feiberi*, *Marisa cornuarietis*, *Tereba granifera* and *Pomacea haustrum* have been found to compete as voracious feeders with the adult and also ingest egg masses and young *Biomphalaria*

glabrata in Pueto Rico (WHO, 1980). Other species of snails studied include *Helisoma durgi*, *Potamopyrgus* and *Physia* species. Fish such as *Clarias gariepinus* and *Tilapia* species and ducks are potential biological control agents in East Africa and Nigeria (Cowper, 1971). Parasitic fungi, leeches, nematodes and oligochaetes and trematodes have all been tried as potential biological control agents (Malek and Cheng, 1974). However, the use of biological agents in schistosomiasis control in most cases is minor and supportive rather than dorminant (WHO, 1980).

CHAPTER 3

MATERIALS AND METHOD

3.1 The Study Area

Kachia Local Government is situated about 120 km south of Kaduna, the capital of Kaduna State, Nigeria. The village schools from where school children were randomly selected are shown in Figure 1. Different ethnic groups live in the area and the majority are christians. Farming is the principal occupation of the population. A number of households raise pigs on an entirely free range system. A few Fulani herdsmen keep other livestock such as cattle, sheep and goat. The vegetation of the area is of the West African Sudan Savanna type. There are two distinct season in the area, the dry season and the rainy season. Duration of the seasons is not constant as variations may occur from year to year. There are no major irrigation or other water resource development project in the area but there are two large water channels that run through Kachia and Gumel. The dry season in this area is characterized by very high temperatures (28-34°C) during which period most of the exposed water bodies and wells virtually dry up.

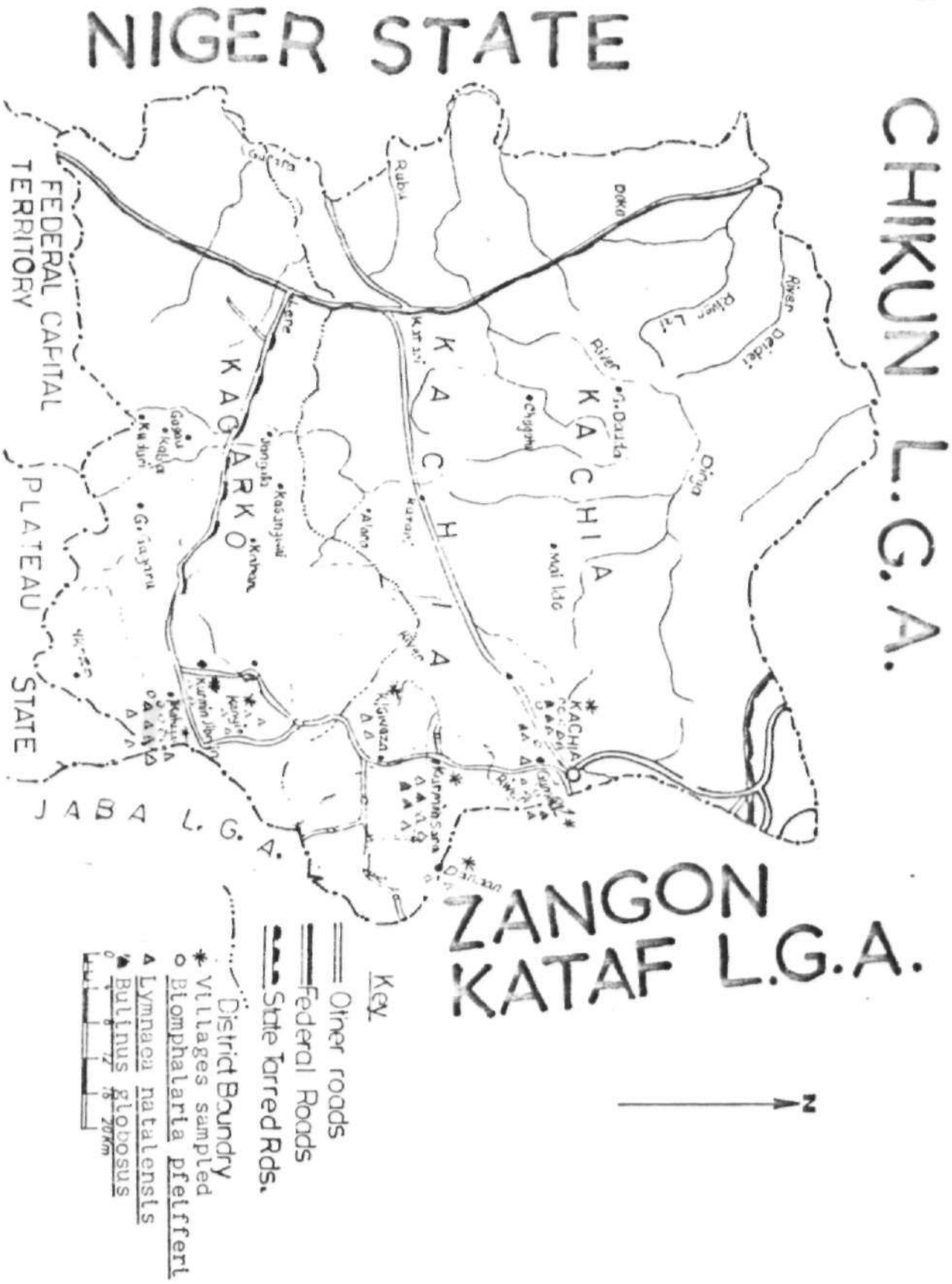


Fig. 1 : Map of Kachia Local Government Area Showing the various Village Schools Sampled.

3.2 Parasitological Survey

Prior to the start of the study a first visit was made to the local government authorities seeking for permission to undertake the study. Also prior to the collection of samples, a visit was made to each school selected explaining the objectives of the study.

The education unit of the Kachia Local Government has divided all the primary schools in the area into ten zones. The average number of schools in each zone is about eight. All the village schools are within a radius of 30 km from the headquarter, Kachia.

By random sampling with replacement three zones were selected. By a similar method eight schools (LEA Kachia I, LEA Gumel, LEA Dandan, LEA K/Sarah, LEA K/Gwaza, LEA Kenyi, LEA K/Jibrin and LEA Katugal) were chosen from these three zones; three from each of the first two zones and two from the third zone. This was based on the total number of schools in each of the zones. Stratified random sampling was then used in selecting the pupils involved in the investigation.

A questionnaire was administered to each of the pupils chosen for details of age, sex, location of home, sources of water supply, frequency of water contact, any previous case of blood in urine (haematuria) or in the stool and any previous treatment or medication (Appendix).

A total of 820 children between the ages of 5 and 19 years were involved in the survey. Four hundred and seventeen (417) (50.85%) of this total number were boys and 403 (49.15%) were girls. Five hundred and eighty (580) (71.34%) of all children sampled were between the ages of 8 and 13 years.

3.2.1 Collection and Analysis of Urine and Faecal Samples

Each pupil was given a labelled plastic container with a snap-on-lid and asked to provide midstream urine specimen. All urine samples were collected between 11.00 hrs and 13.00 hrs. This falls within the estimated time of peak output of *S. haematobium* eggs (Pugh, 1979a). The samples were transported back to the laboratory for analysis. In the laboratory each urine sample was grossly examined for overt blood. Each specimen was then thoroughly agitated to ensure uniform distribution of schistosome eggs if present. 10 cm^3 of the sub-sample was then taken from each gross sample in a centrifuge tube and the tube centrifuged at 1,500 rounds per minute (rpm) for two minutes. The supernatant was decanted and the sediment exhaustively examined using a low power objective (x10) of a light microscope. The total number of ova were then counted. The intensity of infection was expressed as number of ova per 10ml of urine. Whenever possible, each urine sample was examined on the day of

collection. However, when not possible, they were stored in a refrigerator at 4°C for analysis the next day. Egg samples were sent to the British Museum for confirmatory identification.

Small polythene bags were used to collect stool samples. All the selected children were taught how to collect the stool specimen using this bag. Each pupil was then given a labelled bag to provide the specimen. All stool specimens examined were collected on the spot and at the same time as the urine specimens.

In the laboratory, approximately 1gm sub-sample of the stool was transferred after thorough mixing, using a spatula into a specimen bottle containing 10 ml of 10% formol-saline. The sample was then mixed thoroughly and strained through a surgical gauze into a centrifuge tube to remove coarse material. The filterate was centrifuged at 1,500 rpm for three minutes. The supernatant was decanted, formal-saline added to the 9 ml mark and then 1 ml of concentrated ether was added. The resulting mixture was shaken vigorously and then centrifuged at 1,500 rpm for three minutes. The supernatant was decanted and the washed sediment examined using the low power objective (x10) of a light microscope. The intensity of infection was expressed as the number of eggs per gm of faeces (epg). Other helminth ova seen were also noted.

3.2.2 Collection of Snail Samples

Snails were searched for in all types of water body in the study areas. This was done by examining the vegetation rocks, logs polythene bags and other floating objects. Snail samples seen were collected by hand or/by using plastic forceps. The snails were kept in plastic jars and taken back to the laboratory for identification.

3.2.3 Experimental Infection of Laboratory Mice

To confirm the type of schistosome infection in the area, the naturally infected snails collected in the study area and brought back to the laboratory were exposed to light in vials containing distilled according to species water for about two hours. At the end of this period the water was examined for cercariae. The cercariae harvested from the snails were used to infect four mice. Each mouse was strapped with the abdomen uppermost on a dissecting board. The abdomen was then shaved and the shaved area wetted well with distilled water. Using a micropipette about 20 cercariae from *Bulinus* snails were directly applied onto the shaved portion. It was then held in this position for about five minutes after which it was then allowed to stand in distilled water for another fifteen minutes to ensure full cercarial penetration in case of an escape from the abdomen. This process was repeated using

cercariae from *Biomphalaria* snails. After twelve weeks post infection the four mice were killed using chloroform and autopsied to recover the adult worms. The worms recovered were then identified.

3.3 Retrospective Study

A retrospective study was also done to investigate the pattern of schistosomiasis among patients that reported at the Kachia Health Centre over a five-year period.

Urine and faecal samples of patients suspected of any disease condition are routinely submitted to the laboratory for analysis. The direct-smear technique was used to examine faecal samples and urine samples were analysed using simple sedimentation technique.

Records of cases reported from January 1987 to December 1991 formed the basis of this study. Other helminth infections recorded during this period were also noted.

The specific rates for each factor were determined. The odds ratios (OR) were also calculated to determine whether or not an association existed between the factor and schistosome infection. A 95% confidence interval was also set for all the variables in each factor and the level of significance determined to show whether a significant association or relationship exist between the variables and schistosome infection.

A case was defined as an individual from whom the characteristic schistosome egg was found either in the urine or faeces. Controls consisted of individuals whose urine and faecal samples were examined and found to be negative.

According to the records, the age group was classified as Adult, Child and "Not Stated". An adult was any individual that was 18 years and above and a child was one below 18 years. A number of individuals had no ages indicated, these were classified as "Not Stated" in this study.

3.4 Statistical Analysis

Chi-squared tests were used to determine the relationship between infection rates of *S. haematobium* and *S. mansoni* with some of the parameters from the questionnaire data.

CHAPTER 4

RESULTS

4.1 Prevalence and Intensity of *S. haematobium*

The prevalence and intensity of schistosomiasis among the school children in the study area are summarized in Tables 2, 3 and 4. The overall prevalence in the study population shows that 18(2.25%) of urine samples collected were found to contain *S. haematobium* eggs. However, 4(22.22%) out of this number were found to contain eggs of unusual shapes. Samples of these eggs were sent to the British Museum Natural History for confirmatory identification. Four types of polymorphic-shaped eggs were identified as belonging to the *S. haematobium* hybrid range (Plates I and II). The fourth type of egg however, had uncertain identity being unusual in shape and slightly more elongated, and which resembled *S. bovis* in outline but not in size. A double infection involving one of the hybrid egg types and normal S. haematobium eggs was found in the urine of an 11-year-old boy. The other hybrid egg types were seen in the urine of three girls in the 7-9-year-age group. No haematuria was observed in the children infected with these hybrid eggs. All these children admitted visiting streams and water bodies that were also frequented by cattle. All hybrid infections were from the same village

Table 2. Overall Prevalence of Schistosomiasis among School Children in Kachia Local Government Area by sex.

Sex	*S. haematobium*		*S. mansoni*		*S. haematobium* and *S. mansoni* combined	
	No. Exam.	No. inf (%)	No. Exam.	No. inf (%)	No. Exam	No. inf(%)
Male	400	6(1.50)	417	12(2.88)	417	18(4.32)
Female	400	12(3.00)	403	9(2.33)	403	21(5.21)
Total	800	18(2.25)*	820	21(2.56)	802	39(4.76)

*4 out of this number were infections involving *S. haematobium* hybrid eggs.

Table 3. Prevalence of Schistosomiasis According to Village.

LEA Village Schools	*S. haematobium*		*S. mansoni*	
	No. Exam.	No. inf (%)	No. Exam.	No. inf (%)
Gumel	170	14(8.24)*	175	4(2.29)
Kachia I	180	1(0.56)	180	9(5.00)
Kurmin Sarah	85	3(3.53)	90	0(0.00)
Dan Dan	70	0(0.00)	70	2(2.86)
Kurmin Gwaza	65	0(0.00)	65	0(0.00)
Kenyi	80	0(0.00)	87	1(1.15)
Kurmin Jibrin	70	0(0.00)	73	2(2.74)
Katugal	80	0(0.00)	80	3(3.75)
Total	800	18(2.25)	820	21(2.56)

*4 out of this number were hybrid eggs belonging to the S. haematobium hybrid range.

school (Gumel). As shown in Table 3 *S. haematobium* infections were only recorded in three village schools from where samples were collected; namely Gumel 14(1.75%, including, hybrid infections), Kachia 1(0.13%) and Kurmin Sarah 3(0.38%). No *S. haematobium* infection was recorded in any of the other village schools from where samples were collected. There was only one recorded case of double infection involving normal *S. haematobium* and *S. mansoni* in the urine samples examined.

The distribution of *S. haematobium* infection according to sex in the sampled population shows that 6(1.5%) of the boys and 12(3.00%) of the girls were positive for *S. haematobium* and its hybrid eggs. The distribution according to age (Table 4) shows that the 5 - 13 age group accounted for 94.44% of the total number of pupils infected. 12(85.71%) of the infected children acknowledged frequenting exposed water bodies for various water contact activities. Out of the urine samples examined, only 3(16.67%) of these had overt blood from all of which *S. haematobium* eggs were found. 742 (92.75%) urine samples had no red blood cells from microscopic examination and only 8 of these were found to contain either *S. haematobium* and S. haematobium hybrid eggs or *S. haematobium* hybrid eggs. Most of the pupils in whom no *S. haematobium* infection was recorded admitted getting in contact with exposed water bodies on a more or less frequent basis. There was no significant association ($P>0.05$) between haematuria and *S. haematobium* infection.

Table 4. Prevalence of Schistosomiasis among School Children in Kachia Local Government Area by Age.

Age Group	*S. haematobium*		*S. mansoni*	
	No. Exam.	No. inf (%)	No. Exam.	No. inf (%)
5 - 7	160	5(3.13)**	165	2(1.21)
8 - 10	270	4(1.48)*	274	5(1.82)
11 - 13	300	8(2.67)*	311	9(2.89)
14 - 16	57	1(1.49)	67	5(7.46)
17 - 19	65	0(0.00)	3	0(0.00)
Total	800	18(2.25)	820	21(2.56)

**Two out of these were hybrids infections.
* One out of these was a hybrid infection.

Individual egg counts ranged from 1 - 60 eggs/10 ml of urine with a geometric mean egg output of 32 eggs/10 ml of urine. 6(33.33%) of the infected had egg counts of 1 - 20 eggs per 10 ml of urine and the same figure had egg counts of 41-60 eggs/10 ml of urine, and 2(11.11%) had egg counts of 21 - 40 eggs/10 ml of urine. On the whole infection with *S. haematobium* in this area was light. There was no significant difference in egg output between males and females ($P>0.05$) and also between the different age groups. The intensity of *S. haematobium* infection was highest in the 11 - 13-year-age group. No infection was recorded in the 17 - 19-year-age group. Figure 2 shows the age and sex distribution of the prevalence of urinary schistosomiasis. There was a slightly higher prevalence in the 5 - 7-year-age group. The intensity according to sex is given in Figure 3.

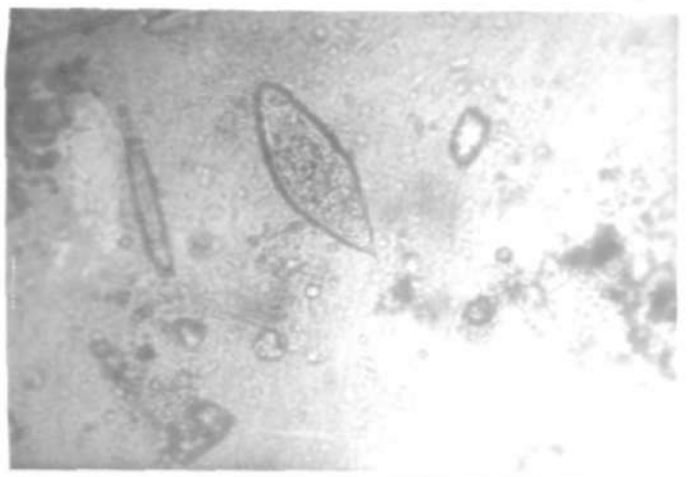
Plate I. Photomicrograph showing *Schistosoma haematobium* eggs.

A. Whole Egg

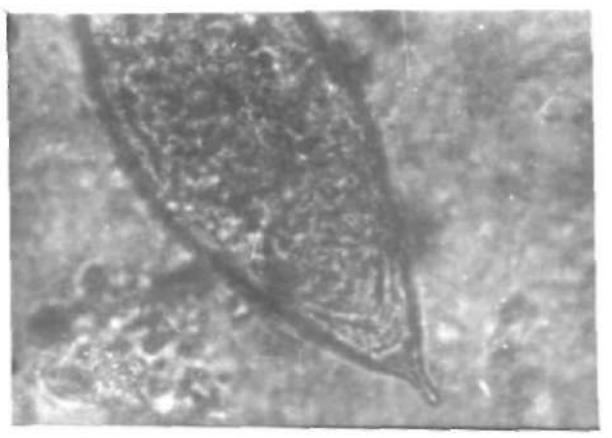
B. Enlarged portion showing terminal spine.

C. Whole egg with comparatively shorter terminal spine.

A



B



C

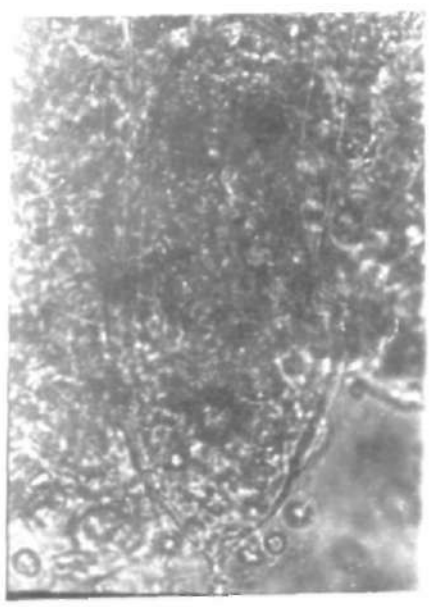


Plate II. Photomicrographs showing *S. haematobium* hybrid eggs seen in urine.

D. One of the polymorphic forms of *S. haematobium.*

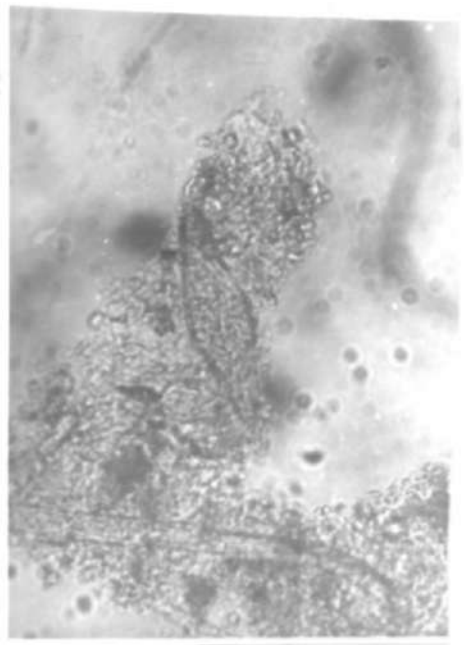
D_1 Enlarged portion of D showing terminal end.

E. Another polymorphic form of *S. haematobium.*

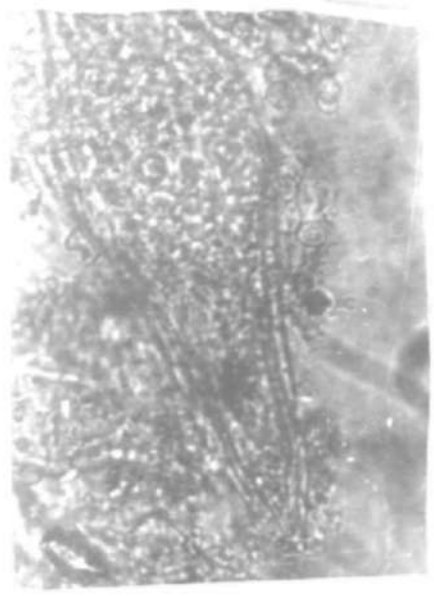
E_1. Enlarged portion of E showing terminal end.

F. Egg resembles *S. bovis* in outline but not in size.

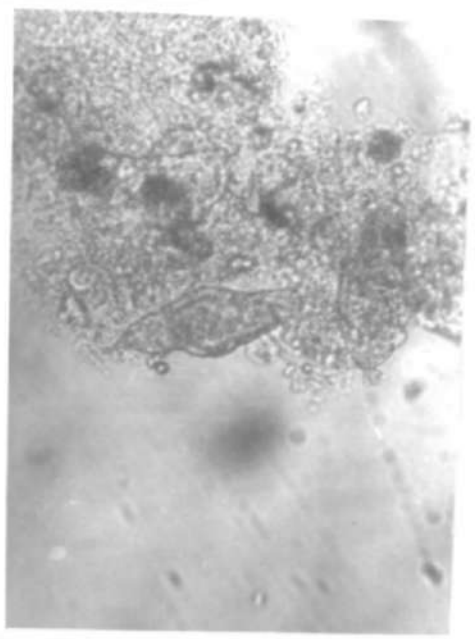
D



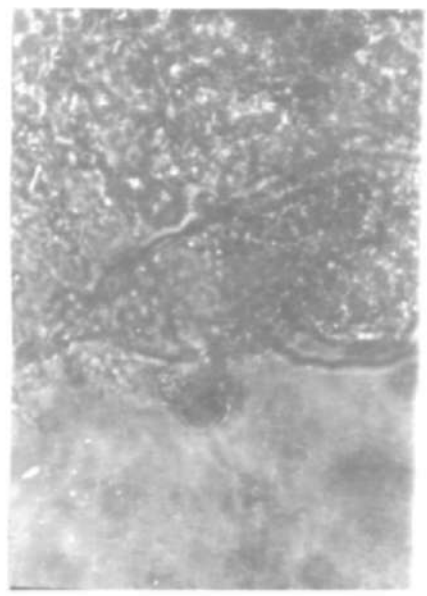
D_1



E



E_1



F

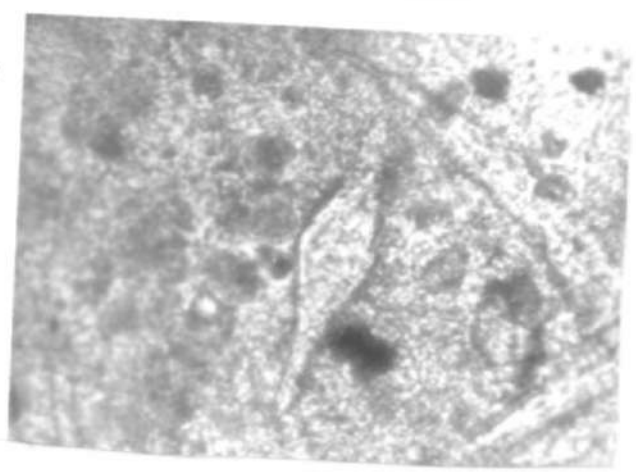


Fig 3. OVERALL INTENSITY OF URINARY SCHISTOSOMIASIS AMONG SCHOOL CHILDREN IN KACHIA LOCAL GOVERNMENT AREA.

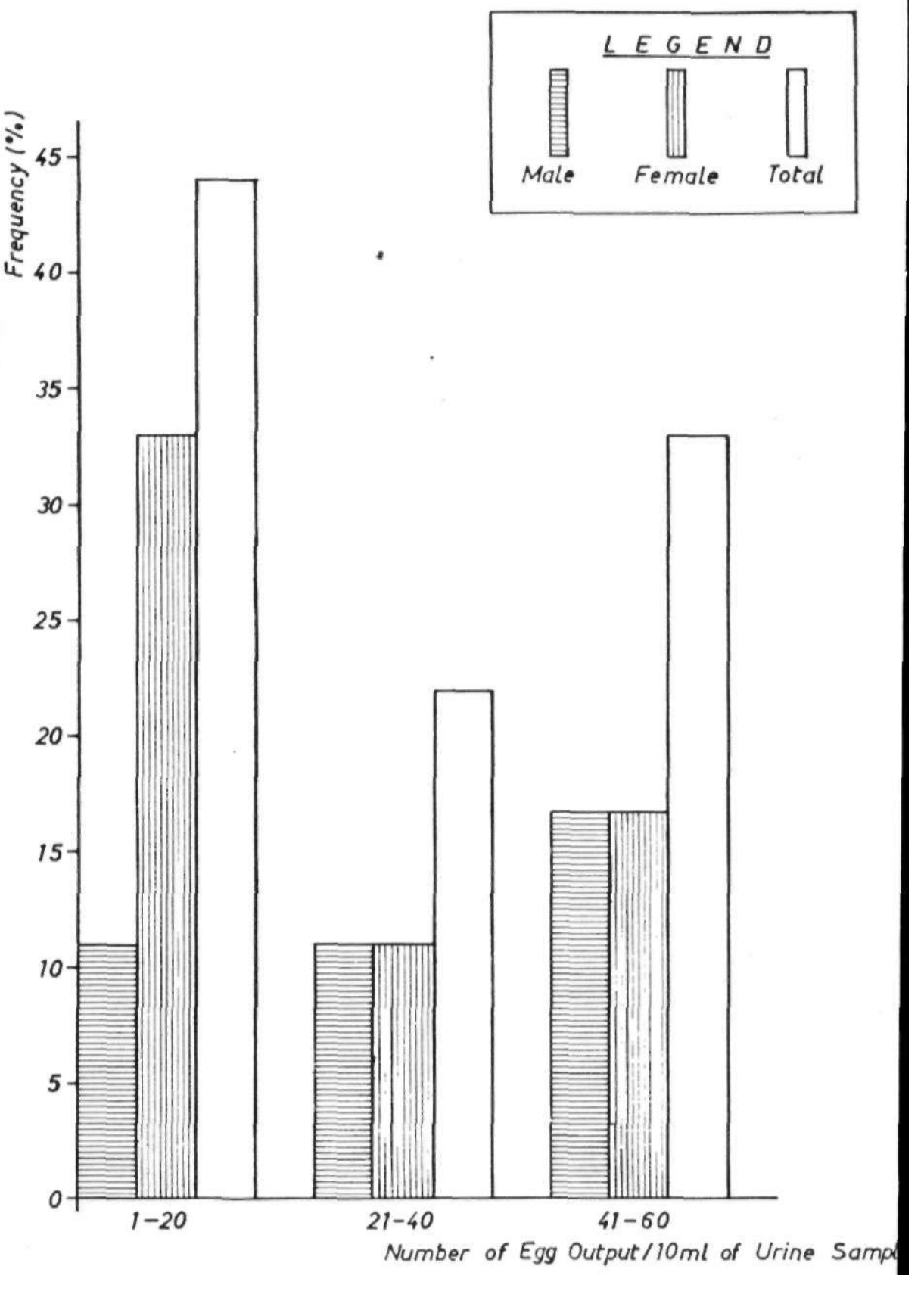
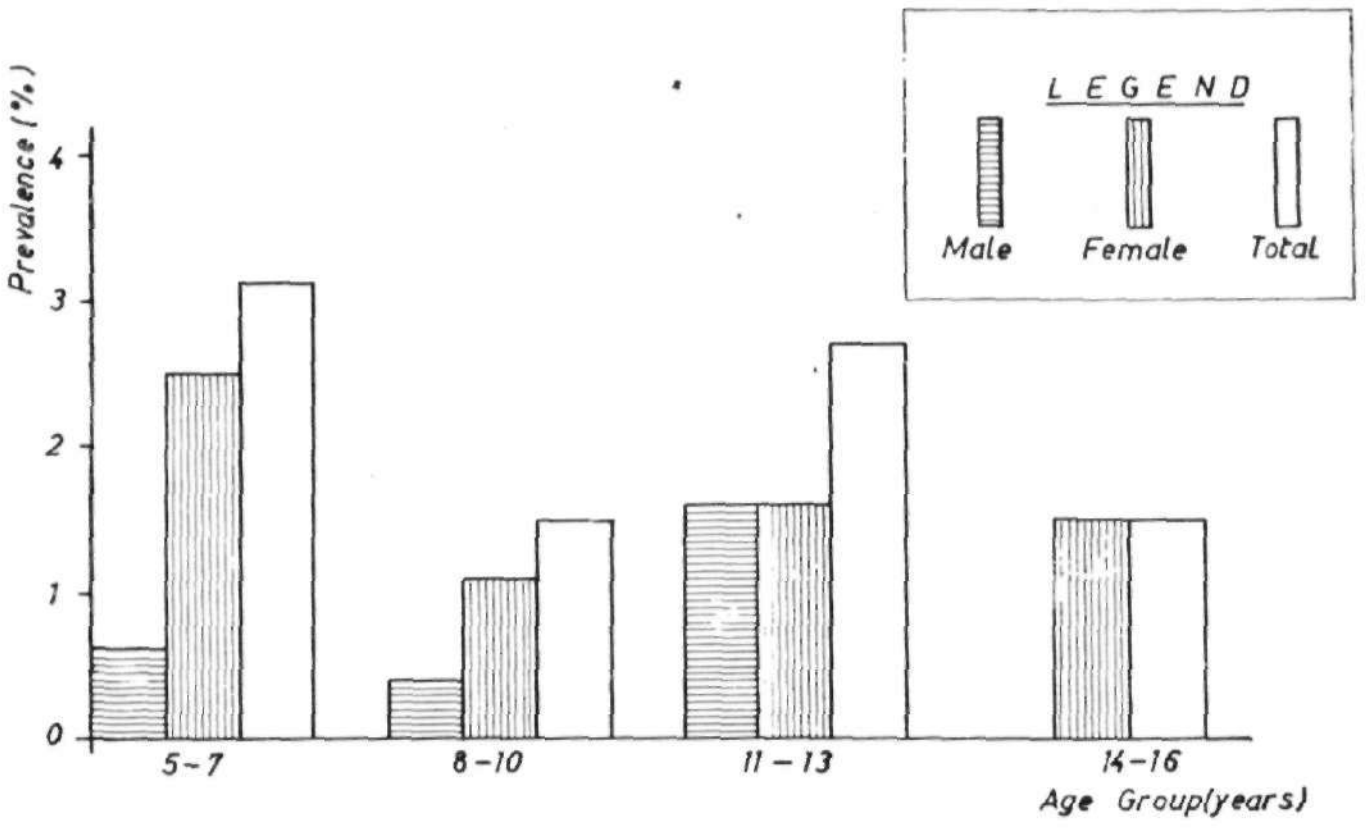


Fig. 2: AGE AND SEX DISTRIBUTION OF THE PREVALENCE OF URINARY SCHISTOSOMIASIS AMONG SCHOOL CHILDREN IN KACHIA LOCAL GOVERNMENT AREA.



In the retrospective study, records of analysis of 3224 urine samples collected from patients who reported at the Kachia Health Centre from January 1987 to December 1991 were considered. Out of this number 1965(60.95%) of the samples were collected from males and 1259 (39.05%) from females. 2680 (83.13%) of patients recorded were adults (18 years old and above), 292 (9.06%) were children and 252 (3.57%) were patients whose ages were not indicated and as such were classified as "Not Stated". A total of 56 (1.74%) of all samples examined were found to be positive for *S. haematobium* (Table 5). Out of the infected samples, 48(85.71%) which represents 1.49% of the overall prevalence were from males and 8 (14.29%) which represents 0.25% of the overall prevalence were from females. A total of 39 (1.46%) adults, 11(3.77%) children and 6(2.38%) in the "Not Stated" (Table 6) group were found to be infected with *S. haematobium*. Adults therefore accounted for 69.64% of all infected patients recorded.

Table 5. Overall prevalence of Schistosomiasis at Kachia Health Centre of Study Area by Sex for the Period 1987-1991.

Sex	*S. haematobium*		*S. mansoni*		*S. haematobium* and *S. mansoni* combined	
	No. Exam.	No. inf (%)	No. Exam.	No. inf (%)	No. Exam	No. inf(%)
Male	1965	48(2.44)	3026	101(3.34)	4991	149(2.99)
Female	1259	8(0.64)	1992	52(2.56)	3251	60(1.85)
Total	3224	56(1.74)	5018	153(3.05)	8242	209(2.54)

Table 6. Prevalence of Schistosomiasis at Kachia Health Centre of Study Area by Age for the Period 1987-1991.

Age Group	*S. haematobium*		*S. mansoni*	
	No. Exam.	No. inf (%)	No. Exam.	No. inf (%)
Adult (> 18 years)	2680(83.13)	39(1.46)	3868(77.08)	119(3.08)
Child (< 18 years)	292(9.06)	11(3.77)	1023(20.39)	34(3.32)
Not Stated	252(7.81)	6(2.38)	127(2.53)	0(0.00)
Total	3224	56(1.74)	5018	153(3.05)

S. haematobium infection was reported throughout the period of study and in each month. The month specific rates and odds ratio (OR) for the whole period under study show no significant association at 95% confidence interval (CI) between prevalence of infection and month of the year (Table 8). The annual distribution of *S. haematobium* (Table 7) is shown in Figure 6 in comparison with other helminth infections. *S. haematobium* infection appears to have been fairly stable over the last five years (1987-1991). When all individuals under study were considered together, the odds ratio shows no significant association between sex and prevalence of infection at 95% CI. However, there was a significant association between children (OR = 2.2) and *S. haematobium* infection at 95% CI. This means that children were 2.2 times significantly more at risk than adults.

4.2 Prevalence and Intensity of *S. Mansoni* Infection

Tables 2, 3 and 4 also give the overall prevalence and intensity of *S. mansoni* infection among the school children in the study area. Out of the total (820) stool samples collected from the area 21(2.56%) were positive for *S. mansoni* eggs. 12 (57.14%) which represents 1.46% of the overall prevalence were from boys and 9(42.86%) which represent 1.10% of the overall prevalance were from girls. The difference between the sexes was not however statistically significant (P>0.05). The distribution of infection according to age shows an increase from the 5 - 7-year-age group to the 14 - 16 year-age group with peak prevalence in the 14-16-year-age group (Figure 4). All of the infected children except one acknowledged frequenting streams and other exposed water bodies around the villages. The intensity of *S. mansoni* infections was low among the sampled population and the individual egg counts ranged from 1 - 40 epg with a geometric mean egg output of 17 eggs/g of faeces. 12 (57.14%) of infected pupils had egg counts of 1 - 20 egg/g of faeces. Egg count exceeding 40 eggs/g of faeces was not recorded from stool samples analysed from the study area. *S. mansoni* infection was recorded in five of the eight village schools from where samples were collected. No *S. mansoni* infection was recorded in the 17-19-year-age group. The intensity was highest in the 11 - 13-year-age group.

The retrospective study considered recorded cases of 5018 patients from whom stool samples were collected and analysed for the presence of *S. mansoni* eggs. Of this total 153 (3.05%) were found to be infected with *S.*

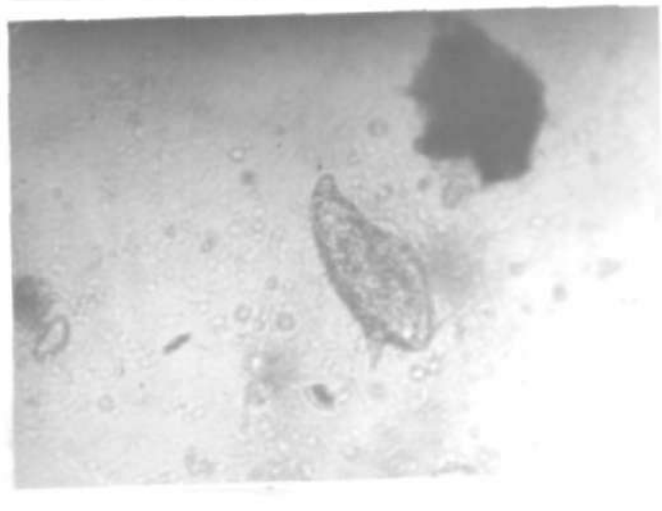
Table 7. Annual Distribution of Schistosomiasis at Kachia Health Centre for the Period 1987-1991.

Year	*S. haematobium*		*S. mansoni*	
	No. Exam.	No. inf (%)	No. Exam.	No. inf (%)
1987	762	18(2.36)	695	10(1.44)
1988	801	16(2.00)	1380	52(3.83)
1989	962	11(1.14)	1768	54(3.05)
1990	527	8(1.52)	1006	33(3.28)
1991	172*	3(1.74)	169	4(2.37)
Total	3224	56(1.74)	5018	153(3.05)

**During this period hospital attendance was unusually very low due to serious administrative problems and lack of a medical doctor for quite some time. The situation has since improved.*

mansoni (Table 5). 3026 (60.30%) of stool samples analysed were from males and 101 (3.34%) of these representing 2.01% of the overall prevalence were infected. 1992 (39.70%) of the stool samples were from females and 52 (2.61%) of these representing 1.04% of the overall prevalence were infected. A total of 3868 (77.08%) adults had their stool samples examined and 119 (3.08%) of these representing 2.37% of the overall prevalence, were infected. Out of 1023 (20.39%) of stool samples analysed from children, 34 (3.32%) of these representing 0.68% of the overall prevalence were infected with *S. mansoni* (Table 6). Males accounted for 66.01% of all infected patients. However, the odds ratios for the sexes suggest no significant association between prevalence of *S. mansoni* infection and sex on the one hand and between prevalence of infection and age on the other at 95% CI.

G



G_1

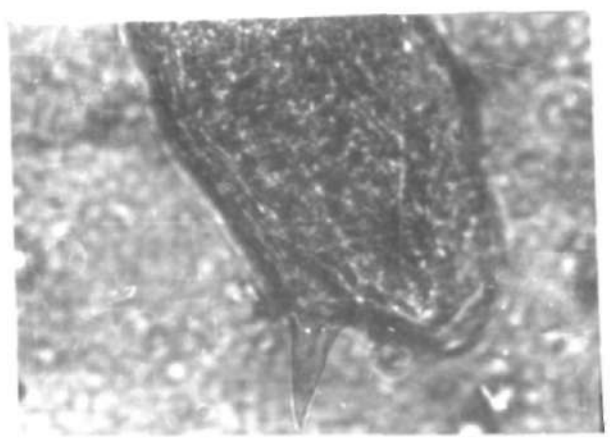


Fig. 4: AGE AND SEX DISTRIBUTION OF THE PREVALENCE OF S. mansoni INFECTION AMONG SCHOOL CHILDREN IN KACHIA LOCAL GOVERNMENT AREA.

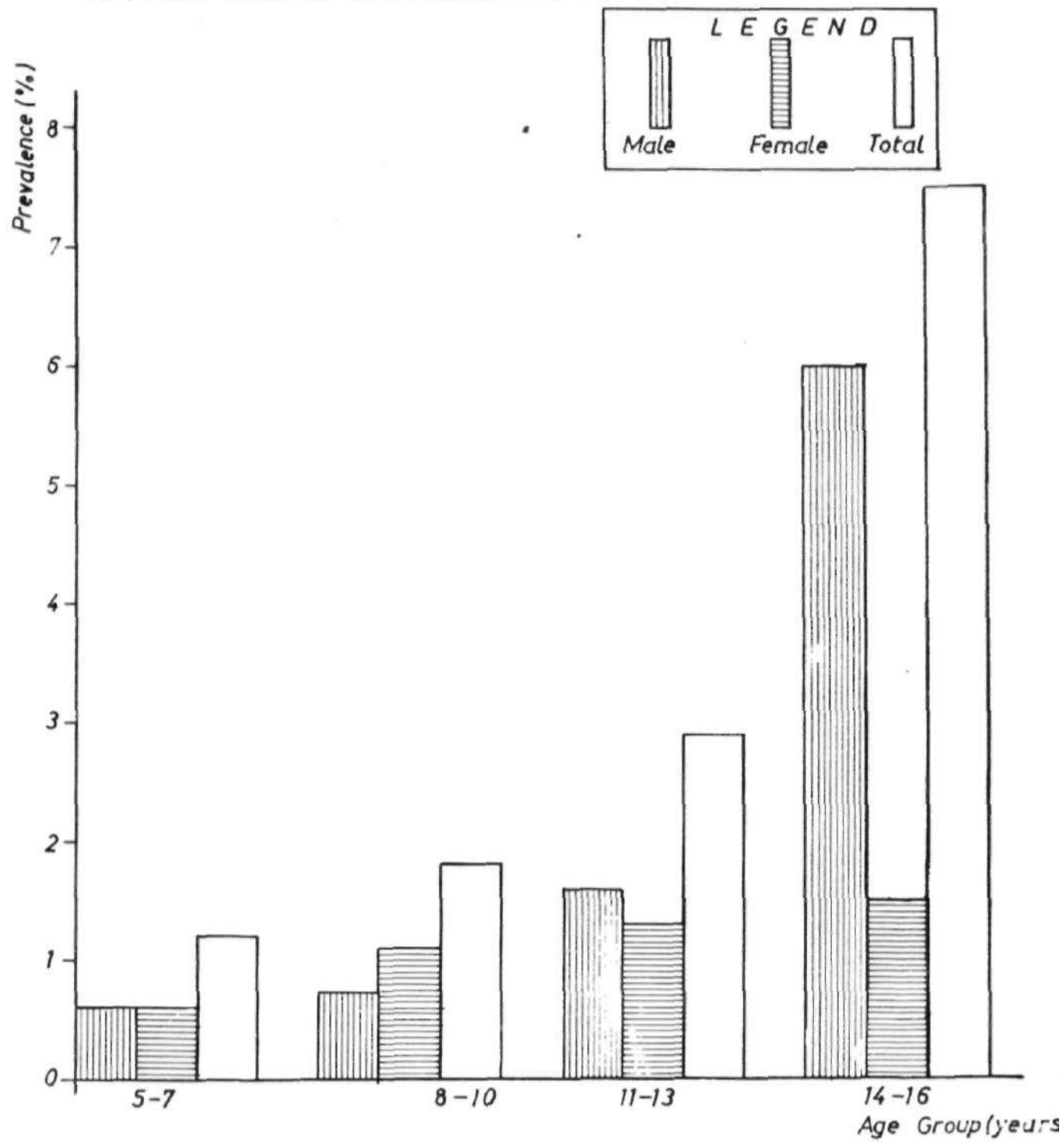
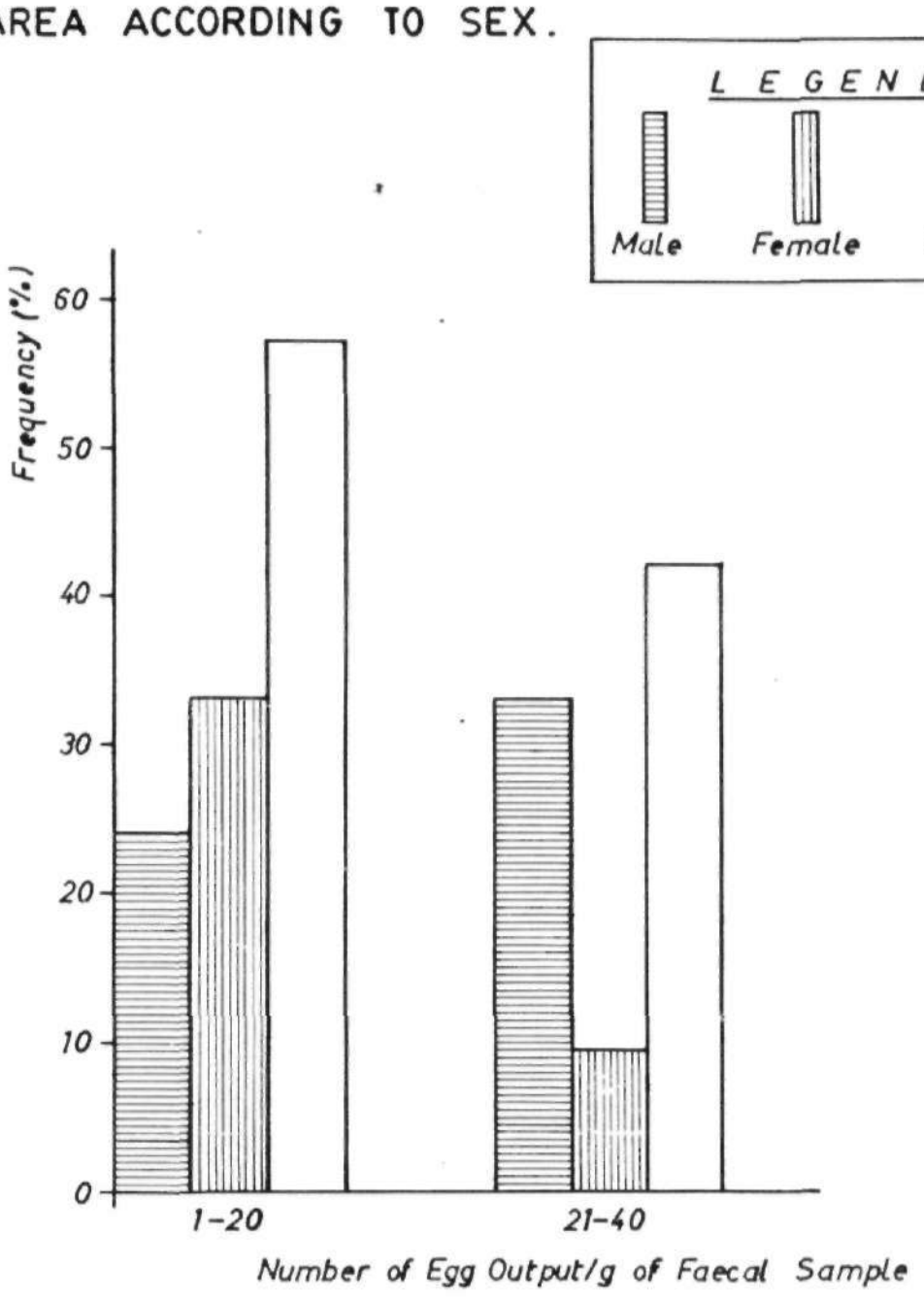


Fig. 5: OVERALL INTENSITY OF S. mansoni AMONG SCHOOL CHILDREN IN KACHIA LOCAL GOVERNMENT AREA ACCORDING TO SEX.



The month specific rates and odds ratios (Table 8) suggests the month of November (OR = 2.5) to have a significant association with the prevalence of *S. mansoni* infection. This means that the infection is 2.5 times more likely to occur in November compared with other months. The infection was reported throughout the period under study and in every month. The annual distribution is comparison with other helminth infections is given in Figure 6. The graph shows a more or less stable state of *S. mansoni* infection, similar to *S. haematobium* but slightly higher, over the five year period of study in this area.

Although it was not possible to analyse egg output in cases recorded in the retrospective study, due to incomplete records, the available information suggest a maximum egg output of about 60 eggs/10 ml of urine.

4.3 Prevalence of Other Parasitic Infections

The prevalence of other parasitic infections encountered in the survey among school children and their distribution in the different villages from where samples were taken are shown in Tables 9 and 10. 335 (40.85%) of the total 820 stool samples examined were positive for hookworm; 30 (3.66%) were positive for *Ascaris lumbricoides*; 13(1.59%) were positive for *Trichuris trichiura*; 7(0.85%) were positive for *Taenia* spp 6(0.73%) were positive for *Enterobius vermicularis*; 1(0.12%) was positive for *Hymenolepis nana*; 39(4.76%) were positive for *Entamoeba coli* and 44 (5.37%) were positive for *Isospora* oocyst. Hookworm accounted for 85.68% of all helminth infection recorded in this area. Infection rate of individual village schools with hookworm range from 16.1% at Kachia to

Table 8. Month Specic Rates and Odds Ratios of Cases of Schistosomiasis at Kachia Health Centre of Study Area for the Period 1987-1991.

Month	*S. haematobium*				Month specific rates	*S. mansoni*				Month Specific Rates
	No. Exam	Cases	Controls	Odds Rates		No. Exam	Cases	Controls	Odds Ratio	
Jan.	260	3	257	0.66	1.15	356	6	350	0.55	1.69
Feb.	248	4	244	0.93	1.67	344	12	331	1.15	3.50
Mar.	329	4	325	0.70	1.22	495	17	478	1.13	3.43
Apr.	316	8	308	1.47	2.53	438	9	429	0.67	2.05
May	292	3	289	0.59	1.03	378	10	368	0.84	2.65
Jun.	204	5	199	1.42	2.45	454	12	442	0.86	2.64
Jul.	246	2	244	0.46	0.81	450	12	438	0.87	2.67
Aug.	244	7	237	1.67	2.51	409	11	398	0.88	2.69
Sept.	239	6	233	1.46	2.24	432	13	419	0.99	3.01
Oct.	313	7	306	1.29	1.58	478	15	463	1.14	3.14
Nov.	317	5	312	0.91	0.93	466	34	432	2.50*	7.30
Dec.	216	2	214	0.53		319	12	307	1.24	3.76
Total	3224	56	3168			5018	153	4865		

*Shows significant association between month and infection.

58.5% at Kurmin Gwaza. Hookworm infections were recorded in all villages while *Ascaris* which account for 7.42% of total helminth infection were recorded in all but two of the villages from where samples were taken. There were thirty recorded cases of double infections 10 of which included infections with one of the schistosomes. There were three cases of tripple infections and one case of quadruple infection (Table 11).

Multiple infections involving hookworm and *Ascaris* were the most frequent. Ova of *E. vermicularis* was found in the urine of four of the pupils infected with this parasite. Stool consistency ranged from diarrhoeic to well formed. In a number of cases blood and/or mucus were seen in the stool samples examined.

Table 9. Prevalence of other Parasitic Infections among School Children in Study Area According to Village.

Village	No. Exam.	Hookworm No. inf (%)	*Ascaris* No.inf (%)	*Trichuris* No. inf (%)	*Taenia* No. in (%)	*S. veraiculoris* No. inf (%)	*H. nana* No. inf (%)	*E. coli* No. inf (%)	*Isospora* No. inf (%)
Dumel	175	71(40.57)	3(7.43)	5(2.86)	2(1.14)	1(0.57)	1(0.57)	11(6.29)	15(8.57)
Kachia	80	29(16.11)	(5.00)	3(1.11)	0(0.00)	4(2.22)	0(0.00)	28(15.56)	2(1.11)
Kurmin Sarah	90	47(52.22)	0(0.00)	0(0.00)	2(2.22)	0(0.00)	0(0.00)	0(0.00)	8(8.89)
Dan Dan	70	35(50.00)	0(0.00)	2(2.22)	1(1.43)	0(0.00)	0(0.00)	0(0.00)	7(10.00)
Kurmin Gwaza	65	27(41.54)	2(3.08)	1(1.43)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	8(12.31)
Kenyi	87	49(56.32)	2(2.30)	0(0.00)	2(2.30)	1(1.15)	0(0.00)	0(0.00)	1(1.15)
Kurmin Jibrin	73	38(52.05)	1(1.37)	2(2.30)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	4(5.48)
Katugal	80	39(48.75)	3(3.75)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	0(0.00)	3(3.75)
Total	820	335(40.85)	30(3.66)	13(1.59)	7(0.85)	6(0.173	1(0.12)	39(04.76)	44(5.37)

Table 10. Prevalence of other Parasitic Infections among School Children in Study Area by Sex and Age.

Parasite	Male (417)* No. inf.(%)	Female (403)* No. inf. %)	5 - 7(165) No. inf. (%)	8 - 10(274)* No. inf. (%)	11 - 13(311)* No. inf. (%)	14 - 16(67)* No. inf. (%)	17 - 19(3)* No. inf. (%)
Hookworm	177(42.45)	158(39.21)	62(37.56)	109(39.78)	131(42.12)	31(46.27)	2(66.67)
Ascaris	19(4.56)	10(2.48)	5(3.03)	13(4.75)	11(3.52)	0(0.00)	0(0.00)
Trichuris	4(0.96)	9(2.23)	2(1.21)	2(0.73)	5(1.61)	4(5.97)	0(0.00)
Taenia	2(0.48)	5(1.24)	1(0.61)	2(0.73)	3(0.96)	1(1.49)	0(0.00)
E. vermicularis	3(0.72)	3(0.74)	1(0.61)	2(0.73)	3(0.96)	0(0.00)	0(0.00)
H. nana	0(0.00)	1(0.25)	0(0.00)	0(0.00)	1(0.32)	0(0.00)	0(0.00)
All helminths combined	205(49.16)	186(46.15)	71(43.03)	128(46.72)	154(49.52)	36(53.67)	2(66.67)
E. Coli	18(4.32)	21(5.21)	13(7.88)	12(4.38)	11(3.54)	3(4.48)	0(0.00)
Isospora oocyst	20(4.80)	24(6.20)	5(3.03)	13(4.74)	18(5.79)	8(1.19)	0(0.00)

*Total number of faecal samples examined.

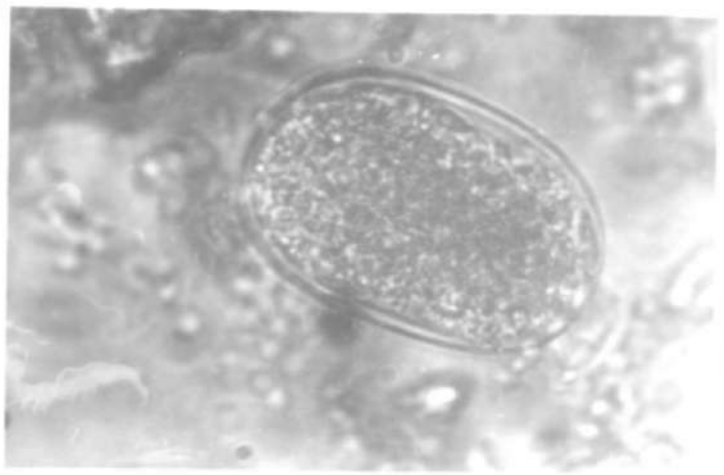
Plate IV. Photomicrographs of some other helminth eggs encountered in the study area.

H. Whole egg of hookworm.

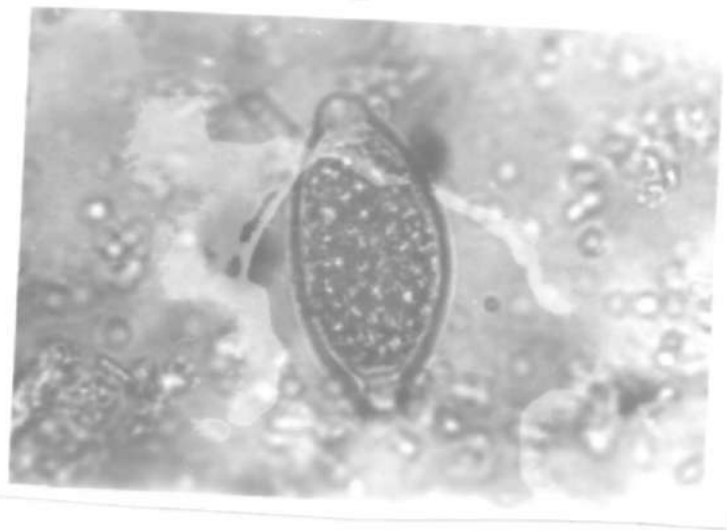
I. Whole egg of *Trichuris trichiura*.

J. Whole egg of *Hymenolepis nana*.

H



I



J



Table 11. Single and Multiple Occurrence of Helminth Infection among school Children in the Study Area

Single Species Infection	Number Infected	Percentage Infected
S. haematobium	9	1.13
S. haematobium hybrid	2	0.25
Hookworm	304	37.07
Ascaris lumbricoides	16	1.95
Trichuris trichiura	6	0.73
Taenia species	3	0.37
Enterobius vermicularis	4	0.49
Total	357	43.54
Two Species Infection		
Ascaris/Hookworm	10	1.22
S.haematobium hybrid/Hookworm	1	0.12
S. haematobium hybrid/*S. haematobium*	1	0.12
E. Vermicularis/Trichuris	1	0.12
Taenia/Hookworm	4	0.49
S. mansoni/Hookworm	6	0.73
S. haematobium/Hookworm	2	0.25
Hookwork/*Trichuris*	4	0.49
E. vermicularis/Hookworm	1	0.12
Total	30	3.66
Three Species Infection		
Hookworm/*Trichuris/Ascaris*	1	0.12
S. haematobium/S. mansoni/Hookworm	1	0.12
S. mansoni/H. nana/Ascaris	1	0.12
Total	3	0.3
Four Species Infection		
S. haematobium/hookworm/Ascaris/Trichuris	1	0.12

Tables 12, 13 and 14 give the prevalence, annual and monthly distribution of other parasitic infections recorded at the Kachia Health Centre for the period January 1987 to December 1991. Prevalence rates recorded were: 19.05% for hookworm, 4.54% for *Ascaris*, 0.74% for *Trichuris*, 1.59% for *Taenia*, 0.38% for *E. vermicularis*, 1.16% for strongyloides, 0.60% for *E. histolytica* and 1.22% for *E. coli*. Hookworm accounted for 59.53% of the total helminth infection reported during the study period. When all the helminth infections were considered together, 1606 (19.49%) of the patients were infected with one type or the other. The annual distribution of the more common helminths is shown in Figure 6. Hookworm appears to be on the increase where as *Ascaris* shows a slight decrease over the period under study. *Taenia* infection follows the same trend of near stability as the schistosomes. The month specific rates show that helminth infection did not appear to follow any regular pattern (Table 14). Although hookworm and *Ascaris* accounted for the majority of helminth cases, the odds ratios suggest no significant association between prevalence of infection and sex on the one hand and of age on the other at a 95% confidence interval. When all helminth infections are considered together there was no association between sex or age and helminth infection at 95% CI. There were 35 recorded cases of double infection with hookworm and *Ascaris*, 15 cases of *S. mansoni* and hookworm and 10 others with different combinations. There were 10 cases with tripple infection. No higher number of helminth infection was recorded. Records of urine and stool samples analysed were separately kept, and from the available information it was not possible to determine whether any of the multiple infections included *S. haematobium*.

Table 12. Prevalence of other Parasitic Infections at Kachia Health Centre of Study Area by Sex and age during the 1987-1991 period.

Parasite	Male (3026)* No. Inf (%)	Female (1992)* No. Inf (%)	Total (5018)* No. Inf (%)	Adult (3968*) (> 18 years) No. inf (%)	Child (1022)* (< 18 years) No. inf (%)	Not Stated (127)* No. inf (%)
Hookworm	577(19.07)	379(19.03)	956(19.05)	790(20.42)	152(14.86)	14(11.02)
Ascaris	126(4.16)	102(5.12)	228(4.54)	160(4.14)	59(5.77)	9(7.09)
Trichuris	27(0.89)	10(0.50)	37(0.74)	24(0.62)	13(1.27)	0(0.00)
Taenia	51(1.69)	29(1.46)	80(1.59)	56(1.45)	24(2.35)	0(0.00)
E. vermicularis	12(0.40)	7(0.35)	19(0.38)	11(0.28)	8(0.78)	0(0.00)
H. nana	13(0.43)	6(0.30)	19(0.38)	10(0.26)	8(0.78)	1(0.79)
Strongyloids	37(1.22)	21(1.05)	58(1.16)	40(1.03)	15(1.56)	2(1.57)
All helminths combined	843(27.86)	554(27.81)	1397(27.84)	1091(28.21)	256(28.21)	2(20.47)
E. histolytica	18(0.59)	12(0.60)	30(0.60)	23(0.59)	7(0.68)	0(0.00)
E. coli	27(0.89)	34(1.71)	61(1.22)	32(0.83)	29(2.83)	0(0.00)

*Total number of samples examined.

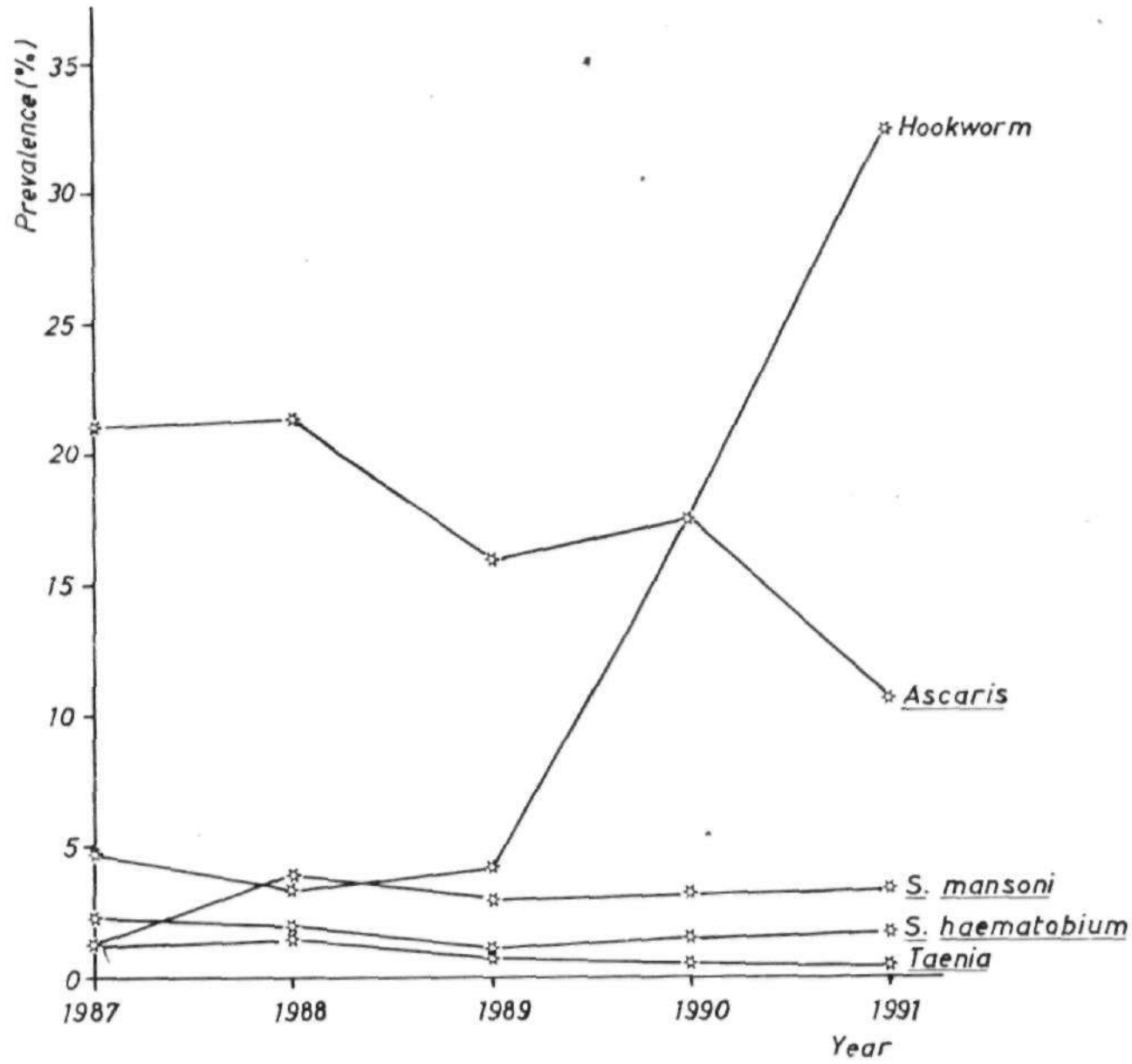
Table 13. Annual Distribution of other Parasitic Infections at Kachra Health Centre of Study Area for the Period 1987-1991.

Number Examined/ Parasite	Years				
	1987	1988	1989	1990	1991
	695	1380	1768	1006	169
Hookworm	146(20.01)	298(21.59)	281(15.89)	176(17.50)	55(32.54)
Ascaris	33(4.75)	48(3.48)	75(4.24)	54(5.38)	18(10.65)
Trichuris	4(0.58)	4(0.29)	11(0.62)	16(1.59)	2(2.28)
Taenia	7(1.01)	21(1.52)	37(2.09)	14(1.39)	1(0.59)
E. vermicularis	1(0.14)	9(0.65)	3(0.17)	4(0.40)	1(0.00)
H. nana	8(1.15)	4(0.29)	4(0.23)	3(0.30)	0(0.00)
Strongyloids	10(1.44)	21(1.52)	15(0.85)	8(0.80)	1(0.59)
E. histolytica	7(1.01)	8(0.58)	10(0.57)	5(0.50)	0(0.00)
E. coli	10(1.44)	25(1.81)	15(0.85)	11(1.09)	0(0.00)

Table 14. Month Specific Rates for Other Parasitic Infections at Kachia Health Centre for the Period 1987-1991 (Figures in bracket show percentage infected).

Month	No. Exam	Hookworm	Ascaris	Trichuris	Taenia	Enterobius	H. nana	Strongyloides	E. histolytica	E. coli
Jan.	356	62(16.99)	9(2.53)	4(1.12)	4(1.12)	1(0.28)	3(0.84)	4(1.12)	5(1.40)	7(1.97)
Feb.	343	65(18.95)	14(4.08)	5(1.46)	4(4.00)	4(4.08)	2(0.58)	5(1.46)	0(0.00)	3(0.87)
Mar.	495	92(18.59)	20(4.04)	3(0.61)	6(1.21)	0(0.00)	1(0.20)	7(1.41)	2(0.40)	5(1.01)
Apr.	438	50(11.42)	16(3.56)	5(1.14)	7(1.60)	0(0.00)	1(0.26)	2(0.46)	0(0.00)	0(0.00)
May	378	75(19.84)	27(7.14)	5(1.32)	10(2.64)	0(0.00)	2(0.53)	7(1.85)	0(0.00)	10(2.65)
Jun.	454	98(21.59)	18(3.96)	4(0.88)	9(1.98)	3(0.66)	1(0.22)	3(0.66)	7(1.54)	8(1.76)
Jul.	450	95(21.11)	23(5.11)	4(0.89)	9(2.00)	2(0.44)	1(0.22)	3(0.67)	3(0.67)	15(3.33)
Aug.	409	82(20.05)	20(4.89)	2(0.49)	3(0.73)	3(0.73)	2(0.49)	9(2.20)	2(0.49)	4(0.98)
Sept.	432	100(23.15)	12(2.78)	0(0.00)	7(1.62)	2(0.46)	4(0.93)	8(1.85)	1(0.93)	8(1.85)
Oct.	478	96(20.08)	31(6.49)	1(0.21)	6(1.26)	0(0.00)	0(0.00)	6(1.26)	1(0.21)	0(0.00)
Nov.	466	77(16.52)	18(3.86)	2(0.43)	11(2.36)	1(0.21)	1(0.21)	3(0.64)	3(0.64)	0(0.00)
Dec.	319	64(20.06)	20(6.27)	2(0.63)	4(1.25)	3(0.94)	1(0.31)	1(0.31)	3(0.94)	1(0.31)

Fig. 6: ANNUAL DISTRIBUTION OF SCHISTOSOMIASIS AND THE MORE COMMON HELMINTH AT KACHIA HEALTH CENTRE DURING THE 1987–1991 PERIOD.



4.4 Responses from Questionnaire

Over 90.00% of the children claimed to have lived in their different villages since birth. Most of the pupils (96.40%) of the pupils acknowledged the use of pit latrines, 0.21%, indicated use of water system toilets and the remaining 3.39% had no toilets and use the surrounding bushes and stream areas. About 85.63% of the pupils also acknowledged various water contact activities such as swimming, fetching of water, laundrying, washing of household utensils etc. Wells serve as the main source (95.60%) of water supply for drinking and other household use. Few streams, ponds and other exposed water bodies were encountered around the villages from where samples were collected.

Personal interview with teachers of the various primary schools from where samples were taken showed complete ignorance about the disease and the pathologic implications.

4.5 Snail Survey

Snail species were collected from the various water bodies examined in the different villages from where samples were collected. These snails identified as *Biomphalaria pfeifferi, Bulinus globosus* and *Lymnaea natalensis*. *Lymnaea natalensis* was the most abundant and widely distributed in the area. *B. pfeifferi* was more abundant in areas where they were found than *B. globosus*. *B. Pfeifferi* was collected from two large water channels between Kachia and Gumel and from a stream in Katugal. Fewer *B. globosus* snails were seen and a small number was collected from Kachia-Gumel water channels and from a stream in Kurmin Sarah. The streams and other water bodies examined in other villages had *Lymnaea*

snails only. When the snail species were separately exposed to light for shedding, *Lymnaea natalensis* shedded *gymnocephalus* cercaria while *Bulinus* and *Biomphalaria* snails shedded brevifurcate cercariae.

At the time the snail samples were collected the main water channels between Gumel and Kachia had shallow water levels, muddy substratum, moderate water flow, a few floating plants and other objects and a lot of organic debris. In areas where *Biomphalaria* and *Bulinus* species were not seen, the water bodies were either small and fast flowing or had thick plant growth.

4.6 Experimental Infection

At the end of 12 weeks post infection the mice were killed using chloroform and autopsied to recover the adult worms. Schistosomes were recovered from the liver and meserteric veins of mice exposed to cercariae from *Bulinus* and *Biomphalaria* snail species. Few more adult schistosomes were recovered from mice infected with *Biomphalaria* cercariae.

The adult schistosomes recovered from mice infected with *Biomphalaria pfeifferi* was identified as *S. mansoni* and those from mice infected with cercariae from *B. globosus* was identified as *S. bovis*. Some eggs recovered from the mouse were similar to *S. haematobium* eggs.

CHAPTER 5

DISCUSSION

The present study obtained data on the prevalence of schistosomiasis in Kachia Local Government Area for the first time. The results of this study were then compared with those obtained from a five-year retrospective study using hospital records at the Kachia Health Centre.

Both studies have revealed an overall low prevalence of schistosomiasis in the area. The present survey recorded an overall prevalence rate of 2.25% for urinary schistosomiasis and its hybrids and 2.56% for *S. mansoni*. The same low prevalence rates were recorded in the retrospective studies; 1.74% for *S. haematobium* and 3.05% for *S. mansoni*. The low prevalence of schistosomiasis in this area could be very closely related to the presence and relative abundance of the snail intermediate host. In general, few of the *Bulinus* and *Biomphalaria* snail species were seen in the study area. The two intermediate snail hosts were absent in some of the villages.

Relatively low prevalence rate (6.2%) for *S. haematobium* have been reported in Maiduguri (Chugh *et al.*, 1986) and (15%) in Benue State (Gemade and Dipeolu, 1983), all in the northern guinea savannah belt of Nigeria. However, high prevalence rates of *S. haematobium* ranging from 20 - 74% have been reported in various studies in Nigeria (Ogbe and Ogunsekan, 1985; Bassey, 1988; Edungbola *et al.*, 1988; Ityondo, 1991). In Ghana prevalence rate as high as 96% has been recorded in some regions (Wen and Chu, 1984). The low prevalence rate of *S. mansoni* recorded in this study has been

similarly recorded in the Soba and Igabi local government areas of Kaduna State, Nigeria (Ityondo, 1991). Higher prevalence rate of 61% although relatively lower for *S. haematobium* has been reported in irrigated areas in Kano State, northern Nigeria (Bassey, 1988). Prevalence of *S. mansoni* infections have been reported to be generally less common than infections due to *S. haematobium* (Akingube, 1962; Cowper, 1963; Gilles *et al.*, 1965a, b; Awogun, 1988). The slightly higher prevalence of *S. mansoni* recorded in this study deviates from the generally observed trend. This observation corresponds to the relatively higher prevalence and infestation of the *Biomphalaria* species encountered in the area compared with *Bulinus* species the intermediate host of *S. haematobium*. *S. mansoni* causes the more lethal intestinal schistosomiasis which result in serious pathologic consequences. Its higher prevalence in the population should be given serious attention not only as a public health problem but a socio-economic problem as well.

The distribution of schistosomiasis in the different villages were not uniform. These variations reflect the presence or absence of habitats suitable for the snail intermediate hosts; and within the areas where these occur, it also reflects the individual characteristics of these habitats and their proximity to villages (Goll and Wilkins, 1984). In the village schools where no schistosome infection was recorded, some of the exposed water bodies examined were either some distance away from the nearby houses or such water bodies were small and relatively fast flowing or the vegetation was unlikely to support the intermediate hosts. The variation may also depend on how long

the water bodies around the community can support transmission before drying up.

The occurrence of natural hybrid eggs involving *S. haematobium* is being recorded for the first time in this area. Natural hybrid eggs with polymorphic shapes involving *S. haematobium* and *S. intercalatum* (Southgate *et al.*, 1976), and *S. haematobium* and *S. mattheei* (Pitchford, 1961) have been reported in similar surveys in Africa. The stool samples of the children that were found to be positive for these hybrid eggs were more closely examined for *S. intercalatum. S. mattheei* and *S. bovis* but all were found to be negative. There is no known recorded case of *S. intercalatum* in Nigeria, but is present in neighbouring Cameroun (Southgate *et al.*, 1976). *S. bovis* infections have however, been reported in different parts of Africa including Nigeria (Marill, 1961; Mouchet *et al.*, 1988; Ityondo, 1991). In the present study also eggs similar to *S. bovis* in outline but different in size (Plate 2F) were recorded. It is therefore more likely that the hybridization occurring in this area is between *S. haematobium* and *S. bovis*. This could be due to the extensive area covered by the normadic fulani herdsmen with their cattle which could have brought the foci of transmission of *S. haematobium* and *S. bovis* close enough to overlap and cause such interaction. This is more likely, since *S. bovis* and *S. haematobium* have been shown to use the same intermediate host (Ityondo, 1991). Alternatively, the different polymorphic eggs could actually be those involving new strains of schistosome parasites. In order to make a more definite identification

of the schistosome species involved in these hybridizations it would be necessary to isolate the parasite and examine the biochemical and molecular characteristics. The biological significance of hybrids is that they tend to be more adapted to their hosts and the environment than either of the parents. That is they exhibit heterosis. The hybrid is more infective to both the intermediate and definitive hosts than the parents, grows and matures more quickly and is more fecund. The possible practical significance of these findings is that, the chances are that a higher proportion of the snail population will become infected, the cercariae will have greater infectivity to man and possibly domestic animals, resulting in greater worm and egg burden and hence increased pathology (Wright and Ross, 1980). An additional problem may also arise in the chemothrapeutic control of schistosomiasis (Pitchford and Lewis, 1978). It would therefore be of interest to determine the infectivity of these hybrid eggs to each of the snail species collected from the area.

The children harbouring the parasite did not show signs of haematuria at both macroscopic and microscopic levels. Repeated urine samples collected from these children proved positive for these hybrid eggs. Thus, it will also be of interest if the pathologic effects of these hybrids is investigated.

The variations in schistosomiasis recorded between the sexes in these studies are not uncommon. In Northern Nigeria, the prevalence rate for *S. haematobium* has been reported to be greater in males than in females (Pugh

et al., 1976b; Pugh and Gilles, 1978; Pugh *et al.*, 1980a; Edungbola *et al.*, 1988; Anigbo and Nwaorgu, 1988). Similar results have been reported in the Nile delta in *S. mansoni* infection (Farooq *et al.*, 1966). Wilkins *et al.* (1984a) however, found the prevalence and intensity of *S. haematobium* infection in The Gambia to be equal in both sexes despite apparent differences in exposure to infection. White *et al.* (1982) reported higher prevalence of schistosomiasis in females among the Mende community in Sierra Leone where fishing is a female occupation. These results then suggest that the level of infection among the sexes will depend on the cultural activity of each community.

The high prevalence rates of urinary schistosomiasis seen in the 11-13-year-age group and of *S. mansoni* infection in the 14-16-year-age group recorded in this study falls within the age groups recorded in other parts of the world including Nigeria where similar studies have been done (Pesignan *et al.*, 1958; Polderman, 1979; Domingo *et al.*, 1980; Bassey, 1988).

Schistosomiasis appears to have attained some form of stability over the last five years as shown in Figure 6. This observation could be explained by an almost lack of any major ecological change during these periods to alter transmission pattern. It could also well be that the parasites have over the years become well adapted to their snail intermediate hosts such as not to affect transmission pattern. At present schistosomiasis is not a major public health problem in the study area and low intensity of infection means that all cases are treatable.

The other intestinal parasites recorded in these studies have been reported in various other surveys. High prevalence rates of hookworm and tapeworm infestations have been reported in northern Nigeria with up to 89% of cases being positive for hookworm (Ramsay, 1934). Recently, Ndifon (1991) reported cases of hookwork, *Hymenolepis, Ascaris, Trichuris, Enterobius* among others in the Tiga Lake Basin of Kano. Hookworm (30%) was found to be the most prevalent. Okpala (1956) had earlier reported about 85.1% overall prevalence of intestinal parasites with up to four different parasites among Lagos school children in Nigeria. Up to 16 different species of parasites have been reported among Government workers in Lagos, with *Ascaris* (71.5%), *Trichuris* (66.6%) and hookwork 58.3% being the most prevalent. Ityondo (1991) reported prevalence of hookworm *Ascaris, Hymenolepis, Trichuris, Enterobius, Entamoeba histolytica* and *E. coli* in the Soba and Igabi Local Government Areas of Kaduna State, Nigeria. Hookworm (14.4%) was found to be the most prevalent. Results of this study is consistent with literature reports. A total of 9 different intestinal parasites including *strongyloides* sp and *Isospora* sp infections were recorded. Most of the *Isospora* oocyst were found mainly in the stool of children in the 8-10-year-age group. Faust *et al.* (1961) also observed *Isospora* oocyst mainly in children under 10 years.

Hookworm infection was the most prevalent; 19.05% in the retrospective study and 40.85% in the survey among school children. The figures also give a higher limit to the prevalence range (12-21%) suggested by Nwosu (1982) of

hookwork infection in rural areas in Nigeria. As Figure 6 also shows, *Ascaris* shows a slight decrease over the five year period which is in line with present result of survey among school child. *Taenia* infection however, like the schistosomes appear to have been fairly stable over the last five years and this also compares well with the survey results. The higher prevalence of hookworm could be due perhaps to its better mode of transmission which involves both oral and skin penetration. It could also be that the environmental conditions and hygiene of the population favour hookworm transmission more than the other parasites. For example even where children are in the habit of washing their hands and fruits clean before eating which reduces the risk of *Ascaris* and other helminth infection; walking bare-footed increases the risk of hookworm infection.

As in most other rural communities, poor sanitary conditions and personal hygiene especially that regarding preparation and handling of food items and refuse disposal mainly account for the prevalence and spread of these parasitic infections. Of serious concern is the relatively high prevalence (40.85%) of hookwork among the children. This is because of the propensity of hookworm to cause severe morbidity among children and the labour force in a typical rural setting where malnutrition and other concomittant infections, including, malaria are rampant. The underlying factor in the spread of these parasitic infections is the high level of illiteracy among the rural population. The majority of adults as well as children interviewed were completely ignorant about the dangers of these infections.

CHAPTER 6

SUMMARY AND CONCLUSION

Two separate studies were conducted to obtain information about the status of schistosomiasis in the Kachia Local Government Area of Kaduna State, Nigeria.

A total of 800 urine and 820 stool samples collected from school children drawn from eight different villages were examined. Prevalence rates of 2.25% and 2.56% were recorded for *S. haematobium* and *S. mansoni* respectively. The *S. haematobium* infections include 4(0.50%) cases involving polymorphic-shaped hybrid eggs belonging to the *S. haematobium* hybrid range.

In the retrospective study records of 3224 urine and 5018 stool samples were analysed. Prevalence rates of 1.74% and 3.05% for *S. haematobium* and *S. mansoni* respectively were recorded.

High prevalence rates were recorded in the 5-7 and 11-13-year-age groups with a peak in the 5-7-year-age group for *S. haematobium*. The highest prevalence for *S. mansoni* was in the 14-16-year-age group. The highest intensity of infection for both schistosomes was in the 11-13-year-age group.

The species of fresh-water snails observed in the various water bodies examined were *Bulinus globosus*, *Biomphalaria Pfeifferi* and *Lymnaea natalensis*. These was a generally low infection in *Biomphalaria* and *Bulinus* species. *Biomphalaria* shedded more furcocercous cercariae and was found to be infected with *S. mansoni*. Adult worms recorded from mouse infected with cercariae from *Bulinus* were identified as *S. bovis*. Some eggs recovered from this mouse resembled *S. haematobium* eggs. This was not however certain.

Other intestinal parasitic infections recorded in the area of study are hookworm, *Ascaris lumbricoides*, *Trichuris trichiura*, *Taenia* sp, *H. nana*, *E. vermicularis*, *Strongyloides* sp, *E. histolytica*, *E. coli* and *Isospora* oocyst. Hookworm, *Ascaris* and *Taenia* appear to be the most prevalent with hookworm having the highest prevalence rate.

The findings of these studies suggest that schistosomiasis is hypoendemic in this area with a near stability over the last five years. These studies have also recorded for the first time the presence of polymorphic-shapped eggs in the field indicating that hybridization between schistosome species may be taking place in the area. It is recommended that further studies be carried out to adequately ascertain the schistosome interactions in this area, their actual and potential snail hosts and the infectivity of the hybrid eggs. The overall findings therefore provide baseline information in the interest of public health statistics which would be necessary for proper planning of health and other developmental programmes in this area in particular and the state as a whole.

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APPENDIX

QUESTIONNAIRE (CONFIDENTIAL)

A SURVEY OF THE PREVALENCE OF SCHISTOSOMIASIS AMONG SCHOOL CHILDREN AND FACTORS THAT CONTRIBUTE TO ITS SPREAD IN KACHIA LOCAL GOVERNMENT AREA, KADUNA STATE, NIGERIA

1. Village/Town:.....
2. School .....
3. Name of Pupil .....
4. Sex .....
5. Age/Date of Birth .....
6. Duration of Stay in Village/Town:

   (a) Since birth [ ]
   (b) Less than 1 year [ ]
   (c) Up to 5 years [ ]
   (d) Above 5 years [ ]

7. How long were you out of this village/Town before your return?

   (a) Never [ ]
   (b) About 1 year [ ]
   (c) Up to 5 years [ ]
   (d) Over 5 years [ ]

8. What are your sources of drinking water?

   (a) Stream/ponds [ ]
   (b) Wells [ ]
   (c) Bore-holes [ ]
   (d) Pipe-borne water [ ]

9. How often do your visit streamts/ ponds for any of the following: Swimming, fetching water, laundry, fishing, etc?

   (a) Daily [ ]
   (b) 1-3 times a week [ ]
   (c) Once a month [ ]
   (d) Not at all [ ]

10. What type of Toilet facilites do you use?

    (a) Pit toilet [ ]
    (b) Modern toilets [ ]
    (c) Stream/rivers [ ]
    (d) Anywhere around [ ]

11. CLINICAL AND PARASITOLOGICAL INVESTIGATIONS.

11.1 Have you been passing out blood in your urine? Yes [ ] No [ ]

11.2 Have you been passing out blood in your stool? Yes [ ] No [ ]

11.3 Have you had any treatment for this? (if answer to 11.1 or 11.2 is YES) Yes [ ] No [ ]

11.4 Nature of urine sample
Overt blood [ ] Occult blood [ ]

11.5 Result of Dip Stick
(a) Level of protenaemia

High [ ] Moderate [ ] Low [ ]

(b) Level of haematuria

High [ ] Moderate [ ] Low [ ]

11.6 Result of Urine sampling

(a) Type of egg seen

S. haematobium [ ] *S. mansoni* [ ]

(b) Egg count per gramme (epg)

.....

11.7 Result of faecal sampling

(a) Nature of faecal sample

Formed [ ] Diarrhoeic [ ]
Bloody [ ] Mucus [ ]

(b) Type of egg seen

S. haematobium [ ] *S. mansoni* [ ]

Any other type [ ]

(c) Egg count per gramme

.....

INSTRUCTION: Tick [✓] where appropriate