EVIDENCE OF SCHISTOSOMIASIS AND THE SNAIL INTERMEDIATE HOSTS IN THE TONO DAM IN THE KASENA/NANKANA EAST DISTRICT

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BY

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DEDICATION

I dedicate this work to my daughter Shantel Apaliya. May the good Lord richly bless you.

CERTIFICATION

This is to certify that this project work was carried out by me Solomon Ayangbah Apaliya, under the supervision of Prof. B.W.L Lawson and that no previous submission for a degree in this university or elsewhere has been made. Related works by others, which served as source of information, have been duly acknowledged by reference to the authors.

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ABSTRACT

Various socio-epidemiological factors influence the transmission and level of infection with Schistosomiasis. Some of these factors are: distance of residence from transmission site, mass migration as in social conflict leading to the emergence of new foci, urbanization, socio-economic status, sanitation, water supply patterns and level of faecal contamination of water source. Persons at most risk of infection include those involved in water- related activities such as fresh water fishing, farming, handling of infected snail host in the case of collecting edible ones where the appropriate type of snail intermediate host is present, irrigated rice farming etc.

A survey was undertaken to determine the presence, transmission and levels of infection with urinary and intestinal schistosomiasis in the Tono irrigation dam area. Urine and stool samples were collected and processed using the centrifugal sedimentation technique and wet smear methods respectively. Snail samples were also collected, identified and the intermediate host species screened for cercariae using the illumination method. Of those examined about 72% from Gia and 28% from Gognia had intestinal schistosomiasis whereas 68% from Gia and 32% from Gognia had urinary schistosomiasis with the prevalence of *Schistosoma mansoni* being significantly higher than that of *Schistosoma haematobium* .

Infection levels in males and females were 33% and 67% for intestinal schistosomiasis and 41% and 59% for urinary schistosomiasis respectively.

Prevalence of infection was very high among the age group 11-20 years, about 46% and 53% for urinary and intestinal schistosomiasis respectively. Low literacy rates increases chances of infection and it is believed that awareness creation may decrease infection with schistosomiasis

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ABBREVIATIONS

WHO - WORLD HEALTH ORGANIZATION

FGS - FEMALE GENITAL SCHISTOSOMIASIS

MGS - MALE GENITAL SCHISTOSOMIASIS

IFCAT- INSTITUTE FOR FIELD COMMUNICATION AND AGRICULTURAL TRAINING

ICOUR- IRRIGATION COMPANY OF UPPER REGION

CHAPTER ONE

1.0 INTRODUCTION

Human- and snail-related aspects of transmission of urinary and intestinal schistosomiasis were studied in the Tono Irrigation Scheme in northern Ghana. The scheme became operational in 1977. In some communities, prevalences and intensities of both Schistosoma mansoni and S. haematobium infection were alarmingly high, pointing to human schistosomiasis being at least focally a health problem of major public health concern. Positive correlations between intensity of schistosome infection, as measured by egg output, with frequency of visible haematuria and history of haematuria point to opportunities for community-based assessment of morbidity and identification of high risk population subgroups. Bulinus globosus is the most important snail host for S. haematobium while Biomphalaria pfeifferi serves as host for S. mansoni. While transmission of S. mansoni is taking place only in the main canal, transmission of S. haematobium takes place in all parts of the irrigation system (lateral canal, night storage dam, main reservoir). The knowledge of how intestinal parasites pass from person to person is known and variously documented by Amankwa *et al.*, (1994) who did similar work in the area and modern drugs are available, providing powerful weapons against them. Nevertheless, these infections continued to be a widespread problem and although their impact on an individual may seem slight, the global burden of the parasitic worm infections is a major health care challenge. The capacity of man to combat intestinal parasite does not seem to fall down in diagnosis and treatment, rather, it is in the low priority accorded to the control of the parasitic diseases by government of where they are endemic.

The control of schistosomiasis and indeed other intestinal parasitic infections require a combined approach involving health knowledge and awareness of risk factors for transmission.

There is need for updated information on the extent of disease burden, communities at risk and factors associated with infection at the district and sub-district level to facilitate effective prioritization and monitoring while ensuring ownership and sustainability of prevention and control programs at the local level.

The present study is aimed at providing current data on infection levels among individuals living around the Tono dam and the sex and age group that carries the highest worm load , which data is needed for planning and designing interventions to help alleviate suffering in the communities.

1.1 RESEARCH OBJECTIVES

1. To determine the prevalence of urinary and intestinal schistosomiasis in the Tono dam catchment area/communities
2. To determine the species of snails present in the dam and the schistosome parasites being harbored.
3. To determine the seasonal variation in prevalence/infection levels in the communities
4. To determine the knowledge, attitudes and practices of inhabitants around the dam that could expose them to schistosomiasis infection.

1.2 JUSTIFICATION

Schistosomiasis is an increasing problem around the world as countries build and develop new agricultural and water resources and as more people are exposed to infection. Over the past 20 years throughout the tropics, wide spread dam construction has been the rule. While dams allow for the possibility of creating massive irrigation schemes, large reservoirs for supplying drinking water, and, in some cases, the generation of hydroelectric power, they also have inadvertently increased snail habitats, and mosquito and black fly breeding sites. For example, in Senegal, recently constructed dams and irrigation projects have led to the spread of *S. mansoni* into previously uninfected areas.

However, even in these seemingly intractable situations, innovative management practices have occasionally saved the day. Many dams can be controlled with respect to water flow regimens, permitting intermittent drying out of littoral zones of impoundments. Stranding snails and mosquito larvae on dry lakeshores effectively limit the population densities of unwanted vector and intermediate host species.

According to Amankwa et al. (1994), the disease is especially important in poor ,rural areas where attempts to alleviate poverty also promote small-to-large scale water related development projects that may increase transmission and the Tono dam is not an exception as people are variously engaged in such activities as fishing, washing rice farming and other irrigation activities.

CHAPTER TWO

2.0 LITERATURE REVIEW

Schistosomiasis, also known as Bilharziasis, is a parasitic disease caused by blood flukes of the genus *schistosoma* and that leads to chronic ill health. It is the major health risk in the rural areas of Central China and Egypt and continues to rank high in other developing countries.

Infact, it is the second most prevalent tropical disease in the world (WHO, 2004) after malaria. Schistosomiasis has been recognized since the time of the Egyptian pharaohs (WHO, 2007). The worms responsible for the disease were eventually discovered in 1851 by Theodor Bilharz, a young German pathologist, from whom the disease took its original name, Bilharziasis. The disease is indicated either by the presence of blood in the urine or, in the case of intestinal schistosomiasis, by initially atypical symptoms which can lead to serious complications involving the liver and spleen.

Schistosomiasis is endemic in 74 tropical developing countries. Some 600 million people are at risk of becoming infected. It is estimated that 200 million people are already infected. Extreme poverty, the unawareness of the risks, the inadequacy or total lack of public health facilities plus the unsanitary conditions in which millions of people lead their daily lives are all factors contributing to the risk of infection. (WHO, 2007)

Schistosomiasis mainly affects adult workers in rural areas, employed either in agriculture or the freshwater fishing sector. In many areas, a high proportion of children between the ages of 10 and 14 are infected. Urinary schistosomiasis affects 66 million children throughout 54 countries. In some villages around Lake Volta in Ghana, over 90% of the children are infected by the disease (WHO, 2004).

As with other tropical diseases, population movements and refugees in unstable regions contribute to the transmission of schistosomiasis. Rapid urbanization has been accompanied by new foci of transmission. The increase in "off-track" tourism has led to increasingly serious infections with previously unencountered sequelae, including paralysis of the legs (WHO, 2007).

The large fresh water reservoirs associated with dams such as Akosombo Dam in Ghana, the Kainji Dam in Nigeria and the Kariba Dam in Zimbabwe as well as smaller reservoirs in the Sahel and irrigation systems throughout Africa are major transmission foci and thus endemic areas for schistosomiasis(WHO, 2007).

There is an association between urinary schistosomiasis and a form of cancer of the bladder in some regions. This link is mainly recorded among the active section of the population, most of whom are farmers. In Egypt, schistosomiasis linked with cancer of the bladder is the primary cause of death among men aged between 20 and 44 years. In the industrialized countries, cancer of the bladder without schistosomiasis is usually prevalent among workers (fishermen, rice farmers) aged around 65. In some regions of Africa where *Schistosoma haematobium* is prevalent, the incidence of cancer of the bladder linked to schistosomiasis is 32 times higher than the incidence of cancer of the bladder in the USA.

2.1 Parasitology

The main forms of human schistosomiasis are caused by five species of the flatworm, or blood flukes, known as schistosomes:

- *Schistosoma mansoni* causes intestinal schistosomiasis and is prevalent in 52 countries and territories of Africa, the Caribbean, the Eastern Mediterranean and South America
- *Schistosoma japonicum/Schistosoma mekongi* cause intestinal schistosomiasis and are prevalent in 7 African countries and the Pacific region (China, East Asia, Philippines)
- *Schistosoma intercalatum* which causes intestinal schistosomiasis is found in ten African countries.
- *Schistosoma haematobium* causes urinary schistosomiasis and affects 54 countries in Africa and the Eastern Mediterranean.

2.2 Life Cycle of Schistosomiasis

People are infected by contact with water used in normal daily activities such as personal or domestic hygiene and swimming, or by professional activities such as fishing, rice cultivation, and irrigation.

Due to lack of information or insufficient attention to hygiene, infected individuals may contaminate their water supply with faeces or urine. The eggs of the schistosomes in the excreta of an infected person open on contact with fresh water and release a stage of the parasite, the miracidium. To survive, this motile form must find a fresh water snail.

Without snails, there can be no schistosomiasis. Because schistosome-transmitting snails occur in very particular ecological circumstances that are subject to rapid change in an increasingly human-dominated world, one of the greatest challenges to understanding the future of this neglected yet persistent human disease is to understand how snails will be affected by global changes in climate, increased pollution of aquatic habitats, continued transport of exotic and invasive species, construction of dams and irrigation systems, mass movements of humans, and changes in human population density and standard of living. Some of these factors such as continued high levels of poverty and civil unrest will have more predictable effects on transmission, but others, like climate change, pollution of aquatic habitats or movement of exotic species, have impacts that are far harder to predict. For example, increased pollution of water bodies with human wastes might favor transmission, but pollution with agricultural or industrial wastes may have the beneficial impact of eliminating transmission, but for all the wrong reasons. Because schistosomes by necessity follow the snails, we must not ignore the snails as they will ultimately dictate where in the world schistosomiasis can occur, and likely at what level of prevalence it can occur (Loker E.S., 2005).

Once it has found and penetrated its snail host, the miracidium divides, producing thousands of new parasites (cercariae). The cercariae are then excreted by the snail into the surrounding water. They can penetrate an individual's skin within a few seconds, continuing their biological cycle once they have made their way to the victim's blood vessels. Within 30 to 45 days, the parasite is transformed into a long worm which is either male or female. The female lays from 200 to 2000 eggs per day over an average of 5 years, according to the species.(WHO, 2007).

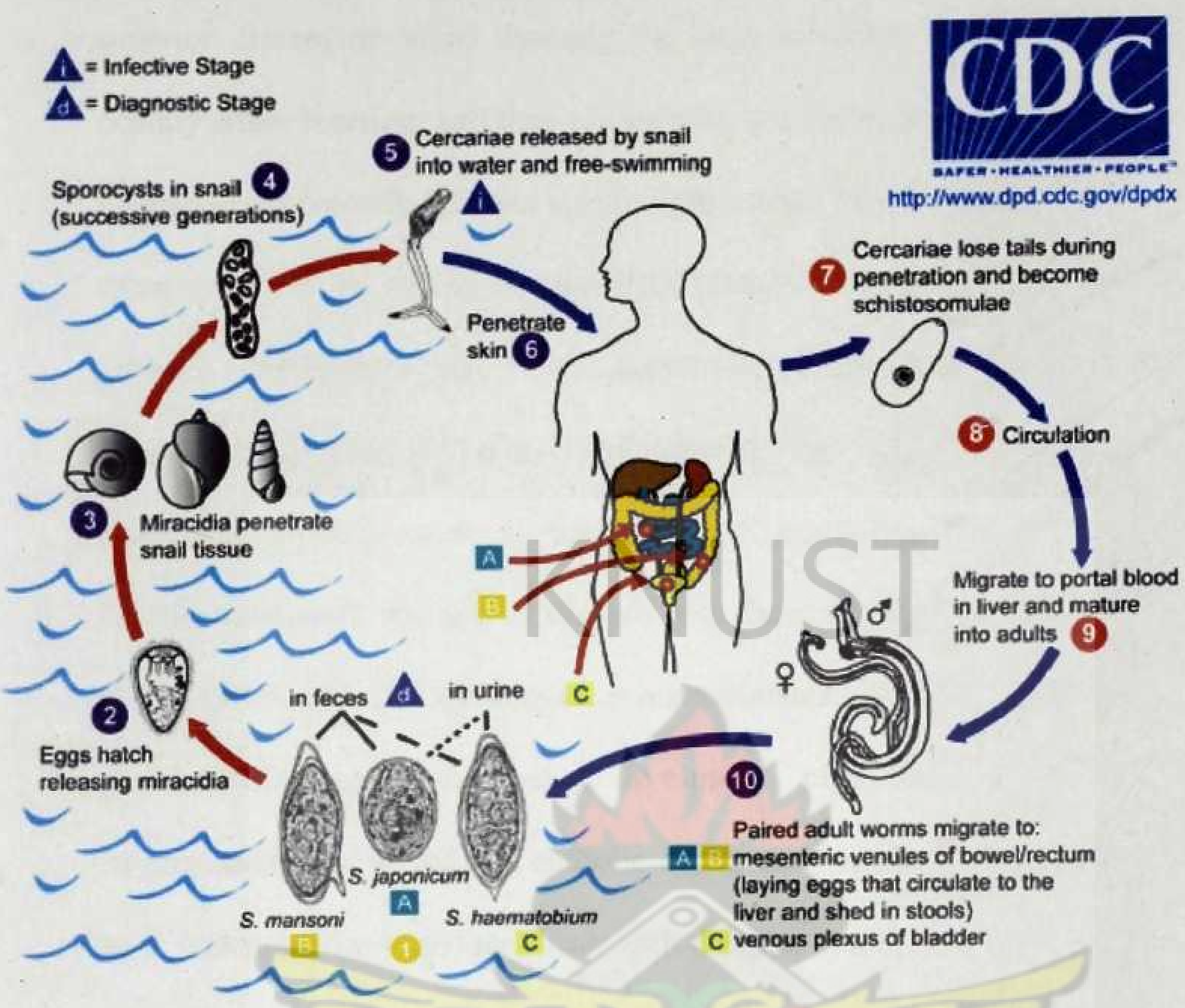

Figure 1. Life cycle of *Schistosoma* species . Source: CDC

Eggs are eliminated with feces or urine into snail- inhabited fresh water bodies ❶. Under optimal conditions the eggs hatch and release miracidia ❷, which swim and penetrate specific snail intermediate hosts ❸. The stages in the snail include 2 generations of sporocysts ❹and the production of cercariae ❺. Upon release from the snail, the infective cercariae swim, penetrate the skin of the human host ❻, and shed their forked tail, becoming schistosomulae ❼. The schistosomulae migrate through several tissues and stages to their residence in the veins (❽, ❾). Adult worms in humans reside in the mesenteric venules in various locations, which at times seem to be specific for each species ❿. For instance, *S. japonicum* is more frequently found in the superior mesenteric veins draining the small intestine A, and *S. mansoni* occurs more often in the superior mesenteric veins draining the large intestine B. However, both species can occupy either location, and they are capable of moving between sites, so it is not possible to state unequivocally that one species only occurs in one location. *S. haematobium* most often occurs in the venous plexus of the bladder C, but it can also be found in the rectal venules. The females (size 7 to 20 mm; males slightly smaller) deposit eggs in the small venules of the portal and perivesical systems. The eggs are moved progressively toward the lumen of the intestine (*S. mansoni* and *S. japonicum*) and of the bladder and ureters (*S. haematobium*), and are eliminated with feces or urine, respectively 1. Pathology of *S. mansoni* and *S. japonicum* schistosomiasis includes: Katayama fever, hepatic perisinusoidal egg granulomas, Symmers' pipe stem periportal fibrosis, portal hypertension, and occasional embolic egg granulomas in brain or spinal cord. Pathology of *S. haematobium* schistosomiasis includes: hematuria, scarring, calcification, squamous cell carcinoma, and occasional embolic egg granulomas in brain or spinal cord.

In the case of intestinal schistosomiasis, the worms reside in the blood vessels lining the intestine. In urinary schistosomiasis, they live in the blood vessels of the bladder. Only about a half of the eggs are excreted in the faeces (intestinal schistosomiasis), or in the urine (urinary schistosomiasis). The rest stay in the body, damaging other vital organs. It is the eggs and not the worm itself which cause damage to the intestines, the bladder and other organs.

2.3 Control of Schistosomiasis

The priorities are:

- health education
- the supply of drinking water and the planning of adequate healthcare facilities
- diagnosis and treatment
- management of the environment
- control of the intermediate hosts (freshwater snails)

Schistosomiasis control is far more effective when placed in the context of a general health care system. The integration process is slow, but this "horizontal" approach is now becoming an integral part of health care at village level. Schistosomiasis control and prevention measures should be implemented before dam construction work begins. Control approaches for each form of schistosomiasis vary and must be adapted to the epidemiological situation, available financial resources, and the particular local culture. This strategy has produced excellent results; in some regions it has met the planned objectives within two years. It is nevertheless essential to plan surveillance and maintenance over periods of 10 to 20 years.

Until recently, the control of schistosomiasis was largely based on vertical programmes (Gryseels *et al*., 1991; Barakat *et al*.,1995), with separate budgeting from regular health services supported by donor organizations. The 'vertical' concept aims at reducing prevalence of the infection, and thereby morbidity, through active case findings. Within this approach, treatment of infected individuals or target groups with the standard dose of

40mg praziquantel/kg body weight is applied in many endemic countries (WHO, 1985). Nevertheless, the vertical approach has not been sustainable because of high cost and rapid reinfection (Kumar and Gryseels 1994). The inability to sustain schistosomiasis control has prompted many endemic countries to consider integration of control activities within the regular health services 'the horizontal approach', as a more viable alternative (Tanner and Degremont 1986; WHO 1993). This approach aims at providing treatment to those who self- report to health facilities with schistosomiasis-related signs and symptoms. The assumption here is that , if signs and symptoms are recognized early enough by the patients themselves, most severe forms of pathology that develop later can be prevented.

2.4 Health education

Health education on schistosomiasis has greater importance than ever before. The introduction into schools of diagnosis and treatment has made children and parents much more aware of the problem connected with the disease. School teachers and local health workers are effective in explaining the role played by people in the transmission of schistosomiasis. Campaigns in the Egyptian mass media have proved particularly successful in increasing awareness of the need for diagnosis and treatment. (WHO, 2004)

The supply of safe drinking water is fundamental to schistosomiasis control. The beneficial results of chemotherapy - normally quite spectacular - are even more marked in communities with adequate water supplies. The high prevalence of schistosomiasis is clearly a reliable criterion to select communities for installing a clean water supply.

2.5 Chemotherapy

Until the 1970's, treatment of schistosomiasis was nearly as dangerous as the disease itself. Modern treatment is effective and without risk. Three new drugs have revolutionized treatment:

- **Praziquantel** - effective in the treatment of all forms of schistosomiasis, with virtually no side effects
- **Oxamniquine** - used exclusively to treat intestinal schistosomiasis in Africa and South America
- **Metrifonate** - effective for the treatment of urinary schistosomiasis

Modern diagnostic techniques are simple, easy to apply and cost very little. Although reinfection may occur after treatment, the risk of serious disease developing in the body organs has been greatly reduced, and it has been observed that there is a marked regression of lesions in young children following treatment of the infection. In the majority of localities where treatment is provided, the total number of cases is reduced within 18 to 24 months (WHO, 2004). In other localities, according to the local situation, the prevalence has been substantially reduced, and it is encouraging to note that no further intervention is required for intervals between 2 and 5 years.

To be effective, schistosomiasis control strategies should be adapted to the local epidemiological situation and caution must be taken when destroying freshwater snails using chemicals - particularly in terms of impact on the environment.

2.6 Transmission of Schistosomiasis

Schistosomiasis in man is a chronic and debilitating disease caused by flat worms known as schistosomes. It is one of the most common parasitic infections in the world (Okpala *et al.*, 2004; WHO, 2004). The perpetuation of schistosome infection within a population relies on several factors. First, there must be humans (or in the case of *S. japonicum*, animals) and snails living in close proximity and moving through the same aqueous environments. Additionally, infected humans must excrete their feces or urine into or nearby the snail-infested water. These are the conditions necessary to maintain the multi-stage life cycle.

Because multiple settlements often use the same or adjoining water sources the level of intervillage connectivity in particular places may cause varying rates of transmission. In areas with high levels of connectivity, geographic clustering of parasites may result, producing a greater schistosome burden in the water sources and an increased likelihood of local infection. The degree of schistosomiasis presence upstream has an impact on the degree of infection in villages downstream and using the same water source (Xu *et al.*, 2006)

The demands of growing populations for water and electricity has often led to increased levels of transmission as a result of irrigation and the building of dams. The slow-moving water created by dams and irrigation canals provide an ideal habitat for the host snails in many areas. (Chitsulo *et al.*, 2000).

The construction of water resource schemes to meet the power and agricultural requirements for the growing population has led to the proliferation of the snail vector and hence, transmission of the disease worldwide (Pointier and Jourdane, 2000).

It is mostly common in the tropical areas of the globe especially the rural areas where only the surface water bodies are the sources of water supply (Mbata *et al.*, 2009).

Like most parasitic diseases, schistosomiasis prevalence is related to poverty and poor living conditions (Engels *et al*., 2002)

Extreme poverty, the unawareness of the risks, the inadequacy or total lack of public health facilities plus the unsanitary environment in which millions of people live daily are some of the factors that contribute to the high prevalence of the disease and its continuous transmission in endemic communities. Population movements and refugees in unstable regions also enhance the introduction of the disease into other areas and the creation of new foci in non-endemic areas. Rapid urbanization has also been accompanied by new foci of transmission.

The transmission of schistosomiasis is seasonal (Elias, 1992,) and related to the breeding pattern of the snail intermediate hosts and water contact pattern. In some communities, transmission is sex -related with patterns that reflect the cultural roles assigned to the male and female sexes which affect their water contact behavior (Husting, 1983).

2.7 Prevalence of Schistosomiasis

Schistosomiasis mainly affects adult workers in rural areas, employed either in agriculture or the freshwater fishing sector. In many areas, a high proportion of children between the ages of 10 and 14 are infected. Urinary schistosomiasis affects 66 million children throughout 54 countries. In some villages around Lake Volta in Ghana, over 90% of the children are infected by the disease (WHO, 2007).

Although the majority of people in endemic areas have only light infections or no symptoms, the impact of schistosomiasis on economic conditions and the general health situation should not be underestimated. In the north-east of Brazil, in Egypt and the Sudan, the work capacity of rural workers has been estimated to be seriously undermined. The disease also substantially affects children's growth and school performance.

According to Bowie and his colleagues, all water bodies in Malawi are considered to be potential transmission sites for schistosomiasis. The most recent national estimate puts the prevalence of schistosomiasis between 40% and 50% of the population. This is based on surveys carried out prior to 1991 Bowie *et al.*,(2004) Numerous local surveys have been conducted more recently in different parts of that country. A survey performed by the Bilharzia Control Programmes in Mangochi Lake reported in 1999 showed between 60–80% of school children living along the shore has *S. haematobium*.

This level of infection was confirmed in a later survey performed by the Lakeshore Schistosomiasis Control Project, which found the prevalence amongst school aged children (5–15 years old) to be as high as 80% along the lake shore, with some areas having 100% infection rates Bowie *et al.,(*2004).

Schistosomiasis is usually prevalent with other helminthes in endemic communities especially where the standard of personal and environmental hygiene is low. A study in some villages of Debu north, Ogun state, Nigeria (Agbolade *et al.*, 2004) revealed a high prevalence of *Ascaris lumbricoides* and hookworm infestations occurring with *S. haematobium* infection.

Blais *et al.*,(2009) revealed a high prevalence of *S. haematobium* infection in a Zambian subpopulation that lacked many of the traditionally perceived risk factors of a water-borne disease and report an overall prevalence of 20.72% in the school-age population under study

According to Mbata *et al*., (2009) the result of their study (Nigeria) showed a relatively high prevalence of urinary schistosomiasis (45.68%) in Ogbadibo local government area of Benue State (Nigeria). Adeyeba and Ojeaga (2002) reported a close infection rate of 57.5% among school children in Ibadan, Nigeria. Edungbola *et al.,* (1998) recorded similar infection rate among school children in Babana district, Kwara State, Nigeria

A study conducted by Amankwa *et al*.,(1994) in the Tono irrigation area in the Kassena-Nankana District, of northern Ghana revealed high prevalence levels of 68% and 67% for *S. mansoni* and *S. haematobium* respectively. The finding of Amankwa *et al*., (1994) were similar to findings in irrigation schemes in other semi-arid areas of Africa (Elias, 1992;) reflecting the level of transmission in relation to water contact behavior in accordance with activities such as farming and fishing.

In Ghana, schistosomiasis assumed major importance as a public health problem in the early 1960s following construction of the Akosombo dam (Paperna 1970). The resulting lake Volta, 8739km^2, created a vast area suitable for the breeding of schistosome host snails. Before the construction of the dam, prevalence of *S. haematobium* was 5-10%; it rose to>90% in most communities along the Volta lake, raising serious public concern (Scott *et al*., 1982; Aryeetey *et al*., 2000). The situation was worsened by rapid increase in the prevalence of intestinal schistosomiasis at the lower Volta (Odei 1983; Wen &Chu 1984). *S. mansoni*, until recently, a rare species in Ghana (Rambajan 1994), now is common in the northern parts of the country (Amankwa *et al*. 1994).

2.8 Complications of *Schistosoma* Infection

Schistosomiasis presents with various signs and symptoms. These include, fever, night sweating, weight loss, abdominal pain, hepatosplenomegaly and haematuria (Au-Fawaz et al., 1990). Pathological lesions due to schistosome eggs have been observed in the breast (Nkanza, 1989), testis (Soans and Abel, (1999), and the spinal cord(Ruperti,1999). Urinary schistosomiasis in females (Female Genital Schistosomiasis FGS) can lead to pre-term delivery usually with underweight babies (Siegrist and Siegrist- Obimpeh, 1992), abortion and infertility (Nouhou, Seve, Idi and Moussa, 1998). Male Genital Schistosomiasis (MGS) has also been reported to reduce semen volume and cause infertility (Saad, Abdelbaky, Osman, Abdallah and Salem, 1999). Both FGS and MGS could facilitate the spread of sexually transmitted diseases including HIV/AIDS. Genital disease is present in approximately one third of infected women resulting in a variety of vulvar and perineal disease, including ulcerative, fistulous, or wart-like lesions (Poggensee and Felmeier, 2001),

Vulvar schistosomiasis may also facilitate the transmission of HIV (Stephenson *et al.*, 1989). Furthermore, the overall vitality and academic performance of children is affected (Nokes *et al.*, 1999)

For those who go without treatment for a long time, schistosomiasis can be hard to cure. There can be lifelong damage to the liver, lungs, intestines, or bladder. For those who are exposed only briefly, such as during travel, and who are not reinfected, complications are rare even without treatment.

2.9 Snail Distribution

Dramatic changes in the distribution and abundance of snails hosting schistosomes occur or can be anticipated: there is ,therefore, the need to closely monitor such changes because where the appropriate snails go, the schistosomes typically follow.

Biomphalaria pfeifferi is the most important intermediate host in tropical Africa for *Schistosoma mansoni*, the parasite causing intestinal bilharzia in man (Brown, 1980) *Bulinus globosus* is the most important snail host for *S. haematobium* (Amankwa et al., 1994)

The aquarium and aquatic plant trade, the incessant movement of people and their goods, and even natural dispersal events all conspire to move snails from one location to another (Pointier *et al.*, 2005). The hermaphroditic or parthenogenetic reproductive habits of many snails (favor their successful introduction into new locations. Thus a *Biomphalaria glabrata*-like snail was dispersed naturally to Africa within the past five million years creating dramatic new opportunities for schistosome parasites (Campbell *et al.*, 2000; DeJong *et al.*, 2001). With respect to controlling schistosomiasis at the level of the molluscan host, the true enemy is not the snail that is hosting the parasite, but the schistosome miracidia that colonize the snail and transform into sporocysts. It is these sporocysts that will eventually produce the infective stages—cercariae—that infect humans (Loker, E.S. 2005).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study site

The study was conducted in two villages, Gia and Gognia. Gia surrounds the dam whilst Gognia is about 19 km away from the dam.

There are two distinct seasons in the area namely wet/rainy and dry seasons. The wet season (annual average of 800mm) lasts from May to October and is characterized by heavy rains with subsequent flooding of banks of rivers, streams, ponds, ditches and other hydrological resources. The dry season is subdivided into a dry cold (November-January) and a dry hot (February- April) season.

The major occupations of the inhabitants are farming, fishing, trading, carpentry, dressmaking/tailoring and other civil service.

The Tono Irrigation Project is located in the Kassena-Nankana district of the Upper East Region of Ghana. The project is being managed by the Irrigation Company Of Upper Region Ltd. (ICOUR). ICOUR is a Ghana Government organization established to promote the production of food crops by small scale farmers within organized and managed irrigation schemes.

The Tono dam is one of the largest agricultural dams in West Africa and serves as a place for year round farming. About 2,490 hectares of land is irrigated with water from the 2½ mile long dam which serves seven villages in the District. The dam was built in the late 70's and early 80's by Taysec, a British engineering company.

Figure 2 **Section of Tono dam with a cannoe**

The popular cash crops being cultivated on the project are rice, soya bean, and tomato. Future cash crops may also include cashew. While ICOUR tomatoes are marketed in the southern region of Ghana, the soya bean is sold to industries throughout Ghana.

3.2 DATA COLLECTION

Questionnaire administration

The interviews took place between January and February 2011. Opinion leaders and community members were first informed about the study in a durbar and their consent sought. Subjects were assured about confidentiality of information obtained from them.

A pretested questionnaire developed in English was administered to all participants. The questionnaire was made up of a demographic section including name, age, sex and socio-economic indicators such as level of education, occupation and data collected on their knowledge, attitude and practices with respect to exposure to schistosomiasis infection and indicators of schistosomiasis- related signs and symptoms such as duration and severity; and action taken. The signs and symptoms covered by the questionnaire were: blood in urine and painful urination (for urinary schistosomiasis); blood in stool/bloody diarrheoa (for intestinal schistosomiasis).

It is noted that the signs and symptoms covered here are only suggestive of, but not necessarily, due to schistosomiasis till confirmed from results of urine and stool analysis for schistosome eggs by microscopy.

All registered individuals were interviewed. Parents or guardians answered for small children less than 6 years.

Urine, stool and snail sample collection

Urine and stool samples were collected from 400 subjects who were interviewed.

Each subject was given two clean, dry capped plastic containers bearing the same identification numbers as on their questionnaire form. The containers were given a day earlier to the subjects to provide their urine and stool samples the next morning. Emphasis was laid on the very first and last drops of urine. The samples were picked up between 10.00am and 12.00noon and transported to the laboratory for analysis.

Snail samples were, however, picked from the shore of the dam at regular intervals. They were also sent to the laboratory for identification.

3.3 LABORATORY PROCESSING OF SAMPLES

Stool Sample Examination

The stool samples were physically examined for: color, formation, presence or absence of blood and /or mucus. The samples were later processed using the wet saline mount technique for microscopic examination. Using a piece of clean applicator stick, the specimen was mixed in a drop or two of 10% saline.

A small drop of the mixed sample was put on a clean microscope slide and covered with a cover glass. The specimen was examined using the 10× and 40× objectives with the condenser iris closed sufficiently to give good contrast. All fields of the sample on the slide were examined. The number of *Schistosoma mansoni* ova seen was recorded onto a data collection form designed for the study.

Urine Sample Examination

Urine samples were also physically examined. The presence of visible haematuria in any sample and turbidity were noted and recorded. The WHO (1991) centrifugation and sedimentation techniques were employed to analyze the samples. Ten (10)ml urine was taken from the deposit of each specimen bottle after allowing to sediment for about 1 hour and centrifuged for 2mins at 2000rpm. The supernatant was decanted and the deposit was thereafter examined microscopically using X10 and X40 objectives for the characteristics of schistosoma egg or ova. Identification of the eggs was done using the centrifugal sedimentation technique and wet smear methods.

Snail Sample Screening

Snails found were picked and put in wide mouth plastic paint container and taken to the laboratory where they were screened for *cercariae* after exposure to sunlight for about 3hours (Emejulu *et al.,* 1994).

Sampling Procedure

Simple convenient sampling was employed based on the availability of subjects when the researcher visited the study site. This was due to the non-availability of volunteers originally recruited to participate in the study. Participants had their ages ranging from as low as six months to sixty- five years.

Sampling Size

It was envisaged that a total of 400 urine and stool samples would be taken and analyzed. However, three hundred and seventy –four urine and stool samples each were analyzed

3.4 Statistical Analysis

The data obtained in this study was statistically analyzed using the chi square test.

CHAPTER FOUR

4.0 RESULTS

Table 4.1 shows that 174 of the respondents were from Gia and 199 from Gognia; also, 151 were males and 222 were females. Table 4.1 also shows the sex distribution of the respondents in the two communities. In Gia about 37% of the respondents were males and the remaining 63% were females, whereas in Gognia about 44% were males and the remaining 56% were females.

Table 4.1: Sex distribution of study participants.

COMMUNITY	MALE	FEMALE	TOTAL
GIA	64 (37%)	110 (63%)	174 (100%)
GOGNIA	87 (44%)	112 (56%)	199 (100%)
TOTAL	151 (40%)	222 (60%)	373 (100%)

Table 4.2 shows the age distribution of respondents in the communities. Majority of the respondents were within the age group of 11-20 years.

Table 4.2: Age distribution of study participants

AGE	GIA	GOGNIA
1-10	32 (18%)	41 (21%)
11-20	92 (53%)	51 (27%)
21-30	24 (14%)	35 (18%)
31-40	19 (11%)	19 (10%)
41-50	5 (3%)	22 (11%)
51-60	2 (1%)	15 (7%)
61-70	0 (0%)	10 (4%0
70 +	0 (0%)	6 (2%)

There was a variation as to source of drinking water. For the two communities: about 11% of the people from Gia use well water, while 84% use borehole and the remaining 5% use pipe borne water. Furthermore, 4% of those from Gognia use well water, while 52% use pipe borne water and the remaining 44% use borehole (Table 4.3).

Table 4.3: Community and their source of drinking water.

Community	Well	Pipe Borne	Bore-Hole	Total
Gia	19 (11%)	9 (5%)	146 (84%)	174 (100%)
Gognia	7 (4%)	103 (52%)	89 (44%)	199 (100%)
Total	26 (7%)	112 (30%)	235 (63%)	373 (100%)

A chi-square test of association, $\chi^2 = 97.0, p = 0.00$, showed a significant relationship between the community and their source of drinking water.

Table 4.4 shows the age distribution and prevalence of *Schistosoma haematobium* and *Schistosoma mansoni.* Majority of the respondents with *S. haematobium* and *S. mansoni* infection fall within the age category 11-20 years. About 46% of those having *S. haematobium* infection fall between 11-20 years whilst 53% of those with the *S. mansoni* infection were also within the same age category.

Table 4.4: Age distribution and infection with Schistosoma .

Age	Infection with *S. haematobium*	Infection with *S. mansoni*
1-10	1 (5%)	7 (19%)
11-20	10 (46%)	19 (53%)
21-30	2 (9%)	1 (3%)
31-40	8 (35%)	6 (17%)
41-50	1 (5%)	3 (8%)
51-60	0 (0%0	0 (0%)
61-70	0 (0%0	0 (0%)
71 +	0 (0%)	0 (0%0
Total	22 (100%)	36 (100%)

About 81% of those who bath in the open water bodies in the communities have the *Schistosoma mansoni* infection (Table 4.5). A chi- square test of association, $\chi^2 = 9.9, p = 0.002$, showed a significant relationship between bathing in the water bodies around and infection with *S. mansoni* .

Table 4.5: Cross tabulation of infection with *S. mansoni* and bathing in water bodies

Infection with *Schistosoma mansoni*	BATHING IN WATER BODIES		TOTAL
	YES	NO	
YES	29(81%)	7 (19%0	36
NO	179 (53%)	158 (47%)	337
TOTAL	208 (56%)	165 (44%)	373

From Table 4.6, about 75% of those who wash in the water bodies have the *S. mansoni* infection. A chi- square test of association, $\chi^2 = 6.8, p = 0.009$, showed a significant relationship between washing in the water bodies and infection with *Schistosoma mansoni* ovum/ova.

Table 4.6: Cross tabulation of the infection with *S. mansoni* and washing in water bodies

PRESENCE OF *S. mansoni* infection	WASHING IN WATER BODIES		TOTAL
	YES	NO	
YES	27 (75%)	9 (25%)	36
NO	176 (52%)	161 (48%)	337
TOTAL	203 (54%)	170 (46%)	373

Furthermore, investigating the presence of *Schistosoma haematobium* infection with respect to bathing and washing in the water bodies, about 77% of those who wash and bath in the water bodies have the *Schistosoma haematobium*. From Table 4.7, a chi-square test of association, $\chi^2 = 4.9, p = 0.027,$ for washing in water bodies and $\chi^2 = 4.4, p = 0.036,$ for bathing in water bodies showed a significant relationship between bathing and washing in the water bodies and infection with *Schistosoma haematobium*.

Table 4.7: Cross tabulation of washing and bathing in water bodies and the infection with *S. haematobium*.

Infection with *Schistosoma haematobium*	ACTIVITY			
	WASHING IN WATER BODIES		BATHING IN WATER BODIES	
	YES	NO	YES	NO
YES	17 (77%)	5 (23%)	17 (77%)	5 (23%)
NO	186 (53%)	165 (47%)	191 (54%)	160 (46%)
TOTAL	203 (54%)	170 (46%)	208 (56%)	165 (44%)

Also, as shown in Table 4.8, about 68% of the people from Gia have the *Schistosoma haematobium* while 32% of those from Gognia have the *Schistosoma haematobium*. A chi-square test of association, $\chi^2 = 4.4, p = 0.037$, showed a significant relationship between the community in which one lives and infection with *Schistosoma haematobium*.

Table 4.8: Cross tabulation of infection with *Schistosoma haematobium* and the community one lives in.

Infection with *Schistosoma haematobium*	COMMUNITY		TOTAL
	GIA	GOGNIA	
YES	15 (68%)	7 (32%)	22(100%)
NO	159 (45%)	192 (55%)	35(100%)
TOTAL	174 (47%)	199 (53%)	373(100%)

From Table 4.9, about 72% of the people from Gia had the *Schistosoma mansoni* infection while only 28% had the infection in Gognia. A chi- square test of association, $\chi^2 = 10.5, p = 0.001$, showed a significant relationship between community and *Schistosoma mansoni* infection.

Table 4.9: Cross tabulation of the infection with *Schistosoma mansoni* and the community one lives in.

Infection with *Schistosoma mansoni*	COMMUNITY		TOTAL
	GIA	GOGNIA	
YES	26 (72%)	10 (28%)	36(100%)
NO	148 (44%)	189 (56%)	33 (100%)
TOTAL	174 (47%)	199 (53%)	373(100%)

In addition, about 67% of the females had the *Schistosoma mansoni* infection compared with 33% of the males with the *Schistosoma mansoni* infection. Also, about 59% of the females had the *Schistosoma haematobium* while 41% of the males had the infection. Furthermore, about 55% of the males and 45% of the females pass blood in their urine, whilst about 47% of the males and 53% of the females pass blood in their stools. A chi-square test of association, $\chi^2 = 0.52, p = 0.472$, showed no significant relationship between gender and whether a person is infected..

As shown in Table 4.10, about 41% of the males have yellow, cloudy or bloody urine while 59% of the females have yellow, cloudy or bloody urine. A chi-square test of association, $\chi^2 = 0.01, p = 0.922$, showed no significant relationship between gender and colour of urine.

Table 4.10: Cross tabulation of gender and colour of urine

COLOUR OF URINE	GENDER		TOTAL
	MALE	FEMALE	
CLEAR	128(40%)	189 (60%)	317(100%)
YELLOW OR OTHER	23(41%)	33 (59%)	56 (100%)
TOTAL	151 (40%)	222 (60%)	373 (100%)

About 90% of the people from Gia pass blood in their urine while 10% of the people from Gognia pass blood in their urine. A chi-square test of association,

$\chi^2 = 23.37, p = 0.00$, showed a significant relationship between the community type and whether or not the person passes blood in the urine.

Of the total of 373 respondents from the two communities about 83% of the people from Gia reported that they passed blood in their stool whereas 17% from Gognia reported that they passed blood in their stool. A chi-square test of association, $\chi^2 = 17.6, p = 0.00$, showed a significant relationship between community and whether an individual passed blood in his/ her stool (Table 4.11).

Table 4.11: Cross tabulation of community and whether community inhabitant passes blood in his/ her stool

BLOOD IN STOOL	COMMUNITY		TOTAL
	GIA	GOGNIA	
YES	25(83%)	5 (17%)	30(100%)
NO	149(43%)	194 (57%)	343(100%0
TOTAL	174(47%)	199(53%)	373(100%)

The Trend of Schistosomiasis during the Three Years, 2008-2010.

Figure 4 is a time series graph showing the trend of schistosomiasis from 2008 to 2010. From the graph it is evident that high cases of schistosomiasis were recorded between July and September, 2008. After the sharp rise there was a sudden decline in the number of cases in the same year. In 2009, although the cases recorded were not as high there was an insignificant increase between September and November. Also, in 2010 there was another increase in the number of cases between September and November after which there was a drop. It is also evident that between March and May each year there is a drop in the number of cases.

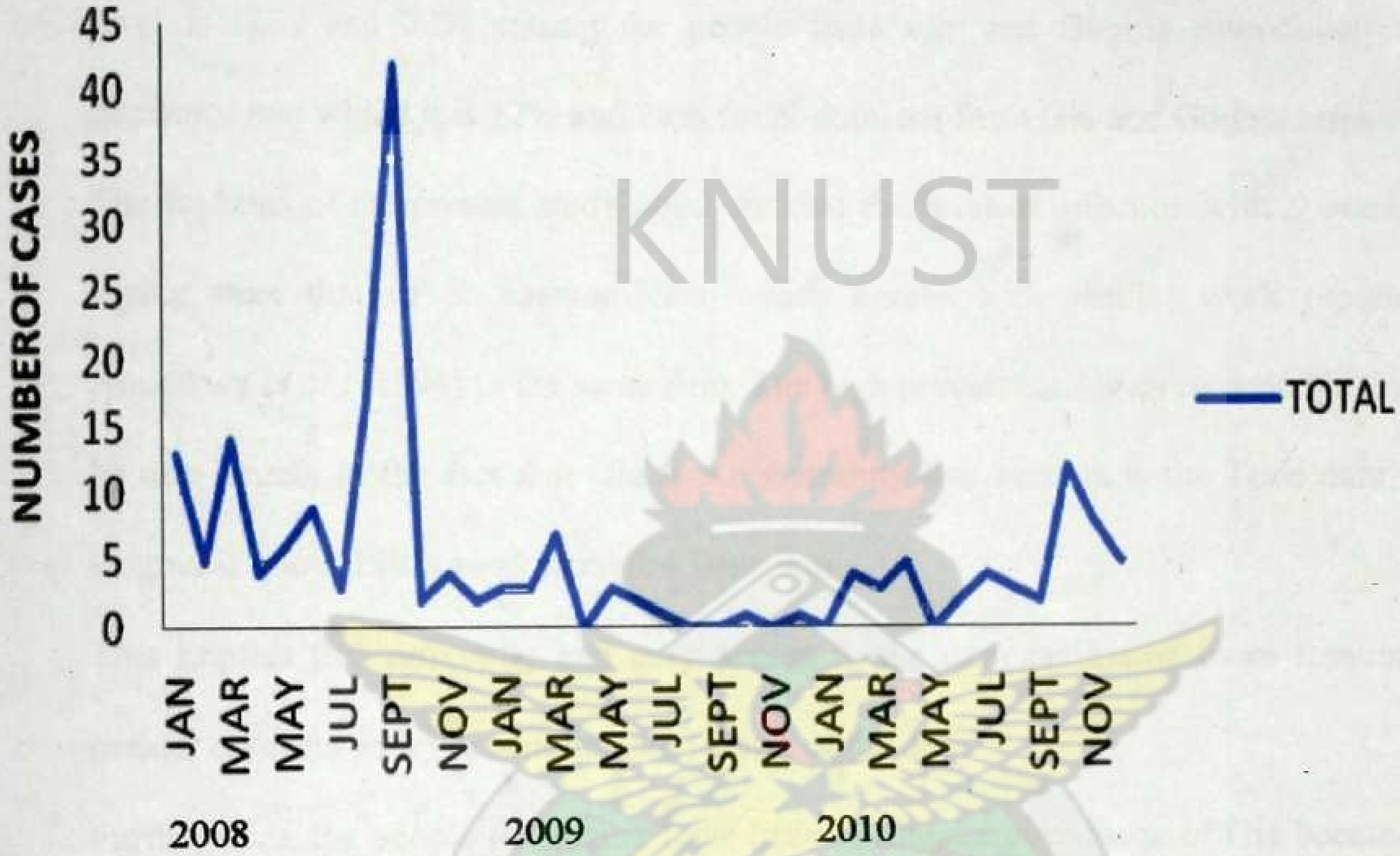

Figure 3: Line graph showing the trend of schistosomiasis from 2008 to 2010

CHAPTER FIVE

5.0 DISCUSSION

Schistosomiasis remains one of the major health problems in tropical and sub tropical countries with school- aged children usually the most affected. The current prevalence level is 68% and 32% among the people from Gia and Gognia respectively for *S. haematobium* whilst it is 72% and 28% for *S. mansoni* from Gia and Gognia respectively. The findings of the present study point out that the level of infection with *S. mansoni* is higher than that of *S. haematobium* which agrees with similar work reported by Amankwa *et al*., (1994) in the same dam. The high prevalence levels recorded in Gia may be due largely to the fact that Gia is a community that surrounds the Tono dam whilst Gognia is about 19km away from the Tono dam.

This implies that proximity and easy access to the dam facilitated more frequent and greater contacts with the contaminated water of the dam.

Furthermore, the people of Gognia have little advantage over those of Gia because they have pipe borne water supply from a water works system even though the supply is grossly inadequate; the short fall is however made up from supplies from constructed bore-holes.

The higher prevalence rate (53%) observed among the age bracket 11-20 years is expected as that is the age that appears to be more adventurous in terms of bathing ,fetching and fishing. This agrees with Mbata *et al*; (2009) in Ogbadibo Local Government Area of Benue state. Okpala *et al*., (2004) Apata and Laranto areas in Jos, Plateau state,nigeria and Nkegbe (2010) in the lower river Volta basin in Ghana.

The high prevalence levels revealed by the study may also be associated with activities such as bathing and washing in the Tono dam as infection rates for *S. mansoni* with respect to bathing and washing were 81% and 75% respectively whilst 77% of all those who washed and bathed in the water bodies had *S. haematobium*.

There was a difference in the infection between the males 33% and the females 67% for *S. mansoni* and 59% and 41% for *S. haematobium*. This is however different from similar work done by Mbata *et al*; (2009) who did not see any significant difference (23.13%) for males and (22.53%) for females. The higher levels of infection (schistomiasis) among the study participants can presumably be attributed to the fact that in this part of the country many people are engaged in such activities as rice farming ,washing, fetching water, swimming and bathing in the Tono dam , the Gia dam for dry season gardening and the IFCAT dam in Gognia.

Most of the subjects in the study population, as revealed by questionnaire analysis, were knowledgeable about the disease which is called "bondundurum" (in Nankani) and "bonafia" (in Kasem). The observation in this study that many of the urine samples with blood stains contained *Schistosoma haematobium* eggs is in line with observations of Emejulu *et al.* (1994) in Agulu lake area of Anambra state, Nigeria.

However, there is a high level of ignorance as to the causative agent, mode of transmission of the disease, its debilitating effect and chemotherapy. Some wrongly thought the disease was contracted from taking too much salt. Haematuria was also observed in more than half of the infected subjects (55%) for males and (45%) for females, and this trend has been observed by other workers (Oniya and Odaibo,2006) from a south western village in Nigeria.

The availability of various species of snails in the waters of the dam especially the *Bulimus* and *Biomphalaria* species highlights the prevalence of the disease in the area.

It was clear from the results that the distribution and infection rate of the schistosome intermediate hosts were greatly influenced by rainfall. This assertion is clearly shown in the report obtained from the War Memorial Hospital (Navrongo) over the past three years. Infection rates were higher between the months of July and September. Though infection rate was generally low but much higher in *Biomphalaria* than in *Bulinus*, there is evidence of high transmission of schistosomiasis in the study area.

Occupational activities influenced the prevalence of schistosomiasis as salaried workers recorded less infection rates as compared to farmers and fishermen.

This observation agrees with the results obtained by Okanla (1991), in Ilorin, Nigeria. The relationship between schistosomiasis and occupation has long been known (Edungbola, 1980; Fenwick and Jorgensen, 1972). Also, contact with water for recreational or other activities has also been associated with infections with schistosomes. (Fernwick and Jorgensen , 1972).

CHAPTER SIX

6.0Conclusion And Recommendations

6.1 Conclusion

Schistosomiasis, like other neglected diseases is a disease of poverty. It is mostly prevalent in Sub- Saharan Africa where not only does it overlap with other low priority (politically) diseases but also high priority diseases such as HIV, malaria, and TB. Schistosomiasis has low mortality but high morbidity rates and because of prioritization, the high mortality diseases are treated first at health facilities. Thus, an integration of schistosomiasis control programs with efforts to curb these high priority diseases has been repeatedly advocated [Molyneaux, 2004; Hotez et al., 2006]. Low literacy increases chances of infection and it is believed that increasing literacy rates may decrease infection with schistosomiasis and regular application of molluscicidal chemicals in water bodies could reduce drastically snail species.

6.2 Recommendation

Based on the findings from the study, it is recommended that:

1. Intense health education be carried out on the risk factors of schistosomiasis in all communities along the irrigation system.
2. This should be a collaborative activity between the health, education and irrigation scheme authorities with the full participation of the communities.

3. The health education should be supported by annual praziquantel administration to at least all inhabitants in the communities.

4. The district health directorate could attempt to control snails through the application of molluscicidal chemicals derived from either the chemical industry or from local indigenous plants.

5. Information on such a disease should be provided to local populations by formal and informal education in schools, multimedia (TV, radio, magazine, booklets) and meetings within communities(community durbars).

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QUESTIONNAIRE

Topic: Evidence of schistosomiasis and the snail intermediate hosts on the Tono dam.

Dear respondent, this questionnaire is to aid me complete my dissertation on the afore-mentioned topic. The information you provide would be treated with utmost confidentiality and is intended for academic purpose only. Thank you.

1. Name ....
2. Sex ....
3. Age.................
4. Where do you obtain your drinking water from?

   a) Well b) Pipe borne c) Bore-hold d) River e) Dam f) Canal
5. What are the water bodies around you? a) Canal b) river c) dam d) other none
6. Do you bath in them? a) Yes b) no
7. Do you wash in the water bodies? a) Yes b) no
8. If yes, what do you wash in there? a) Utensils b) Clothes c) Others specify

   ....
9. What work do you or your parents do? a) Fish b) Farming c) Trading

   d) others specify...
10. If fishing, do you go fishing with them? a) Yes b) No
11. If farming, what do the grow? a) Rice b) millet c) maize d) others

    Specify ....
12. Do you know blood in urine disease? a) Yes B) no

13 Do you know bloody diarrheoa disease?

14. Have you ever seen blood in your urine? a) Yes B) no

15. Do you pass blood in your urine now? a) Yes b) no

16. Have you ever seen blood in your stool? a) Yes b) no

17. Do you pass blood in your stool now? a) Yes b) no

18. Do you know anybody that passes blood in his/her urine? a) Yes b) no

19. Do you normally fill some pains when urinating? a) Yes b) no

20. Do you normally fill some pains around your abdomen when easing yourself?

    a) Yes b) no

21. How do people get blood in urine disease?

    a)..

    b) I don't know

22. How do people get bloody diarrheoa disease?

    a)..

    b) I don't know

Laboratory Results

1. Color of urine..
2. Bloody stool? Yes/no
3. Presence of *Schistosoma haematobium* ovum. Yes/No
4. presence of *Schistosoma mansoni* ovum. Yes/No