PREVALENCE OF *Schistosoma haematobium* AMONG SCHOOL CHILDREN IN USEN COMMUNITY, OVIA SOUTHWEST LOCAL GOVERNMENT AREA, BENIN CITY, EDO STATE

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CERTIFICATION

This is to certify that this research work reported in this project work was carried out by DIBOSA, THERESA CHUKWUNONSO with matriculation number BMS1907260 in the Department of Medical Laboratory science, Faculty of Basic Medical Sciences, University of Benin in Fulfillment of the requirement for the award of Bachelor of Medical Laboratory Science (B.MLS) degree.

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DEDICATION

I dedicate this work to God Almighty who has been a source of strength, inspiration and also my beloved parents for their support towards the success of this project work.

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ABSTRACT

Schistosomiasis is a parasitic disease of major public health concern in sub-Saharan Africa, with school-aged children at particular risk due to frequent water contact. The aim of this research was to determine the prevalence of *Schistosoma haematobium* among school children in Usen community, Edo state, Nigeria. This study determined the prevalence of *Schistosoma haematobium* among school children and examined its association with demographic and behavioral factors. A cross-sectional survey was conducted among 50 students of Ilawure Grammar School, Usen. Urine samples were collected between 10:00 a.m. and 2:00 p.m. and examined microscopically after centrifugation for *Schistosoma haematobium* eggs and red blood cells. Demographic and behavioral data were obtained using structured questionnaires and analyzed with IBM SPSS Statistics version 27. The overall prevalence of *Schistosoma haematobium* was 16.0% (8/50). Infection was higher among males (15.4%) and among older children aged 18–20 years (25.0%), though differences by age and sex were not statistically significant. River/stream contact was significantly associated with infection (24.2%, $p = 0.037$). Other factors such as urinating in rivers, walking barefoot, and lack of toilet facilities showed higher proportions of infection but were not statistically significant. Children with prior knowledge of water protection practices were significantly less likely to be infected ($p = 0.004$). The study confirms that urinary schistosomiasis remains endemic in Usen Community. Health education, improved sanitation, safe water provision, and strengthened school-based interventions including mass drug administration are recommended to reduce infection among school-aged children.

CHAPTER ONE

INTRODUCTION

1.1. BACKGROUND OF THE STUDY

Schistosoma haematobium are parasitic blood-dwelling fluke worms belonging to the genus *Schistosoma*, family *Schistosomatidae*, order *Digenea*, class *Trematoda*, phylum *Platyhelminthes*, and kingdom *Animalia* (McConnaughey, 2024).

Schistosoma haematobium is prevalent in African and Middle Eastern countries, especially in communities without safe drinking water and adequate sanitation (Adu and Ojo, 2019). Infection occurs when larval forms of the parasite, released by freshwater snails, penetrate the skin during contact with infested water (Manz *et al.,* 2020). *Schistosoma haematobium* is the only species responsible for urogenital schistosomiasis. Schistosomiasis, also known as bilharzia, is an acute or chronic disease caused by blood flukes of the genus *Schistosoma*. It is a neglected disease that is endemic in Nigeria and one that poses a public health problem, especially among school-aged children in rural communities (Onyekwere *et al.*, 2022).

The larva forms (cercariae) penetrate the skin and mature into adult worms in the blood vessels that migrate to the venous plexus of the bladder, where they lay eggs (Santos *et al.,* 2021). *Schistosoma haematobium* infection can cause hematuria, proteinuria, dysuria, and leukocyturia. In complicated cases it can cause hydroureter and hydronephrosis, bladder calcification, and stones. Long-term infections have been linked to chronic kidney disease and squamous cell carcinoma of the bladder (Santos *et al.,* 2021). To prevent this complication, urinary schistosomiasis has to be identified and treated immediately.

School children are at more risk due to their frequent exposure to water sources, including freshwater snails that harbor the parasites. They gain access through swimming, bathing, or

playing in contaminated water (Umoh *et al.*, 2022) They also get infected by walking barefoot in areas where the snails are present and drinking contaminated water sources. Their underdeveloped immune system further increases the risk of infection.

There is serious schist endemic in school children in Nigeria, with 40% prevalence in southwest Nigeria (Ojo *et al.,* 2021). A similar study in the Etsako West local government area, Edo State, recorded a 65.3% prevalence (Noriode et al., 2017a).

Usen community, located in Ovia Southwest, Benin City, Edo State, is a rural area with many school-aged children potentially exposed to streams of stagnant water bodies. However, data on the prevalence of *Schistosoma haematobium* infection among school children in this area is limited or nonexistent. This study seeks to determine the prevalence of *Schistosoma haematobium* among school children in the Usen community, to inform control efforts, improve health outcomes, and guide public health interventions such as deworming programs and health education.

1.2. JUSTIFICATION OF THE STUDY

This study is essential for understanding the prevalence of *Schistosoma haematobium* in Usen community, Ovia South-West, Benin City, Edo State, an area likely to be endemic due to its geographic and socio-environmental conditions. *Schistosoma haematobium* infection, commonly known as urinary schistosomiasis, is a major public health issue in many parts of sub-Saharan Africa, including Nigeria (Onasanya *et al.*, 2020). Chronic infections can lead to severe long-term health complications such as hematuria, obstructive uropathy, chronic kidney disease, and even squamous cell carcinoma of the bladder (Zaghlou *et al.,* 2020). By assessing the local prevalence, this study will provide data that can aid in developing effective public health interventions, including health education, hygiene promotion, and targeted preventive chemotherapy. Furthermore, the findings could guide local and state

health authorities in creating evidence-based policies aimed at reducing transmission, improving sanitation, and potentially eliminating the parasite, not only in the Usen community but also in neighboring endemic areas as well.

1.3. AIM OF THE STUDY

The aim of the study is to examine the prevalence of *Schistosoma haematobium* among students attending Ilawure grammar school, Usen community, Ovia Southwest, Benin City, Edo State.

1.4. SPECIFIC OBJECTIVES

The specific objectives of the study are to;

1. Determine the prevalence of *Schistosoma haematobium* among school aged children attending Ilawure grammar school, Usen community, Ovia South-West, Benin City, Edo State.

2. Identify the distribution of *Schistosoma haematobium* in relation to gender and age among the school-aged children

3. Assess the relationship between *Schistosoma haematobium* infection and water contact behaviors.

1.5. RESEARCH QUESTIONS

1. What is the prevalence of *Schistosoma haematobium* infection in the Usen community, Ovia South-West, Benin City, Edo State?

2. What is the distribution of *Schistosoma haematobium* in relation to gender and age among the school-aged children?

3. Is there a significant relationship between *Schistosoma haematobium* infection and water contact behaviors?

1.6 RESEARCH HYPOTHESIS

NULL HYPOTHESIS: There is no significant prevalence of *Schistosoma haematobium* infection in Usen community, Ovia South-West, Benin City, Edo State.

ALTERNATE HYPOTHESIS: There is a significant prevalence of *Schistosoma haematobium* infection in Usen community, Ovia South-West, Benin City, Edo State.

CHAPTER TWO

LITERATURE REVIEW

2.1 HISTORY OF SCHISTOSOMIASIS

Schistosomiasis is a neglected tropical illness caused by blood flukes of the genus *Schistosoma* (Alibrahim *et al.,* 2024). It is a water and vector borne illness with a significant impact in more than 70 tropical and subtropical nations in South America, Asia and Africa (Alibrahim *et al.,* 2024; Xue *et al.,* 2022). About 252 million people live with the infection, while 800 million people are exposed to it (Alibrahim *et al.,* 2024). It accounts for over 70 million disabilities and about 280 to 300 thousand individuals die from it, annually (Ekloh *et al.,* 2024). Still, It is the second most frequent neglected tropical disease in the world (Alibrahim *et al.,* 2024).

After malaria, Schistosomiasis is the 2nd most pathogenenic human parasitic infection primarily affecting those who live in low to middle income countries (Caldwell *et al.,* 2023). In areas of high prevalence and death rates, the disease is common among school children, adolescents and young adults of school going age, women, fishermen and farmers using poor irrigation practices (Ekloh *et al.,* 2024).

The major species responsible for human infection are *Schistosoma haematobium, Schistosoma Japonicum* and *Schistosoma Mansoni* (Alibrahim *et al.,* 2024). There are other minor less prevalent species that can cause human disease including *Schistosoma mekongi* (found in Southern Cambodia and the Mekongi River in Laos), *Schistosoma Guineensi* and *Schistosoma Intercalatum* (Both found in West and Central Africa) (Caldwell *et al.,* 2023).

The disease affects several organs such as the Urethra, Liver, Bladder, Intestines, Skin and Bile ducts. (Ekloh *et al.,* 2024). Common clinical manifestations of the disease include fevers, chills, headaches, cough, dysuria, hyperplasia and hydronephrosis (Ekloh *et al.,* 2024).

The exact origin of Schistosomiasis is difficult to predict. Nonetheless, evidence from surviving written records and Schistosoma parasite eggs found in human remains have been helpful in estimating the beginning of the disease. It is believed that the disease has zoonotic origins that predate documented history. Documentations from Egyptian and Assyrian medical texts suggest the ancient nature of the disease (Ekloh *et al.,* 2024).

The disease was first scientifically documented by Theodore Maximillian Bilharz, a German Pathologist was the first to discover *Schistosoma haematobium* and *Schistosoma mansoni* in 1856. He discribed the eggs of *Schistosoma mansoni* as deformed because he observed a few of them having a lateral spine instead of a terminal spine like in *Schistosoma haematobium* (Ekloh *et al.,* 2024).

Theodore honoured his teacher Sir Patrick Mason by naming the parasite after him. Sir Patrick Mason recognized that *Schistosoma haematobium* was found in urine while *Schistosoma mansoni* was found in fecal matter. In 1916, Robert Leiper confirmed the two species of these organisms and demonstrated their life cycles (Ekloh *et al.,* 2024). Having a common ancestry, the parasites have experienced diversification through evolution millions of years ago because of geographical separation (Ekloh *et al.,* 2024). Praziquantel remains the only drug for treating Schistosomiasis and it was approved in 1980 (Caldwell *et al.,* 2023).

2.2 TAXONOMY

Schistosomes are parasitic blood dwelling fluke worms belonging to;

Kingdom: *Animalia*

Phylum: *Platyhelminthes*

Class: *Trematoda*

Order: *Digenea*

Family: *Schistosomatidae*

Genus: *Schistosoma*

Specie: *Schistosoma hematobium, Schistosoma Mansoni, Schistosoma Japonicum, Schistosoma mekongi, Schistosoma Intercalatum and Schistosoma guineensis.*

2.3 OVERVIEW OF *Schistosoma haematobium*

Schistosoma haematobium has been reported in 54 countries with more than 110 million people infected in Africa alone. It is the most common Schistosome species in the world with more people infected with it than with all the Schistosome species combined (Reguera-Gomez *et al*., 2021).

2.3.1 Morphology

Blood flukes form five different developmental stages; eggs, miracidia, sporocysts, cercariae and adult worms. The eggs are round to oval in shape. They are atypically elongated or spindle shaped. They measure 110um to 170um in length and 40um to 70um in breadth. It is yellowish brown and non - operculated. It features a terminal spine at its posterior end. The miracidia is pear shaped or oval, about 100 to 200 um long. It is highly ciliated with two pigmented eye spots that help detect light and guide it's movement towards the intermediate host. It contains penetration glands and germinal cells. The cercariae is the infective form of *Schistosoma haematobium.* It has an elongated oval body which measures 150um in length and 60um in breadth. It has two suckers and a forked tail measuring 200um in length. The

entire body is covered with extremely spine like projections. The adult worms are 1 to 2 cm long with a cylindrical body that features two terminal suckers, a complete tegument, a blind digestive tract and reproductive organs. The males body forms a groove in which he holds the longer and thinner female (International agency for research on cancer., 2012).

2.3.2 Life Cycle

The life cycle of *Schistosoma haematobium* involves two hosts: a freshwater snail (intermediate host) and a mammal (definitive host). Asexual reproduction occurs in the snail, while sexual reproduction occurs in the mammalian host (Nelwan, 2019). The asexual stage occurs in Snail Host. The cycle begins when eggs excreted in urine of infected mammals reach freshwater. Upon contact with water, the eggs hatch, releasing ciliated miracidia, which actively seek and penetrate snails of the genus *Bulinus* (Ito *et al.,* 2024). Inside the snail, the miracidium transforms into a mother sporocyst, the mother sporocyst gives rise to daughter sporocysts, which may produce more daughter sporocysts (sporocystogenous), or produce cercariae (cercariogenous). These daughter sporocysts migrate to the digestive glands and reproductive tissues, proliferating and producing thousands of cercariae (Nelwan., 2019). This process takes about one month, and a snail may shed approximately 200 cercariae daily. Over its lifetime, a single miracidium can result in the production of millions of genetically identical cercariae (Nelwan., 2019). The infective stage is the cercariae. Cercariae are released into water in response to temperature and light, swimming tail-first toward the surface. They locate human hosts using chemotaxis and attach via oral and ventral suckers. Each cercaria (~0.5 mm long) has a forked tail and relies on aerobic respiration using glycogen, but it does not feed. If it fails to penetrate the host within hours, it dies. Upon skin penetration, the cercaria discards its tail, transforms into a schistosomulum (skin-stage), undergoes metamorphosis by shedding its glycocalyx, transition from a single- to double-

lipid bilayer tegument, shift from aerobic to anaerobic respiration, acquisition of host molecules (especially lipids). Schistosomula enter blood vessels and migrate through tissues. Around 4 weeks post-infection, they mature into adult worms, initially residing in intrahepatic portal venules, then migrating to the vesical plexus of the bladder and ureters, and occasionally the rectal venules. Adult worms can live up to 30 years, with a mean lifespan of 3–6 years. Each female produces up to 300 eggs daily (Nelwan., 2019).

Egg Release and Pathogenesis

Approximately half of the eggs migrate to the bladder lumen and are excreted via urine. The remainder become trapped in tissues, where they live for about three weeks and trigger the host's immune response, causing the characteristic pathology of schistosomiasis. Eggs measure 144 × 58 μm, and contain about 40 yolk cells and one oocyte. In tissue, eggs mature over a week to release the miracidium, which is about 150 × 70 μm. Once in water, miracidia must find a snail host within hours or they die, as they do not feed (International Agency for Research, 2012b).

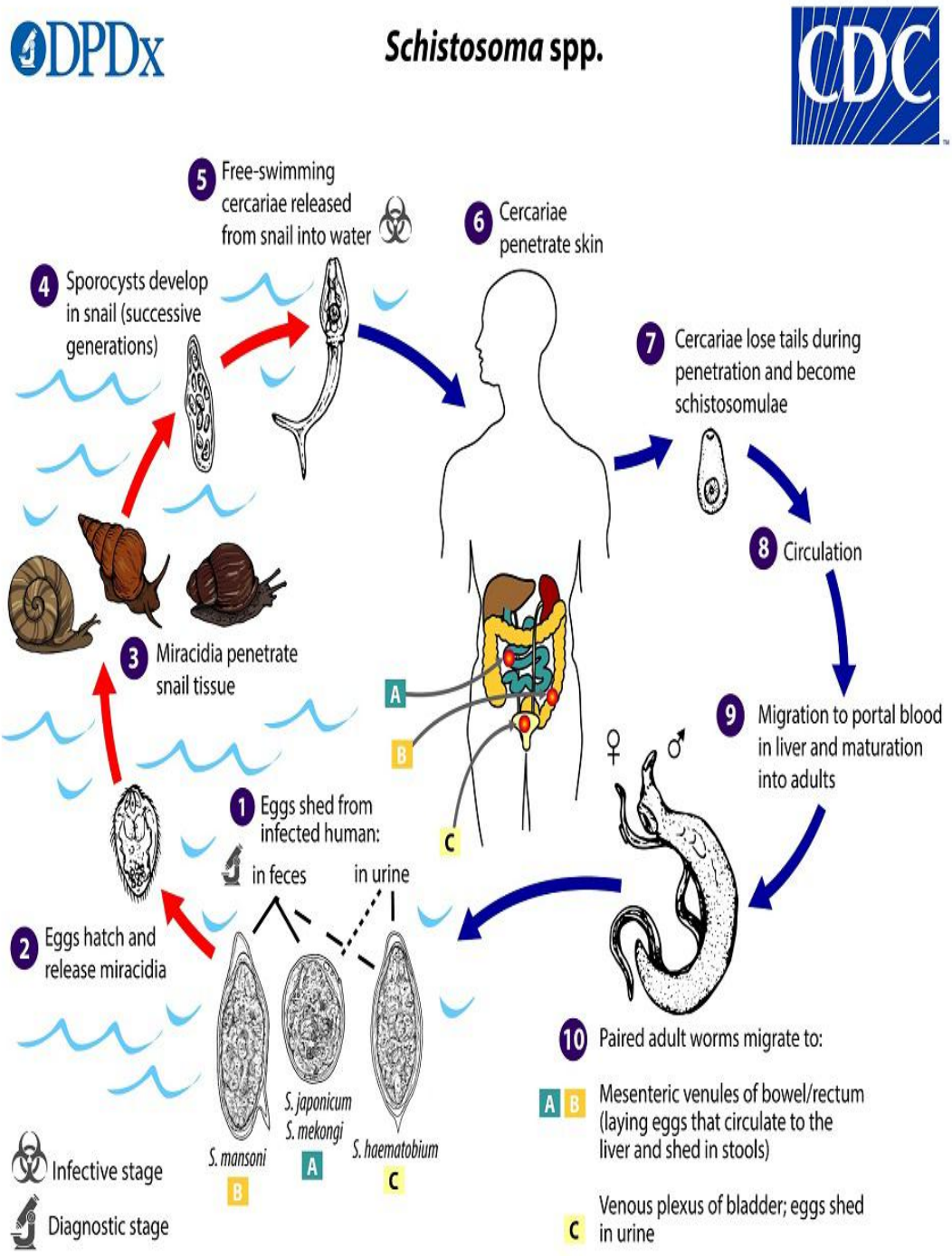

Fig 2.1: Life cycle of *Schistosoma haematobium*

(CDC b- DPDX - Schistosomiasis Infection)

2.4 EPIDEMIOLOGY AND PREVALENCE OF *Schistosoma haematobium*

Several epidemiological surveys have reported varying prevalence rates of *Schistosoma haematobium* across different regions of Nigeria, reflecting differences in environmental conditions, water contact patterns, and the effectiveness of control interventions. For instance, a study conducted in Anaocha, Anambra State, reported an overall prevalence of 14.5%, with females showing a slightly higher prevalence (16.1%). Heavy infections were observed in 7.5% of the population (Aribodor *et al.,* 2024). In southwestern Nigeria, particularly in the Illie and Ore communities of Osun State, prevalence among primary and secondary school students reached 19% (Ojo *et al.,* 2021). In the northwest, the Jidawa and Zobiya communities of Jigawa State recorded much higher prevalence levels, reaching 65.7% (Balogun *et al.,* 2022). Nigeria is recognized as the country with the highest schistosomiasis endemicity in the world, with over 25 million people infected. Urinary schistosomiasis, caused by *Schistosoma haematobium*, is the most widespread and dominant form of the disease in the country.

2.5 GEOGRAPHICAL DISTRIBUTION

Human schistosomiasis is endemic in extensive regions of the tropics and subtropics. It is estimated that over 700 million people in 74 countries are at risk of infection, with approximately 200 million individuals infected as of 2003. Of these, around 85% of cases occur in sub-Saharan Africa, with *Schistosoma haematobium* and *Schistosoma mansoni* accounting for about 95% of all infections (International Agency for Research on Cancer, 2012b). *Schistosoma haematobium,* the parasite responsible for urogenital schistosomiasis, is endemic in 53 countries, mainly across sub-Saharan Africa and parts of the Middle East (International Agency for Research on Cancer, 2012b). Globally, an estimated 243 million people are affected by schistosomiasis, with sub-Saharan Africa bearing the heaviest

burden—home to 85% of all cases (Sang *et al.,* 2014). In Kenya, nearly 6 million people are currently infected, and an additional 15 million are at high risk, particularly in endemic regions (Sang *et al.,* 2014).

2.6 TRANSMISSION ROUTES

Infection with *Schistosoma haematobium* occurs when free-swimming larval forms of the parasite, known as cercariae, penetrate human skin during direct contact with contaminated freshwater. These cercariae are released by freshwater snails, which act as the parasite's intermediate hosts (World Health Organization, 2023). The transmission cycle of Schistosoma species is sustained by three major factors: (1) contamination of freshwater bodies with human excreta (urine or feces) containing schistosome eggs, (2) the presence of specific snail species that can support the parasite's developed water (International Agency for Research on Cancer, 2012b). Once inside the human body, cercariae lose their tails and transform into schistosomulae. These migrate through the bloodstream and mature into adult worms. In the case of *Schistosoma haematobium,* the adult schistosomes preferentially inhabit the venous plexus around the urinary bladder, where females deposit eggs. While some eggs are passed out in urine to continue the life cycle, many become trapped in tissues. The host's immune response to these trapped eggs causes chronic inflammation, fibrosis, and progressive urinary tract damage, including hematuria, bladder wall pathology, and an increased risk of squamous cell carcinoma (World Health Organization, 2023).

2.7 HOST RANGE

Schistosome parasites require intermediate freshwater snail hosts to develop into the infective larval stage that can infect humans. For *Schistosoma haematobium*, snails of the genus *Bulinus* serve as the intermediate hosts (Joof *et al.,* 2021). Among these, *Bulinus truncatus* is the most prominent species associated with urinary schistosomiasis transmission (Pennance *et*

al., 2020). In certain regions, such as the United Republic of Tanzania, *Bulinus globosus* has been reported as the predominant intermediate host (Pennance *et al.,* 2022). Bulinus spp. are found in diverse aquatic habitats, including rivers, ponds, streams, rice paddies, secondary and tertiary irrigation canals, branching streams, and spillways (Pennance *et al.*, 2020). The definitive host of *Schistosoma hematobium* is humans, in whom the adult worms reside in the venous plexus of the urinary bladder and reproductive tract.

2.7.1 Pathogenesis

Urogenital schistosomiasis (UGS) is caused by *Schistosoma haematobium*, a parasitic trematode that resides in the venous plexus draining major pelvic organs, including the bladder, uterus, and cervix. Infection begins when the parasite's larval stage (cercariae), released from freshwater snails, penetrates human skin upon contact with infested water. After entering the bloodstream, the larvae migrate, mature, and establish themselves in the pelvic venous plexus. Adult worms reproduce in this location, with female worms releasing up to 3,000 eggs daily. Approximately half of these eggs are excreted in urine, perpetuating the parasite's lifecycle, while the remainder become trapped in the capillaries of pelvic organs, particularly the bladder, ureters, and reproductive tract (Santos *et al.,* 2021). Pathological changes in UGS are primarily driven by the host's immune response to retained eggs. Soluble egg antigens stimulate a polarized T helper cell type 2 (Th2) immune response, resulting in the recruitment of inflammatory cells such as eosinophils, monocytes, fibroblasts, and mast cells. Granulation tissue and fibrosis form around the trapped eggs in an attempt to limit egg-induced injury (Joekes *et al.,* 2023). This process, however, triggers a chronic immune-mediated reaction characterized by persistent inflammation, granuloma formation, tissue scarring, and the development of fibrotic nodules known as "sandy patches." Clinically, these egg-induced lesions cause chronic inflammation of the bladder and ureters, with

hematuria (blood in urine) occurring in over 50% of cases. Progressive pathology can result in anatomical deformities such as ureteral narrowing and complications including secondary urinary tract infections, hydronephrosis, and, in severe cases, renal failure. One of the most serious complications of chronic UGS is bladder cancer. The incidence of schistosomiasis-associated squamous cell carcinoma (SCC) is estimated at 3–4 cases per 100,000 individuals. Unlike transitional cell carcinoma, which predominates in non-endemic regions, SCC in UGS patients often presents earlier in life, typically as well-differentiated but locally advanced tumors with poor survival outcomes. The risk and severity of malignancy are closely associated with the duration and intensity of infection. Schistosomiasis-related carcinogenesis has been linked to genetic mutations, chromosomal abnormalities, and cytological changes, with N-nitroso compounds suspected of contributing to tumor development (Santos *et al.*, 2021).

2.8 COMORBIDITIES ASSOCIATED WITH *Schistosoma haematobium* INFECTION

Individuals living with *Schistosoma haematobium* are often at risk of concurrent infections, which can complicate diagnosis and lead to misdiagnosis or overlooking of schistosomiasis (Mduluza-Jokonya *et al.,* 2020).

2.8.1 HIV/AIDS Coinfection

One of the most notable coinfections is HIV/AIDS. The epidemiological overlap between HIV and urogenital schistosomiasis (UGS) is particularly significant in females, leading to the conclusion that UGS may predispose women to HIV acquisition. This association is thought to arise from several mechanisms, including disruption of the urogenital epithelial lining, induction of pro-inflammatory changes, and an increase in HIV target cells coupled with enhanced genital vascularity. Moreover, schistosomiasis elicits a predominantly Th2-

type immune response, which may impair Th1-mediated immunity—critical for controlling bystander pathogens such as HIV (Zirimenya *et al.,* 2020).

2.8.2 Malaria Coinfection

Schistosomiasis and malaria are frequently co-endemic across sub-Saharan Africa, imposing a substantial socioeconomic burden. Coinfections with *Plasmodium falciparum* malaria, schistosomes, and soil-transmitted helminths are common in this region and often result in anemia, particularly among school-aged children. This contributes to adverse health outcomes and reduced school attendance (Dassah *et al.*, 2022).

2.8.3 Bladder Cancer

Bladder cancer represents another major comorbidity. A review by Bowa *et al*. (2018) revealed that up to 85% of squamous cell carcinoma (SCC) cases of the bladder in Africa are strongly associated with schistosomiasis (Jalloh *et al.,* 2021). By contrast, transitional cell carcinoma (TCC) predominates in non-endemic regions (Botelho *et al.,* 2017). The pathogenesis of schistosomiasis-associated SCC is linked to the deposition of *Schistosoma haematobium* ova in the venous plexus of the bladder, which induces chronic inflammation, tissue damage, and granulomatous changes. Parasite eggs release antigens and metabolites (adaptations likely aimed at facilitating excretion into urine) that in turn trigger hematuria and persistent inflammation, ultimately increasing cancer risk. Epidemiological evidence from both case–control studies and geographic correlations strongly supports this association. The incidence of UGS-related SCC is estimated at 3–4 cases per 100,000 per year. Unlike TCC, which typically presents later in life, schistosomiasis-associated SCC often occurs earlier, during the mid-decades, due to the chronicity of infection and frequent reinfections. In its most recent monograph, the International Agency for Research on Cancer (IARC) confirmed that chronic *Schistosoma haematobium* infection is a definitive cause of urinary bladder

cancer (Botelho *et al.,* 2017). These diseases (malaria, HIV, Bladder cancer) can occur as a result of *Schistosoma haematobium* infection.

2.9 CLINICAL MANIFESTATIONS

Urogenital schistosomiasis caused by *Schistosoma haematobium* can be broadly divided into two clinical stages: acute and chronic.

2.9.1 Acute Clinical Manifestations

Acute manifestations occur during the early stages of schistosome invasion and migration (Barsoum *et al.,* 2013). This stage is characterized by a systemic hypersensitivity reaction that typically develops 3–8 weeks after the initial infection. Although more frequently associated with *Schistosoma mansoni* and *Schistosoma japonicum,* Katayama-like syndromes have also been reported in *Schistosoma haematobium* infections.

Swimmer's Itch

Swimmer's itch is a localized inflammatory wheal that appears at the site of cercarial penetration. It is composed of edema, dilated capillaries, and a small cellular infiltrate, and is attributed to the local release of monokines. The severity and duration of the lesion depend on how long schistosomula remain in the dermis. Consequently, the reaction is more pronounced in infections caused by non-human schistosome species, whose schistosomula are unable to migrate further. In some cases, particularly in expatriates acquiring infection in endemic regions, an Arthus-type skin reaction has been described (Barsoum *et al.,* 2013).

Cercarial Dermatitis

A pruritic rash may occur within 12 hours of infection. This transient rash, consisting of discrete erythematous raised macules measuring 1–3 cm, develops at the site of percutaneous

penetration by schistosomal cercariae. Although pathogenetically similar to "swimmer's itch," this reaction is typically seen in sensitized individuals who are re-infected by schistosome species that do not establish permanent colonization in humans (Barsoum *et al.,* 2013).

Katayama Syndrome

This condition represents a delayed hypersensitivity reaction that typically occurs 4–8 weeks after infection, coinciding with worm maturation (Barsoum *et al.,* 2013). It is characterized by fever, chills, urticaria, dysuria, vomiting, hematuria, proteinuria, cough, and eosinophilia, with elevated serum IgM being a typical finding (Ashta & Kumar, 2010). Most patients recover spontaneously within 2–10 weeks; however, in some cases, the disease progresses to a more severe form, presenting with weight loss, dyspnoea, diarrhoea, diffuse abdominal pain, toxaemia, hepatosplenomegaly, and widespread rash. If left unchecked, it may evolve rapidly into hepatic fibrosis, splenomegaly, and portal hypertension (Barsoum *et al.,* 2013).

2.9.2 Chronic Clinical Manifestations

Schistosoma haematobium causes localized damage to the urinary system and genital tract, as well as systemic manifestations such as anemia, growth stunting, and complications affecting both male and female sexual and reproductive health. Inflammation associated with *Schistosoma haematobium* can induce bladder changes, including masses and ulceration, which commonly present as pain, dysuria, and hematuria. During chronic infection, immunoregulation may dampen (modulate) the host's immune response; however, irreversible fibrosis and calcification of the bladder wall or distal ureters can occur. In advanced cases, this thickening may lead to ureteric dilatation and renal obstruction, which represent late-stage pathology. Life-threatening complications such as renal failure or squamous cell carcinoma of the bladder develop in approximately 1% of individuals in highly endemic areas (Santos et al., 2021). Other chronic sequelae include obstructive uropathy,

kidney failure, urolithiasis, hydronephrosis, bladder cancer, palpable splenomegaly, and hepatomegaly. In females, the most frequently observed manifestations are abdominal and pelvic pain, dyspareunia, dysmenorrhea, post-coital bleeding, cervicitis, endometriosis, salpingitis, early abortion, ectopic pregnancy, and infertility. In males, pathology may involve the seminal vesicles, prostate, and other reproductive organs (WHO, 2024).

2.10 DIAGNOSIS

The most common methods for diagnosing urogenital schistosomiasis are reagent urinalysis dipstick, urine filtration, and point-of-care urine circulating cathodic antigen (POC-CCA) assay examination of urine samples. The reagent urinalysis dipstick has long been recommended as a relatively inexpensive and accurate proxy for the detection of *Schistosoma haematobium* nfection. Following detection of microhaematuria using the dipstick, the diagnosis of *Schistosoma haematobium* is confirmed through urine filtration and microscopy to identify and quantify the presence of *Schistosoma haematobium* eggs in urine. Several studies confirmed reagent urinalysis dipstick against standard urine filtration and detection of microhaematuria is an adjunct for estimation of urogenital schistosomiasis and related morbidity (Mohamed *et al.,* 2022)

2.10.1 Urine Reagent Strips (URS)

Schistosoma haematobium infects the urinary system, causing hematuria (blood in the urine) due to bladder wall damage induced by the parasite's eggs, leading to the presence of red blood cells or hemoglobin in the urine . URSs can detect this condition, with hematuria severity (trace, mild, moderate, or severe) serving as an indicator of infection intensity. However, hematuria may also result from menstruation, urinary tract infections, immune system or metabolic disorders, or other factors. Therefore, confirmation through Urine Filtration microscopy or antigen-based tests is recommended for accurate diagnosis and

assessment of infection intensity. URSs do not require a microscope, electricity, or trained personnel, and are cheap and easy to transport and use in remote areas. However the test is not sensitive enough and urine Filtration microscopy should remain the gold standard (Degarege *et al.,* 2025).

2.10.2 Urine Filtration Technique

Microscopic examination is performed using a urine filtration technique. Each urine sample was vigorously shaken to ensure even distribution of eggs, after which 10 mL of urine is drawn into a syringe and passed twice through a nylon filter with a pore size of 20 μm. The two prepared filters are placed on microscope slides and stained with a drop of Lugol's iodine to aid identification of *Schistosoma haematobium* eggs. Each slide is examined independently by a different laboratory technician. The presence and number of *Schistosoma haematobium* eggs were recorded for each slide, and the final result was reported as the average egg count per 10 mL of urine from the two slides. A participant is classified as negative if no eggs were detected on either slide, while an egg count of fewer than 50 eggs per 10 mL of urine is classified as a light infection (Degarege *et al.,* 2025). In cases of discordant results between technicians, the slides are re-examined by a senior laboratory technician (Mohammed *et al.,* 2022).

2.10.3 POC-CCA Cassette Test

The POC-CCA cassette test is performed according to the manufacturer's instructions (Rapid Medical Diagnostics, South Africa). One drop of urine is added to the sample well, and test results are read about 20 minutes afterwards. If the control bands did not develop, the cassette test is considered invalid. The valid POC-CCA tests were scored as negative if there is only control line, trace if there is a trace test line, +1 if the test line is weakly visible, +2 if the

test line is the same opacity as the control line and +3 if the test line is darker than the control line. Trace POC-CCA test results should be considered positive (Mohammed *et al.,* 2022).

2.10.4 Polymerase Chain Reaction

To detect *Schistosoma haematobium* infection using real-time PCR, DNA is extracted from urine samples with the Quick-DNA Urine Kit, following a modified protocol. A 4 mL urine sample was first mixed with urine conditioning buffer and clearing beads, then centrifuged to concentrate the DNA. The resulting pellet was digested with Proteinase K at 55 °C for one hour to degrade proteins and release nucleic acids. Following digestion, lysis buffer was added, and the DNA was further purified using a Zymo-Spin I-96 plate with sequential wash buffers. Finally, DNA was eluted with pre-warmed elution buffer to obtain a clean extract. Detection was performed using a multiplex real-time PCR assay targeting the Dra1 repeat sequence, a highly specific marker for *Schistosoma hematobium*. An internal control targeting the eukaryotic 18S rRNA gene was included to verify both extraction efficiency and PCR amplification quality. The reaction mixture contained specific primers and fluorescent probes for both targets and was run on a thermocycler under optimized conditions for sensitivity. A positive fluorescent signal for Dra1 confirmed the presence of *Schistosoma. hematobium DNA,* while amplification of the 18S rRNA gene validated the assay.

2.10.5 Schistostope Digital Microscopy

The Schistoscope 5.0 is a low-cost, automated digital microscope designed for the detection of *Schistosoma haematobium* eggs in urine samples using image capture and analysis. To operate the device, urine filtrates are prepared on slides and placed on a motorized stage. The onboard software, equipped with a simple autofocus function, systematically scans the entire 13-mm filter membrane using a programmed algorithm. Within approximately 12 minutes, the device captures 117 high-resolution images, all of which are automatically stored and

labeled with the corresponding sample ID (Meulah *et al.,* 2022). Egg detection can be performed in two modes:

1. **Manual Analysis**: A trained microscopist reviews the captured images on a connected monitor and directly counts the eggs.

2. **Automated AI Analysis**: The stored images are uploaded to a cloud platform (e.g., Google Colaboratory), where an AI algorithm processes them to detect and quantify egg counts.

For quality control, 10% of the captured images are randomly selected and re-analyzed by a senior microscopist. The egg counts obtained from both manual and AI-assisted approaches are recorded separately and reviewed only after data collection is completed The Schistoscope offers a valuable tool for both on-site and remote diagnostics. Its portability, automation, and integration with AI make it especially useful for large-scale epidemiological surveys and schistosomiasis screening in resource-limited settings ,(Meulah *et al.,* 2022)

2.11 TREATMENT

Praziquantel is the primary drug used in the treatment of *Schistosoma haematobium*. It was approved for use in 2001 and remains the cornerstone of schistosomiasis control worldwide. Despite its effectiveness, concerns have been raised regarding the potential development of resistance, particularly in the context of persistent reinfections and low treatment coverage in endemic areas. Clinical studies demonstrate that praziquantel achieves a 92–98% reduction in schistosome egg excretion, underscoring its high efficacy (Aboagye & Addison, 2022). Nevertheless, reinfections remain common due to continuous exposure of populations to infested freshwater during daily activities such as washing, farming, and fishing. Furthermore, the drug has limited activity against juvenile schistosomes, which may survive treatment, mature, and resume egg production. The recommended dose of praziquantel is 40 mg/kg

body weight. However, in light of reinfection challenges and incomplete parasite clearance, some researchers have suggested increasing the dose to 60 mg/kg. This higher dose has shown improved efficacy but is associated with a slightly higher risk of adverse effects (Kabuyaya *et al.*, 2018). Overall, praziquantel remains the most effective and widely used treatment for S. haematobium infection, though its long-term reliability depends on sustained control efforts and careful monitoring for emerging resistance.

CHAPTER THREE

MATERIALS AND METHOD

3.1 STUDY AREA

This study was carried out in Usen Community, located in Ovia South-West Local Government Area of Edo State, Nigeria. Geographically, Usen lies in the northwestern part of southern Edo State within the Southwestern region of Nigeria. It is bordered to the west by the Ofosu River, which forms the boundary with Idanre Local Government Area of Ondo State. On the eastern side, the Ala and Ogbese tributaries of the Osse River mark the boundary with Okeluse and Ute in Ose Local Government Area, Ondo State. The Aden River flows through the central part of the territory.The community covers an estimated land area of 416 km² and is situated almost midway between Akure and Benin City, approximately 59 km s outheast of Akure and 55 km northwest of Benin (measured in a straight line). The natural vegetation is predominantly tropical rainforest, and the town is surrounded by dense woodland forming part of the southern section of the Akure-Ofosu Forest Reserve. As of 2008, the population of Usen was estimated at about 30,000. The area was chosen for this study because of the suspected endemicity of Schistosoma haematobium and the high risk of exposure among school-aged children to water bodies infested with the parasite.

3.2 RESEARCH DESIGN

This study was cross-sectional and descriptive involving collection of urine samples from students at Usen community, Ovia southwest, Benin City, Edo State. The samples were examined microscopically to detect the presence of *Schistosoma haematobium* eggs.

3.3. INCLUSION CRITERIA

Students enrolled in Schools at Usen community, Ovia South West LGA,, Edo State.

3.4. EXCLUSION CRITERIA

Students who are not enrolled in Schools at Usen community, Ovia South West LGA, Edo State.

3.5. SAMPLE SIZE DETERMINATION.

The sample size for this study will be determined using the Cochran formula for estimating sample size in prevalence (proportion) studies, which is expressed as:

$n=Z^2 \cdot p \cdot (1-p)/d^2$ (Wickramaratne, 1995).

Where: n = required sample size

Z = Z-score corresponding to the desired confidence level (1.96 for 95% confidence)

p = estimated prevalence of Schistosoma hematobium infections 65.3%. (Boih et al, 2021).

d = desired margin of error (0.07 or 7%).

The minimum required sample size is therefore calculated as:

$n= (1.96)^2 \cdot 0.\ 653 \cdot (1-0.653)/(0.07)^2$

n=3.8416 . 0.226591 / 0.0049= 0. 8707351496 / 0.0049= 178

Therefore, a minimum sample size of approximately 200 participants (school children) will be required for the study.

3.6. SAMPLE COLLECTION AND EXAMINATION

A total of 50 urine samples were collected from school children at Usen community, Ovia southwest, Edo State. Urine samples were collected between 10:00 a.m. and 2:00 p.m., the period during which *Schistosoma haematobium* egg excretion is known to peak. Each sample was centrifuged at 1,500 revolutions per minute (rpm) for 5 minutes to concentrate any eggs and cellular components. The resulting sediments were then examined microscopically using the ×40 objective lens of a light microscope to detect the presence of *Schistosoma haematobium* eggs and red blood cells. This method was selected due to its cost-effectiveness, simplicity, and suitability for field conditions. Although the urine filtration technique is considered the gold standard for *Schistosoma haematobium* diagnosis (Noriode et al., 2017). centrifugation and microscopy remain widely used and effective, particularly in resource-limited settings. The presence of red blood cells will also be noted, as hematuria is a common symptom of urogenital schistosomiasis and can support the diagnosis

3.7. STATISTICAL ANALYSIS

Laboratory findings were compared with demographic and behavioral data obtained through questionnaires. Data were analyzed using IBM SPSS Statistics version 27 (IBM Corp., Armonk, NY, USA).

CHAPTER FOUR

4.1 RESULTS

A total of 50 school children participated in the study. The overall prevalence of *Schistosoma haematobium* infection was 16.0% with 8 out of 50 children testing positive for eggs in urine samples (8/50) as shown in Figure 1. Table 4.1 and Figure 4.1 shows the demographic distribution of participants and the prevalence of *Schistosoma haematobium* among school children in Usen community. Infection was slightly higher among males (15.4%) compared to females (10.7%), though this difference was also not significant (p = 0.671). Children living near water bodies had a higher prevalence (33.3%) compared to those not living near water (12.5%), but the difference did not reach statistical significance (p = 0.392).The age of participants ranged from 13 to 20 years, with a median of 16 years. The prevalence varied across age groups, with the highest observed among children aged 18–20 years (25.0%) and those aged 13–15 years (15.4%), compared to 16–17 years (12.5%). However, these differences were not statistically significant (p = 0.893). Infection was slightly higher among males (15.4%) compared to females (10.7%), though this difference was also not significant (p = 0.671). Children living near water bodies had a higher prevalence (33.3%) compared to those not living near water (12.5%), but the difference did not reach statistical significance (p = 0.392).

Table 2 shows the relationship between environmental and behavioral factors and infection status. Children who reported going to the river/stream had a significantly higher prevalence (24.2%) than those who did not, and this association was statistically significant (p = 0.037). Other behaviors such as urinating in rivers or bushes (25.0%, p = 0.069) and walking barefoot (26.1%, p = 0.089) showed higher proportions of infection, but the associations were not statistically significant. Similarly, children from households where the toilet was unavailable

(28.6%, p = 0.117) or where river/well water was used (21.1%, p = 0.222) had higher infection prevalence, though these associations were not significant. Notably, children who had learnt about water protection practices were significantly less likely to be infected (p = 0.004).

PREVALENCE RATE OF *Schistosoma haematobium* INFECTION.

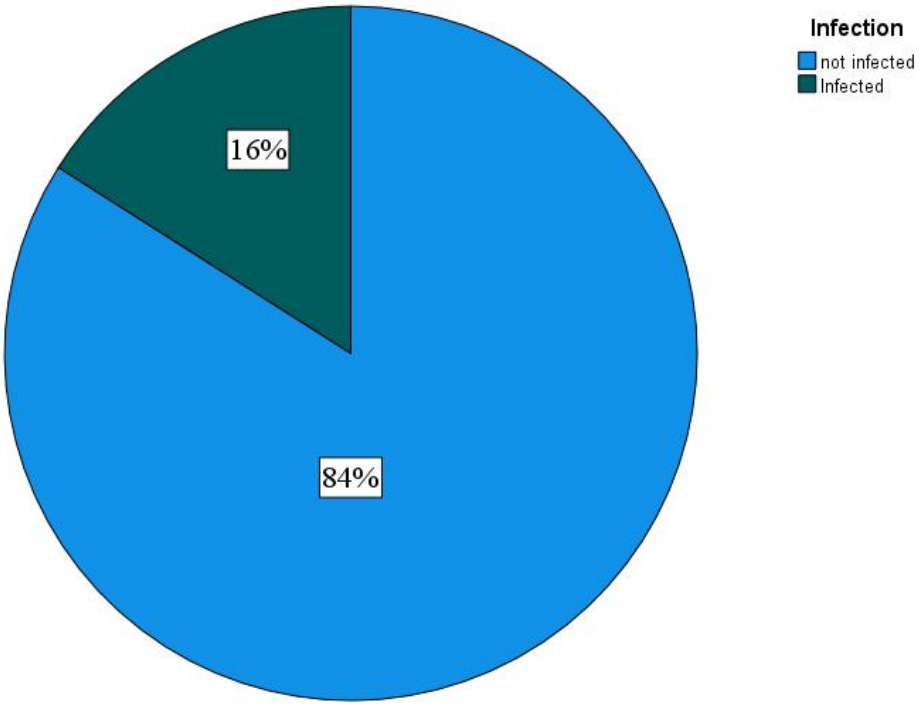

Figure 4.1: Distribution *Schistosoma haematobium* infection among school children in Usen community.

Table 4.1: Demographic characteristics and prevalence of *Schistosoma haematobium* infection among school children (N = 50)

Variable	Category	n (%)	Infected n (%)	Prevalence (%)
Gender	Male	13 (31.7)	2 (15.4)	15.4
	Female	28 (68.3)	3 (10.7)	10.7
Age group	13–15	13 (26.0)	2 (15.4)	15.4
	16–17	24 (48.0)	3 (12.5)	12.5
	18–20	4 (8.0)	1 (25.0)	25
Residence near water	Yes	6 (15.4)	2 (33.3)	33.3
	No	32 (82.1)	4 (12.5)	12.5
	Not sure	1 (2.6)	0 (0.0)	0

No significant association between age group and infection ($p = 0.893$), gender and infection ($p = 0.671$), residence near water and infection ($p = 0.392$).

Table 4.2: Environmental and behavioral factors associated with *S. haematobium* infection

Variable	Infected n (%)	Not infected n (%)	p-value
Go to river/stream	8 (24.2)	25 (75.8)	0.037*
Enter water to play/swim	5 (13.9)	31 (86.1)	0.74
Urinate in river/bush	6 (25.0)	18 (75.0)	0.069
Walk outside barefoot	6 (26.1)	17 (73.9)	0.089
Wash/dishes near river	4 (25.0)	12 (75.0)	0.19
Family uses river/well water	8 (21.1)	30 (78.9)	0.222
Toilet unavailable	6 (28.6)	15 (71.4)	0.117
Learnt water protection	5 (11.6)	38 (88.4)	0.004*

Statistical significance $p < 0.0$

CHAPTER FIVE

DISCUSSIONS, CONCLUSION AND RECOMMENDATIONS

5.1 DISCUSSIONS

Awareness and knowledge of *Schistosoma haematobium* infection at Usen community was recorded to be zero. This study found a prevalence of 16.0% of *Schistosoma haematobium* infection among students in Ilawure Grammar School, Usen community. The prevalence is lower than the 65.3% previously reported in parts of Ovia South-West LGA (Noriode *et al.,* 2017), but similar to the 17.3% observed in Akoko-Edo in 2017 and higher than the 10.7% recorded in Etsako West LGA (Tobin *et al.,* 2013). These variations reflect the nature of schistosomiasis transmission and may be influenced by local water contact patterns and proximity to snail habitats.

In this study, infection prevalence was slightly higher among males (15.4%) than females (10.7%), though the difference was not statistically significant ($p = 0.671$). This aligns with many previous reports in Nigeria where boys tend to have higher prevalence, likely due to greater engagement in swimming, fishing, and other water-related activities (Umoh *et al.,* 2020). However, the lack of statistical significance suggests that both genders in this community face equal risk of infection, possibly because girls also participate in water-fetching and washing chores.

With respect to age, infection was highest in the 18–20-year age group (25.0%), followed by 13–15 years (15.4%) and lowest among 16–17 years (12.5%). Again, the differences were not statistically significant ($p = 0.893$). Similar patterns have been reported elsewhere, where older adolescents show higher prevalence, possibly reflecting cumulative exposure to infested water over time (Imalele *et al.,* 2025)

Environmental and behavioral exposures showed a stronger influence on infection status (Reitzug *et al.,* 2024). Children who reported going to rivers/streams had a significantly higher prevalence (24.2%) compared to those who did not ($p = 0.037$). This finding highlights water contact as the main transmission pathway for *Schistosoma haematobium*. Other risky behaviors such as urinating in rivers/bushes (25.0%), walking barefoot (26.1%), and washing near rivers (25.0%) showed higher infection proportions, though these were not statistically significant. Lack of household toilets and reliance on river/well water also corresponded with higher infection prevalence, pointing to sanitation and water safety as critical determinants of transmission. Importantly, children who had learnt about water protection practices were significantly less likely to be infected ($p = 0.004$), underscoring the value of health education in schistosomiasis control.

This suggests that 1 in 6 children is susceptible to *Schistosoma haematobium* infection and that urogenital schistosomiasis remains a public health concern in the area.

Although the overall prevalence is moderate, the presence of infection in Usen highlights the continued risk of morbidity such as haematuria, anaemia, growth retardation, and reduced school performance among affected children. The significant association with river contact suggests that interventions including regular mass praziquantel treatment, provision of safe water, improved sanitation facilities, and sustained health education are essential to reduce transmission.

5.2 CONCLUSION

This study estimated a prevalence of 16% for *Schistosoma haematobium* among school children in Usen community, indicating that roughly one in every six children is infected. Although the observed prevalence is lower than that reported in some parts of Edo State and Nigeria at large, the presence of infection among school-aged children confirms that urinary

schistosomiasis remains a public health concern in the community. The study also identified risk factors such as frequent water contact (swimming, fetching water, and playing in streams), poor sanitation, and lack of awareness about schistosomiasis transmission, which increase children's vulnerability to infection. Furthermore, cultural beliefs and parental influence limited participation, which may have affected the representativeness of the results.

5.3 RECOMMENDATIONS

Based on the study findings, the following are hereby recommended:

1. Health Education: Schools and health authorities should conduct regular sensitization programs to increase awareness of schistosomiasis transmission, emphasizing the dangers of playing or swimming in infested waters.
2. Improved Water and Sanitation Facilities: Provision of clean, safe water sources and improved sanitation facilities will reduce children's dependence on streams for daily activities and lower transmission risk.
3. Community Engagement: Parents and community leaders should be actively involved in health campaigns to dispel misconceptions about sample collection and improve participation in future research and interventions.
4. School-Based Interventions: Periodic screening and treatment with praziquantel through mass drug administration (MDA) should be strengthened, targeting school-aged children as the most at-risk group.

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APPENDIX A

INFORMED CONSENT FORM

Research Title:

Prevalence of *Schistosoma haematobium* among school children in Usen community, Ovia south-west Local government area (LGA), Edo State, Nigeria.

Researcher:

DIBOSA THERESA CHUKWUNONSO

Department of Medical Laboratory Science

University of Benin, Benin City, Edo State.

09078235305

Introduction:

You are invited to permit your child to participate in a research study. Before deciding, please read this form carefully. It provides details about the study, its purpose, procedures, benefits, and potential risks.

Purpose of the Study:

The purpose of this study is to access the prevalence of Schistosoma hematobium which causes the disease Urinary schistosomiasis (also known as Bilharzia). It also aims to understand the behaviors and environments that may expose children to the organism which is common in areas with rivers or unsafe water. The study will also provide data that may help in designing preventive health programs for children and other at risk groups.

Procedures:

If you agree to participate:

Your child will answer about 15 short questions about their daily habits (such as playing near water or going to the toilet).

Your child will also be asked to provide a small sample of urine in a clean, labeled container.

The urine sample will be tested only for signs of Urinary schistosomiasis (blood in urine or presence of parasite eggs).

There will be no injections, medication, or physical harm involved.

The entire process will take about 15–20 minutes.

Risks and Discomforts:

There are no major risks to your child during this study. However, some children may feel shy or embarrassed when giving a urine sample. We will make sure they have privacy and comfort.

Benefits:

Your Child will receive free screening for Schistosoma hematobium infection.

You may gain useful health information and awareness.

The information gathered may help improve public health programs in your community.

Confidentiality:

All information obtained in this study will be kept strictly confidential. Your child's name or any identifying information will not appear in any report or publication. Your data will be coded and stored securely.

The urine sample will be stored safely and disposed of after testing.

Voluntary Participation:

Your participation in this study is completely voluntary. You are free to refuse to participate or to withdraw at any time without any penalty or loss of benefits to which you are otherwise entitled.

Contact Information:

If you have any questions about this research or your rights as a participant, you may contact the researcher at:

Phone number: 09078235305

Email: theresadibosa@gmail.com

Consent Statement:

I have read and understood the information above. I have had the opportunity to ask questions, and all my questions have been answered to my satisfaction. I voluntarily agree to participate in this study.

Name of Parent: _____

Signature/Thumbprint: _____

Date: _____

Signature of Researcher/Witness: _____

Date: _____

CHILD ASSENT FORM

Study Title:

Prevalence of *Schistosoma haematobium* Among School Children in Usen community, Ovia South-west Local Government Area (LGA), Edo State, Nigeria.

Hello,

We are doing a health study to understand how children's daily habits (like playing near water or going to the toilet) may affect their health.

If you agree to join:

1. We will ask you a few questions about what you do every day — like where you fetch water or if you've had any problems when urinating.

2. You will also be asked to urinate in a clean container, and we will check the urine to see if there are signs of a sickness called Bilharzia (Urinary schistosomiasis).

3. No one will touch you. This is not a medical test or injection.

4. You can skip any question you don't want to answer.

5. You can stop at any time, and no one will be upset or angry.

6. Your answers and sample will be kept private.

This is not a test, and there are no right or wrong answers.

Do you want to take part?

☐ Yes, I agree to take part and give a urine sample

☐ No, I don't want to take part

Your Full Name: _____

Age: _____

Signature or Thumbprint: _____

Date: _____

QUESTIONAIRE ON ENVIRONMENTAL AND BEHAVIORAL RISK FACTORS ASSOCIATED WITH SCHISTOSOMA HEMATOBIUM INFECTION (URINARY SCHISTOSOMIASIS) AMONG SCHOOL CHILDREN IN USEN COMMUNITY, OVIA SOUTH-WEST LOCAL GOVERNMENT AREA, EDO STATE, NIGERIA.

DEPARTMENT OF MEDICAL LABORATORY SCIENCE
SCHOOL OF BASIC MEDICAL SCIENCES
COLLEGE OF MEDICAL SCIENCES
UNIVERSITY OF BENIN
BENIN CITY, EDO STATE, NIGERIA

Dear Respondent,

I am a final year student of the above named institution. I am conducting a research on the **"Prevalence of *Schistosoma hematobium* in school children in Usen community, Ovia south-west Local government area (LGA), Edo State, Nigeria".** This questionaire is designed to collect information for the study.

Kindly respond to the following questions. Please tick (✓) as required in one of the boxes and write in the space provided. All questions and responses are very important to the study. Please do well to answer them properly

Dibosa Theresa Chukwunonso

Researcher

SECTION A: DEMOGRAPHICS

1. Age:

2. Gender: Male: Female:

3. Do you live near a River, Stream or Pond? Yes No. Not Sure

SECTION B: ENVIRONMENTAL EXPOSURE AND BEHAVIOR.

S/N	Questions	Yes	No	Sometimes
4	Do you ever go to the River, Stream or Pond - maybe to fetch water, play or help someone?			
5	Do you ever enter the River or Stream to play, swim or bathe?			
6	When you're out and need to urinate, do you sometimes do it in a river or bush?			
7	Are there days when you walk outside barefoot or without slippers?			
8	Do you sometimes go near the River after school, on weekends and when spending time with friends?			
9	Do you sometimes help wash clothes, dishes or bathe near a River or Stream?			

SECTION C: WATER USE AND TOILET HABITS

S/N	Question	Yes	No	Maybe
10	Do you sometimes urinate outside (like in the bush or near water) when you're not at home?			
11	Does your family ever use River, Stream or Well water for things like bathing or washing?			
12	Are there times when the toilet at home does not work or isn't available to use?			
13	Have you learnt from someone or in school how to protect yourself from dirty water?			

SECTION D: SYMPTOMS AND HEALTH HISTORY

S/N	QUESTION	YES	NO	MAYBE
14	Have you ever seen blood in your urine?			
15	Do you feel pain or burning when you urinate?			
16	Have you gone to the hospital or clinic because of a urine problem?			
17	Do you know anyone (Family or Friend) who has blood in their urine?			

APPENDIX B

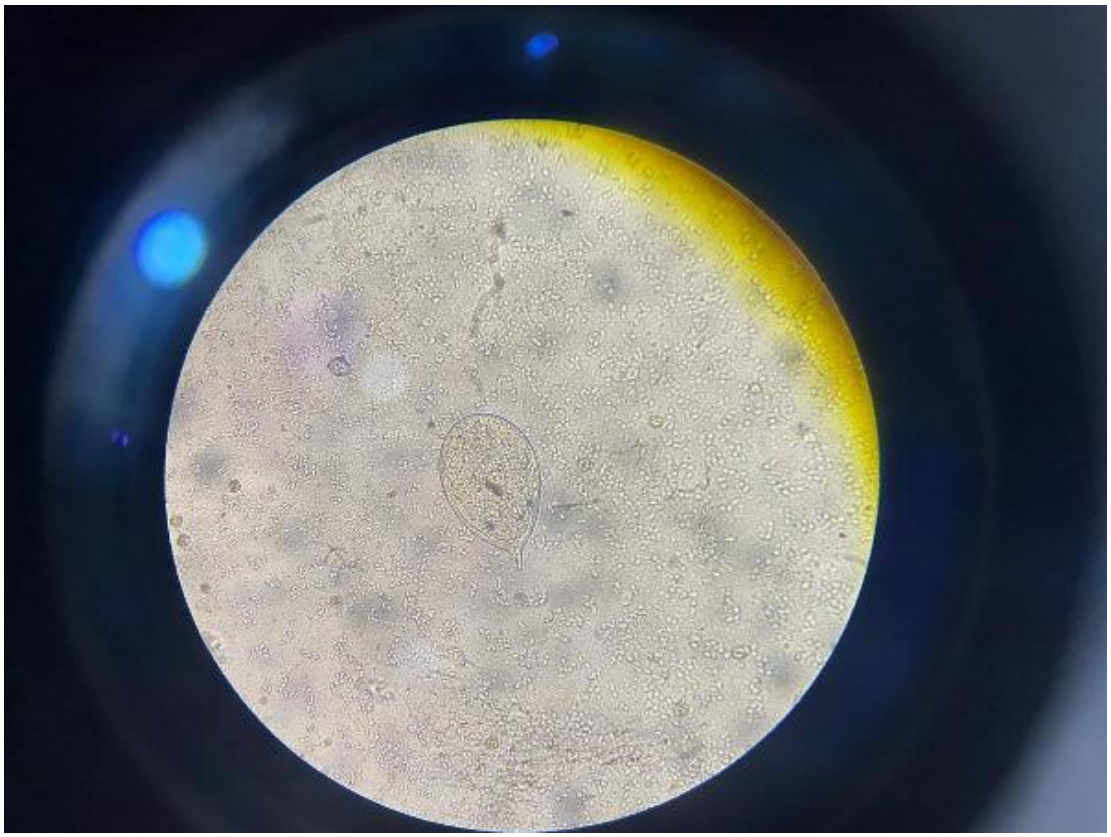

Fig A1: Cross Section of *Schistosoma haematobium* in wet preparation under X40 magnification

Fig A2: Cross Section of the Ofosu River, Usen community, Edo State, Nigeria.