PARASITOLOGICAL INVESTIGATION OF URINARY TRACT INFECTIONS AMONG SELECTED STUDENTS IN UNIBEN, NIGERIA.

By

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UNIVERSITY OF BENIN

BENIN CITY.

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF MICROBIOLOGY, FACULTY OF LIFE SCIENCES, UNIVERSITY OF BENIN, BENIN CITY, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF B.Sc. (HONS) IN MICROBIOLOGY, UNIVERSITY OF BENIN, BENIN CITY.

NOVEMBER, 2025.

CERTIFICATION

This is to certify that this project work was successfully carried out by IJEOMA GLORIA NNAEGBO (MISS) with matriculation number LSC2103975, of the department of Microbiology, Faculty of Life Sciences, University of Benin, Benin City, Edo State, Nigeria, under my supervision.

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(Head of Department)

DEDICATION

This project is dedicated to Almighty God for his grace, strength and guidance throughout this journey.

I also dedicate it to my dear family for their love, prayers, and unwavering support, which have been my greatest motivation.

ACKNOWLEDGEMENTS

First and foremost, I express my profound gratitude to God Almighty for His faithfulness, goodness, and grace throughout my life and academic journey. His divine guidance has been my strength and sustenance.

I sincerely acknowledge my supervisor, Dr.(Mrs.) J. Z. Saidu, for her encouragement, guidance, and insightful contributions towards the success of this work.

My heartfelt appreciation goes to the Head of Department, Professor E. O. Igbinosa, and my Course Adviser, Dr. (Mrs) O. B. Agbonwaneten, for their support and direction throughout my academic years. I am also grateful to all the lecturers in the Department of Microbiology for their dedication, knowledge, and mentorship, which have contributed immensely to my academic growth.

To my family, words cannot fully express my gratitude for your unwavering love, prayers, and support. To my ever-supportive siblings, thank you for believing in me and standing by me every step of the way.

My appreciation also goes to my project group members for their teamwork, constructive suggestions, and cooperation, which greatly enhanced the quality of this project.

Without the collective support, encouragement, and prayers of everyone mentioned, achieving this milestone would have been difficult.

May God Almighty bless you all abundantly.

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ABSTRACT

Urinary tract infections (UTIs) are among the most common infectious diseases globally, affecting people of all ages and sexes, but particularly prevalent among women and young adults. Parasitic UTIs play a significant role in developing regions where environmental, sanitary, and socioeconomic conditions facilitate transmission. The aim of this study was to investigate the presence of parasites in the urine samples of selected students of the University of Benin. A total of sixty (60) midstream urine samples were collected and analyzed using standard microbiological methods, including physical characteristics of each urine sample, such as color and appearance, followed by chemical analysis using commercially available urine strips and microscopic examination using a compound light microscope with the condenser lowered to enhance contrast focused on identifying eggs or trophozoites characteristic of these parasites. The urinalysis showed that 24% of urine samples tested positive for leukocytes, 17% for nitrites, blood appeared in 10% and 15% for protein indicating possible urinary tract infections. Out of the 60 urine samples examined, the overall prevalence of parasitic infection was 11.7%, with *Schistosoma haematobium* (8.3%) being more common than *Trichomonas vaginalis* (3.3%). Higher infection rates were recorded among females and individuals aged 21–25 years. Although parasitic urinary tract infections (UTIs) were found to be less common than bacterial UTIs, their presence among university students indicates that they remain a relevant and concerning health issue. These findings suggest a clear need for public health interventions focused on improving hygiene, sanitation, and regular health monitoring within the university population. Implementing routine urine screening for both biochemical abnormalities and parasitic infections would support early detection and timely treatment, helping to prevent complications. Additionally, students should be encouraged to adopt safe practices such as maintaining personal hygiene, changing underwear regularly, avoiding exposure to contaminated water, and using protective measures in shared facilities. Addressing these factors is essential for reducing the risk and impact of parasitic infections in this vulnerable group.

CHAPTER ONE

INTRODUCTION

1.0 Background of study

Urinary tract infections (UTIs) are among the most common infectious diseases globally, affecting people of all ages and sexes, but particularly prevalent among women and young adults (Medina *et al*., 2019; Elele, 2024). These infections occur when pathogenic microorganisms invade and multiply within the urinary system, affecting the kidneys, ureters, bladder, or urethra. While bacterial agents, such as *Uropathogenic* Escherichia coli*, Proteus mirabilis and Klebsiella pneumoniae* are the most frequently implicated pathogens in UTIs (Flores-mireles et al., 2015). Parasitic infections also play a significant but often overlooked role, particularly in developing countries where environmental, sanitary, and socioeconomic conditions facilitate transmission (Reuben *et al.,* 2013).

In sub-Saharan Africa, including Nigeria, parasitic infections such as urinary schistosomiasis continue to constitute a serious public health concern (Ezeh *et al*., 2019). Urinary schistosomiasis is primarily caused by *Schistosoma haematobium*, a trematode parasite that inhabits the venous plexus of the urinary bladder and causes chronic infection, hematuria (blood in urine), dysuria, and potentially long-term complications like bladder fibrosis and even cancer (Amy, 2002; Elele, 2024). The disease is contracted through skin contact with freshwater bodies contaminated with the larval stage (cercariae) of the parasite released from infected freshwater snails. The infection is particularly endemic in rural and peri-urban areas of Nigeria where communities rely on untreated surface water for domestic use, recreation, and other daily activities (Duwa and Oyeyi, 2009; McManus *et al*., 2011).

Globally, parasite infection of the urinary tract remains one of the most important neglected tropical diseases. According to the World Health Organization, over 200 million people are infected with schistosomiasis worldwide, and more than 700 million live in endemic areas at risk of infection. Of these, an estimated 112 million are infected with *Schistosoma haematobium*, which causes urinary schistosomiasis (WHO, 2020). In Africa, schistosomiasis is hyperendemic in many regions, accounting for over 90% of all global cases. The disease predominantly affects school-aged children and young adults due to frequent contact with freshwater sources for domestic and recreational purposes (Bello *et al*., 2024; Elele, 2024). Countries such as Nigeria, Ghana, Sudan, Tanzania, and Mali report some of the highest prevalence rates in the world (Hotez *et al*., 2024; Adenowo *et al*., 2015; Aula *et al*., 2021). In many African settings, poor water infrastructure, climate conditions, and socio-cultural practices sustain ongoing transmission cycles.

Nigeria ranks among the top endemic countries for urinary schistosomiasis, with millions infected across all geopolitical zones. About 15% of African population is said to be infected with the disease (Bello *et al*., 2024). In Nigeria, about five species of the genus *Schistosoma* have been reported to be pathogenic to man, each having a well-defined distribution which is quiet important in diagnosis. These species include *S. haematobium, S. mansoni, S. japonicum, S. intercalatum and S. mekongi* (Agi and Okafo, 2013). Among the five species mentioned, three species namely *S. haematobium, S. mansoni and S. japonicum* account for more than 95% of all human cases of schistosomiasis found in the world (Mutapi *et al*., 2015). Studies conducted in various Nigerian states have reported prevalence rates ranging from 10% to over 60%, depending on proximity to infested water bodies and community hygiene practices (Akinwale *et al*., 2010; Ekpo *et al*., 2009).

The risk of acquiring parasitic UTIs is strongly linked to environmental, behavioral, and socio-economic factors. Other risk factors include poor personal hygiene, inadequate access to clean water, and the use of shared toilet facilities, especially in overcrowded hostels. Gender differences may also play a role, with young males often more exposed due to outdoor activities. University students from rural backgrounds or those living off-campus may face higher exposure risks due to poor housing and water access.

The diagnosis of parasitic UTIs typically involves microscopic examination of urine samples. A midday urine sample is preferred as egg excretion peaks around noon. The urine is centrifuged or filtered, and the sediment examined microscopically for terminal-spined eggs. Preventing parasitic UTIs requires a combination of individual and public health measures. Avoiding contact with potentially infested water, using protective clothing, ensuring access to safe water and improved sanitation, and health education campaigns are crucial (Wagenlehner *et al*., 2012).

Despite various health campaigns and improved access to healthcare, urinary tract infections caused by parasites are underreported and often mistaken for bacterial UTIs, leading to misdiagnosis and ineffective treatment. This results in prolonged illness, unnecessary use of antibiotics, and an increased risk of chronic complications. In the University of Benin, where students engage in diverse daily activities and originate from various endemic regions, the risk of parasitic UTIs cannot be underestimated. However, data on the prevalence and parasitological profile of UTIs among students remain limited or non-existent. This knowledge gap poses a challenge to effective public health planning and disease management. Therefore, there is a compelling need for systematic investigation and documentation of parasitic causes of UTIs within this population.

1.1 Aim and Objectives

1.1.1 Aim

To investigate the presence of parasites in the urine sample of selected students of the University of Benin, Benin City, Edo State.

1.1.2 Objectives

The specific objectives of this research were to;

1. To identify specific parasites associated with UTIs in the study population.
2. To assess the socio-demographic and behavioral risk factors linked to parasitic UTIs.
3. To evaluate the clinical signs and symptoms reported by infected students.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview of Urinary Tract Infections (UTIs)

Urinary tract infections are characterized by the invasion and multiplication of pathogenic microorganisms within the urinary system, which comprises the kidneys, ureters, bladder, and urethra (Flores-Mireles *et al*., 2015). These infections result in inflammation and a range of symptoms that vary in severity depending on the site and extent of microbial involvement. While bacteria, particularly *Escherichia coli*, are the most common causative agents, parasitic infections such as those caused by *Schistosoma haematobium* and *Trichomonas vaginalis* are significant in certain regions, including Nigeria, where environmental conditions facilitate their transmission (Ekpo *et al*., 2017). The clinical importance of UTIs lies in their high prevalence, potential for recurrence, and risk of progression to severe complications if untreated.

UTIs are classified based on two primary criteria: the anatomical site of infection and the complexity of the clinical presentation. Anatomically, UTIs are divided into **lower** and **upper** infections. Lower UTIs affect the bladder (cystitis) or urethra (urethritis), typically presenting with localized symptoms such as dysuria, frequent urination, and suprapubic discomfort (Hooton, 2012). These infections are generally less severe and more amenable to outpatient management. In contrast, upper UTIs involve the kidneys (pyelonephritis) or ureters and are associated with systemic symptoms, including high fever, flank pain, and nausea, which may require hospitalization (Nicolle, 2015). Upper UTIs are less common but carry a higher risk of complications, such as renal scarring or sepsis, particularly in cases involving parasitic pathogens like *Schistosoma haematobium*, which can cause chronic inflammation and tissue damage (Barsoum, 2013).

Based on complexity, UTIs are categorized as **uncomplicated** or **complicated**. Uncomplicated UTIs occur in individuals with a structurally and functionally normal urinary tract, typically healthy, non-pregnant women. These infections are often caused by *E. coli* and respond well to short-course antibiotic therapy (Hooton, 2012). Complicated UTIs, however, occur in the presence of predisposing factors, such as anatomical abnormalities, urinary catheters, or systemic conditions like diabetes or immunosuppression (Flores-Mireles *et al*., 2015). These infections are more challenging to treat, have a higher likelihood of recurrence, and may involve atypical or resistant pathogens, including parasites in endemic settings. For the student population at the University of Benin, both uncomplicated and complicated UTIs are relevant, as communal living and variable access to healthcare may exacerbate underlying risk factors, including exposure to parasitic infections.

2.2 Epidemiology of UTIs Globally and in Nigeria

UTIs constitute a significant global health burden, with an estimated 150–250 million cases annually, making them one of the most common reasons for healthcare visits worldwide (Flores-Mireles *et al*., 2015). In developed countries, UTIs account for approximately 10–15% of outpatient antibiotic prescriptions and a substantial proportion of hospital-acquired infections (Foxman, 2014). The global epidemiology of UTIs is shaped by factors such as healthcare infrastructure, sanitation standards, and antimicrobial resistance patterns. In high-income countries, bacterial UTIs predominate, with E. *coli* responsible for 70–90% of community-acquired cases (Hooton, 2012). However, in low- and middle-income countries (LMICs) like

Nigeria, the epidemiology is more complex due to the coexistence of bacterial and parasitic infections, compounded by limited diagnostic and treatment resources.

In Nigeria, UTIs are a major public health concern, particularly in regions with poor sanitation and limited access to clean water. Studies indicate a high prevalence of UTIs across diverse populations, with both bacterial and parasitic etiologies contributing to the disease burden (Omoregie *et al*., 2008). Nigeria ranks among the top endemic countries for urinary schistosomiasis, with millions infected across all geopolitical zones. About 15% of African population is said to be infected with the disease (Bello *et al*., 2013). In Nigeria, about five species of the genus Schistosoma have been reported to be pathogenic to man, each having a well-defined distribution which is quiet important in diagnosis. These species include *S. haematobium, S. mansoni, S. japonicum, S. intercalatum and S. mekongi* (Agi and Okafo, 2013). Among the five species mentioned, three species namely *S. haematobium, S. mansoni and S. japonicum* account for more than 95% of all human cases of schistosomiasis found in the world (Mutapi *et al*., 2013). Studies conducted in various Nigerian states have reported prevalence rates ranging from 10% to over 60%, depending on proximity to infested water bodies and community hygiene practices (Akinwale *et al*., 2010; Ekpo *et al*., 2008).

The tropical climate, coupled with widespread use of contaminated water sources for bathing and washing, facilitates the transmission of parasitic infections like urinary schistosomiasis (Ekpo *et al*., 2017). Furthermore, the rising prevalence of antimicrobial resistance in Nigeria complicates the management of bacterial UTIs, with studies reporting resistance rates of up to 60% for common antibiotics like amoxicillin (Odetoyin *et al*., 2019).

Globally, regional variations in UTI epidemiology are evident. In sub-Saharan Africa, parasitic UTIs, particularly urinary schistosomiasis, are a major concern due to the widespread distribution of *Schistosoma haematobium* in freshwater bodies (Ekpo *et al*., 2017). In contrast, parasitic UTIs are rare in Western countries, where improved sanitation and water treatment systems minimize exposure to such pathogens. In Nigeria, the interplay of environmental, socio-economic, and healthcare-related factors creates a unique epidemiological profile, necessitating localized studies to inform targeted interventions, particularly in settings like the University of Benin, where students may be exposed to both bacterial and parasitic pathogens.

2.3 Prevalence and Incidence in Various Populations

The prevalence and incidence of UTIs vary significantly across populations, influenced by demographic, behavioral, and environmental factors. Globally, young adults, particularly those aged 18–30 years, are at high risk due to lifestyle factors such as sexual activity, poor hygiene practices, and communal living arrangements (Foxman, 2014). University students, like those at the University of Benin, represent a high-risk group due to their unique living conditions, including crowded hostels, shared sanitation facilities, and variable access to clean water. These factors increase the likelihood of both bacterial and parasitic UTIs.

Studies indicate that the incidence of UTIs among young women is approximately 0.5–0.7 episodes per person-year, with up to 50–60% of women experiencing at least one UTI in their lifetime (Foxman, 2014). In Nigeria, a study by Nmorsi *et al*. (2014) reported a UTI prevalence of 26.7% among university students in Edo State, with females being disproportionately affected. Parasitic UTIs, particularly those caused by *Schistosoma haematobium*, are also significant in Nigeria, with prevalence rates ranging from 10–50% in endemic areas, depending on proximity to contaminated water sources (Ekpo *et al*., 2017). For instance, areas near rivers or lakes in Edo State, where students may engage in recreational or domestic water contact, report higher rates of urinary schistosomiasis.

Among university students, the prevalence of UTIs is often underreported due to several factors, including lack of awareness, stigma associated with genitourinary symptoms, and limited access to diagnostic facilities (Okonko *et al*., 2018). A study in a Nigerian university found that up to 40% of students with UTI symptoms did not seek medical care, leading to potential complications such as chronic infections or renal damage (Okonko *et al*., 2018). This underscores the need for targeted investigations, such as the current study, to accurately assess the burden of UTIs among University of Benin students and to identify the contribution of parasitic infections, which may be overlooked in routine clinical practice.

2.3.4 Gender and Age-Specific Patterns of UTIs

Gender and age are critical determinants of UTI susceptibility and presentation. Women are significantly more likely to develop UTIs than men due to anatomical differences, including a shorter urethra (approximately 4 cm in women vs. 20 cm in men) and its proximity to the anus, which facilitates microbial ascension into the urinary tract (Hooton, 2012). Globally, women have a 50-fold higher risk of UTIs than men, with a lifetime prevalence of 50–60% compared to 1–2% for men (Foxman, 2014). In Nigeria, studies consistently report higher UTI prevalence among females, with rates ranging from 30–40% in young adult women compared to 5–10% in men (Omoregie *et al*., 2008).

Age-specific patterns also influence UTI epidemiology. Young adults, particularly those in their late teens to early twenties, are at elevated risk due to behavioral factors such as increased sexual activity, which is a well-established risk factor for UTIs (Hooton, 2012). University students, who often fall within this age group, are particularly vulnerable due to lifestyle factors such as irregular hygiene practices and communal living. Parasitic UTIs, such as those caused by *Schistosoma haematobium*, are more prevalent among adolescents and young adults in endemic areas, as these individuals are more likely to engage in water-related activities like bathing or washing in contaminated rivers (Ekpo *et al*., 2017). In Edo State, where water contact is common due to reliance on natural water bodies, students may face an elevated risk of parasitic UTIs.

Gender-specific differences are also evident in the clinical presentation and causative agents of UTIs. Women are more likely to experience uncomplicated bacterial cystitis, while men with UTIs often have underlying complications, such as prostatic involvement or urinary tract abnormalities (Nicolle, 2015). For parasitic UTIs, gender differences are less pronounced, as both males and females are susceptible to *Schistosoma haematobium* infections through water contact, though females may experience more severe symptoms due to anatomical factors (Barsoum, 2013). These patterns highlight the importance of gender- and age-specific analyses in the current study to understand the unique burden of UTIs among University of Benin students.

2.4 Risk Factors for UTIs

The development of UTIs is influenced by a complex interplay of host, environmental, and behavioral factors, many of which are particularly relevant to university students in Nigeria. Key risk factors include:

1. **Hygiene Practices**: Poor personal hygiene, such as inadequate perineal cleaning or infrequent urination, increases the risk of microbial colonization in the urinary tract (Hooton, 2012). In university settings, shared bathrooms and limited access to clean water can exacerbate this risk. For instance, studies in Nigerian universities have reported that overcrowded hostel facilities and inconsistent water supply contribute to poor hygiene practices among students (Okonko *et al*., 2018).
2. **Sexual Activity**: Sexual intercourse is a major risk factor for UTIs, particularly in women, as it facilitates the introduction of pathogens into the urethra. Studies estimate that sexual activity increases UTI risk by up to 60%, with frequent intercourse or new sexual partners further elevating the risk (Foxman, 2014). Among university students, who may engage in active social and sexual behaviors, this factor is particularly significant.
3. **Immune Status**: Compromised immune function, whether due to chronic conditions like diabetes or HIV/AIDS, or transient factors like stress and poor nutrition, increases UTI susceptibility (Nicolle, 2015). University students, often under academic and financial stress, may experience immune suppression, making them more vulnerable to infections.
4. **Environmental Factors**: In Nigeria, exposure to contaminated water sources is a major risk factor for parasitic UTIs, particularly *Schistosoma haematobium* infections. Students who use rivers or lakes for bathing, washing, or recreational activities are at high risk of contracting urinary schistosomiasis (Ekpo *et al*., 2017). In Edo State, where access to safe water is limited, this risk is amplified.

5. **Other Factors**: Additional risk factors include urinary tract abnormalities, use of catheters, and low fluid intake, which can promote bacterial or parasitic growth in the urinary tract (Flores-Mireles *et al*., 2015). Among students, low fluid intake may be common due to busy schedules or limited access to potable water on campus.

2.5 Clinical Manifestations and Complications of Untreated UTIs

The clinical presentation of UTIs varies depending on the site of infection, the causative agent, and the host's immune response. Lower UTIs, such as cystitis and urethritis, typically present with localized symptoms, including dysuria (painful urination), urinary urgency, frequent urination, and suprapubic pain (Hooton, 2012). These symptoms can significantly impair quality of life, particularly among students, who may face disruptions in academic and social activities. Upper UTIs, such as pyelonephritis, are more severe and present with systemic symptoms, including high fever, chills, nausea, vomiting, and flank pain, indicating kidney involvement (Nicolle, 2015). Parasitic UTIs, particularly those caused by *Schistosoma haematobium*, may present with hematuria (blood in urine), chronic pelvic pain, and bladder irritation, which can mimic bacterial cystitis and complicate diagnosis (Ekpo *et al*., 2017).

Untreated or inadequately treated UTIs can lead to serious complications, with significant implications for individual and public health:

1. **Pyelonephritis and Renal Damage**: Ascending infections can progress to acute or chronic pyelonephritis, causing renal scarring and, in severe cases, renal failure. Parasitic infections like schistosomiasis are particularly concerning, as chronic inflammation from

Schistosoma haematobium eggs can lead to bladder fibrosis and obstructive uropathy (Barsoum, 2013).

2. **Sepsis**: Bacterial UTIs, if untreated, can result in urosepsis, a life-threatening condition characterized by systemic infection and organ dysfunction. Sepsis has a mortality rate of up to 20% in severe cases, particularly in settings with limited access to intensive care (Nicolle, 2015).
3. **Bladder Pathology**: Chronic parasitic UTIs, especially those caused by *Schistosoma haematobium*, are associated with bladder squamous cell carcinoma, a rare but devastating outcome in endemic areas like Nigeria (Barsoum, 2013). This risk underscores the importance of early diagnosis and treatment of parasitic infections.
4. **Recurrent Infections**: Untreated UTIs, particularly in women, are associated with a high risk of recurrence, with 20–30% of women experiencing a second episode within six months (Foxman, 2014). Recurrent infections can lead to chronic symptoms, reduced quality of life, and increased healthcare costs.

In Nigeria, the high prevalence of untreated UTIs, particularly parasitic infections, is exacerbated by limited access to healthcare, diagnostic challenges, and low health literacy among students (Okonko *et al*., 2018). For University of Benin students, these complications highlight the need for targeted screening and health education programs to mitigate the long-term consequences of UTIs.

2.6. Parasitic Infections of the Urinary Tract

The urinary tract, comprising the kidneys, ureters, bladder, and urethra, serves as a critical system for waste filtration and excretion. While bacterial infections dominate the etiology of urinary tract infections (UTIs), parasitic infections, though less frequent, pose significant clinical challenges due to their complex life cycles and chronic pathological effects. Parasites, ranging from trematodes to protozoa, infiltrate the urinary tract through diverse routes, including hematogenous spread, direct migration, or environmental exposure. These organisms thrive in specific ecological niches, often in regions with limited sanitation, making parasitic UTIs a public health concern in tropical and subtropical areas. The resulting infections can lead to symptoms ranging from mild dysuria to severe complications like bladder fibrosis or malignancy. Unlike bacterial infections, parasitic UTIs often require specialized diagnostics and treatments, as their mechanisms involve intricate host-parasite interactions. This expanded exploration delves into the key parasites involved, their pathogenic mechanisms, and their distinctions from bacterial causes, supported by insights from recent research and authoritative sources.

2.6.1. Common Parasites Associated with Urinary tract infections

2.6.1.1. *Schistosoma haematobium* (Urinary Schistosomiasis)

Schistosoma haematobium, a blood fluke endemic to sub-Saharan Africa, the Middle East, and parts of South Asia, is the primary parasitic cause of urinary tract infections, manifesting as urinary schistosomiasis. The parasite's life cycle begins with cercariae, released by infected freshwater snails, penetrating human skin during water contact. These develop into adult worms that reside in the venous plexuses around the bladder and ureters, where females lay thousands of eggs. Many eggs become trapped in the urothelium, inciting granulomatous inflammation, tissue fibrosis, and symptoms such as hematuria, dysuria, and urinary frequency. Chronic infection can lead to severe outcomes, including ureteral obstruction, hydronephrosis, and squamous cell carcinoma of the bladder. The World Health Organization estimates that 112 million people are affected globally, with 90% of cases in Africa (WHO, 2020). A study by Colley *et al*. (2014) highlights the immunological cascade triggered by egg antigens, which drives chronic inflammation and increases susceptibility to secondary bacterial infections, amplifying UTI severity.

2.6.1.2. Trichomonas vaginalis

Trichomonas vaginalis, a flagellated protozoan, is best known for causing sexually transmitted infections but can also contribute to UTIs, particularly in women. This parasite colonizes the urogenital tract, adhering to epithelial cells via surface adhesins and causing localized inflammation. In women, ascension from the vagina to the bladder can result in cystitis, presenting with symptoms like burning micturition and pelvic discomfort. In men, *T. vaginalis* may infect the urethra or prostate, leading to urethritis or prostatitis that mimics bacterial UTI symptoms. Research by

Meites *et al*. (2015) indicates that *T. vaginalis* is detected in 5-10% of women with symptomatic UTIs in high-prevalence settings, often missed due to reliance on bacterial culture diagnostics. The parasite disrupts the urogenital microbiome, as noted in a study by Martin *et al*. (2013), which found that *T. vaginalis* infections increase vaginal pH and facilitate bacterial overgrowth, compounding infection risk. Its role in UTIs underscores the need for targeted diagnostics, such as wet mount microscopy or nucleic acid amplification tests, to ensure accurate detection.

2.6.1.3. Other Relevant Parasites

Several less common parasites can also affect the urinary tract, often through ectopic migration or systemic dissemination. *Enterobius vermicularis* (pinworm), primarily an intestinal parasite, may migrate to the perianal region and, in rare cases, ascend the urethra to the bladder, particularly in children. This can cause localized irritation and secondary bacterial infections, as reported in a case study by Kashyap *et al*. (2014). *Wuchereria bancrofti*, a filarial nematode causing lymphatic filariasis, can lead to chyluria—milky urine due to lymphatic fluid leakage into the urinary tract—altering urine composition and predisposing to infections. A review by Nutman (2013) notes that chyluria results from lymphatic obstruction, which disrupts normal urinary dynamics. Additionally, *Echinococcus granulosus*, the causative agent of hydatid disease, may form cysts in the kidneys or bladder during disseminated infection, leading to structural damage and infection risk, as documented in a case series by Yang *et al*. (2015). Other rare parasites, such as *Fasciola hepatica* or *Toxoplasma gondii*, have been reported in isolated renal infections, highlighting the diverse parasitic etiologies that clinicians must consider in atypical UTI presentations.

2.7. Mechanisms by Which Parasites Cause UTIs

Parasites disrupt the urinary tract through complex interactions that differ from the rapid proliferation typical of bacterial infections. In Schistosoma haematobium, pathology primarily arises from egg deposition within the bladder and ureteral walls. This elicits a Th2-driven immune response, leading to granuloma formation, fibrosis, and urothelial ulceration . Schistosome eggs may also harbor bacteria, predisposing to secondary infections. Chronic inflammation progressively remodels the urinary tract, resulting in bladder wall thickening, ureteral stenosis, and urine stasis—conditions that further promote bacterial colonization. By contrast, Trichomonas vaginalis employs direct epithelial disruption. Through adhesins and lytic enzymes, the parasite compromises the mucosal barrier. Fichorova et al. (2012) demonstrated that T. vaginalis infection stimulates cytokine release, intensifying inflammation and disturbing the local microbiome. This disruption predisposes to bacterial superinfections and recurrent lower urinary tract symptoms. Other parasites, such as Wuchereria bancrofti, exert their effects indirectly. Lymphatic obstruction leads to chyluria and hydronephrosis, altering urinary pH and flow (Dreyer et al., 2000). These changes create an environment that supports infection and compromises urinary tract integrity. Together, these mechanisms—mechanical obstruction, immune-mediated damage, and facilitation of secondary infections reveals the intricate interplay underlying parasitic UTIs. Management often requires addressing both the parasite itself and the structural and microbiological sequelae of infection**.**

2.8. Differences Between Parasitic and Bacterial Causes of Urinary tract infections

The distinctions between parasitic and bacterial UTIs are profound, spanning clinical presentation, pathogenesis, diagnosis, and treatment. Bacterial UTIs, predominantly caused by *Escherichia coli* (80-90% of cases), are acute, driven by rapid bacterial replication and toxin production, leading to symptoms like dysuria, urgency, and pyuria within days. Parasitic UTIs, such as those caused by *S. haematobium*, are often chronic, with symptoms like hematuria or bladder dysfunction emerging over months or years due to cumulative tissue damage. A study by Foxman (2014) emphasizes that bacterial UTIs are diagnosed via urine culture, which is ineffective for parasites, necessitating microscopy (e.g., for *S. haematobium* eggs) or molecular tests (e.g., for *T. vaginalis*). Treatment also diverges: bacterial UTIs respond to antibiotics like nitrofurantoin or fluoroquinolones, whereas parasitic infections require antiparasitic agents, such as praziquantel for schistosomiasis or metronidazole for trichomoniasis, as outlined in WHO guidelines (2020). Moreover, parasitic infections carry a higher risk of long-term complications, such as bladder cancer in schistosomiasis, compared to the typically reversible nature of uncomplicated bacterial UTIs. These differences underscore the need for region-specific diagnostic algorithms and awareness of parasitic etiologies in endemic areas or among travelers.

2.9. Public Health Implications of Parasitic UTIs

Parasitic UTIs, particularly schistosomiasis and trichomoniasis, have profound effects on both individual and community health. At the individual level, schistosomiasis can cause hematuria, dysuria, and chronic bladder damage, increasing the risk of squamous cell carcinoma in untreated cases (Mostafa *et al*., 1999). Trichomoniasis, while less severe, can lead to persistent discomfort and, in women, may increase susceptibility to other sexually transmitted infections, including HIV (McClelland *et al*., 2007). Chronic infections can also impair quality of life, causing pain, stigma, and reduced productivity.

At the community level, parasitic UTIs contribute to cycles of poverty and disease. In endemic areas, high prevalence rates strain local healthcare systems, diverting resources from other priorities. For example, schistosomiasis affects over 200 million people globally, with sub-Saharan Africa bearing the highest burden (WHO, 2020). Communities with poor sanitation and limited access to clean water face ongoing transmission, perpetuating health disparities.

The economic toll of parasitic UTIs is substantial. Untreated schistosomiasis can lead to long-term complications, such as bladder fibrosis or kidney dysfunction, requiring costly interventions like surgery or dialysis, which are often unavailable in low-resource settings. A 2018 study estimated that schistosomiasis results in an annual economic loss of $1.4 billion in sub-Saharan Africa due to reduced productivity and healthcare costs (Hotez *et al*., 2018). Trichomoniasis, though less studied, contributes to economic losses through missed workdays and increased healthcare utilization, particularly in women with recurrent infections.

Socially, parasitic UTIs carry significant stigma, particularly for women with trichomoniasis, who may face blame or ostracism due to its sexual transmission. Schistosomiasis-related symptoms like hematuria can also lead to social isolation, particularly among children, who may avoid school due to embarrassment. These social consequences compound the cycle of poverty, as reduced education and employment opportunities limit economic mobility.

Public health interventions are critical to controlling parasitic UTIs. Water sanitation initiatives, such as building wells and improving sewage systems, are among the most effective strategies for reducing schistosomiasis transmission. The WHO's 2021–2030 roadmap for neglected tropical diseases emphasizes integrating WASH programs with mass drug administration to achieve sustainable control (WHO, 2021). For trichomoniasis, public health campaigns promoting safe sexual practices and routine screening in high-risk populations can reduce prevalence.

Health education campaigns are equally vital. Mass media, community outreach, and school-based programs can raise awareness about parasitic UTIs and encourage early treatment-seeking behavior. For example, Uganda's schistosomiasis control program, which combines praziquantel distribution with community education, has reduced prevalence by over 50% in some regions

(Kabatereine *et al*., 2011). Partnerships with non-governmental organizations and local governments can enhance the reach and impact of these interventions.

Surveillance systems are also essential for monitoring disease trends and evaluating intervention effectiveness. Molecular epidemiology, such as PCR-based detection of *Schistosoma* DNA in urine, can improve diagnostic accuracy and guide targeted interventions (Hamburger *et al*., 2013). By addressing both the biological and social determinants of parasitic UTIs, public health efforts can mitigate their impact and promote healthier communities.

2.10. Diagnostic Methods for Parasitic UTIs

Diagnosing parasitic UTIs requires a multifaceted approach, as these infections cannot be detected using standard bacterial culture methods. The primary diagnostic tools include microscopy, serological tests, and molecular techniques, each offering distinct advantages and limitations depending on the clinical context, resource availability, and parasite involved.

2.10.1. Microscopy

Microscopy is a foundational method for diagnosing parasitic UTIs, particularly for detecting *Schistosoma haematobium* eggs in urine samples. The technique typically involves urine sedimentation or filtration to concentrate parasitic elements for visualization under a light microscope. *Schistosoma haematobium* eggs are identifiable by their characteristic terminal spine, making microscopy a definitive diagnostic tool when eggs are present (Gryseels *et al*., 2006). The procedure is relatively simple: a urine sample, preferably collected between 10 a.m. and 2 p.m. to coincide with peak egg excretion, is centrifuged or filtered, and the sediment is examined for eggs. This method is cost-effective and widely used in endemic areas, where schistosomiasis accounts for significant morbidity (Colley *et al*., 2014).

However, microscopy has limitations. Its sensitivity depends on the parasite burden, and low egg counts may lead to false negatives, particularly in early or chronic infections. Additionally, the technique requires skilled microscopists to differentiate parasitic eggs from other urine sediment components, such as crystals or cellular debris. For *Trichomonas vaginalis*, wet-mount microscopy of fresh urine or urogenital samples can detect motile trichomonads, but its sensitivity is low (approximately 50–70%), especially in asymptomatic cases or when parasite numbers are sparse (Kissinger, 2015).

2.10.2. Serological Tests

Serological tests detect host antibodies or parasite antigens, offering a complementary approach when microscopy is inconclusive. Enzyme-linked immunosorbent assays (ELISA) targeting *Schistosoma*-specific antigens, such as soluble egg antigens (SEA), are commonly used to confirm exposure to schistosomiasis (Gryseels *et al*., 2006). These tests are particularly valuable in non-endemic settings, where patients, such as travelers, may present with atypical symptoms or low egg output. Rapid diagnostic tests (RDTs) detecting circulating anodic antigens (CAA) or cathodic antigens (CCA) in serum or urine have emerged as practical tools for diagnosing active schistosomiasis. For instance, urine-based CAA tests have shown sensitivities of 80–90% in endemic areas, making them suitable for field use (Corstjens *et al*., 2020).

For *Trichomonas vaginalis*, serological tests are less commonly used due to variable antibody responses, but they can support diagnosis in research settings. A key limitation of serological tests is their inability to distinguish active from past infections, as antibodies may persist for years post-treatment. Cross-reactivity with other parasitic infections, such as filariasis or strongyloidiasis, can also reduce specificity, necessitating confirmatory testing (Colley *et al*., 2014).

2.10.3. Molecular Techniques

Molecular methods, particularly polymerase chain reaction (PCR), have revolutionized the diagnosis of parasitic UTIs by offering high sensitivity and specificity. Real-time PCR assays targeting *Schistosoma haematobium* DNA in urine or blood can detect low parasite loads, making them ideal for early infections or cases with minimal egg excretion (Cnops *et al*., 2013). For *Trichomonas vaginalis*, PCR targeting specific DNA sequences in urine or urogenital samples is significantly more sensitive (up to 95%) than wet-mount microscopy or culture, and it is now considered the gold standard for diagnosis in developed settings (Schwebke and Bachmann, 2010).

Despite their precision, molecular techniques are not without challenges. They require sophisticated equipment, trained personnel, and controlled laboratory conditions, which are often unavailable in resource-limited settings where parasitic UTIs are most prevalent. The cost of PCR assays can also be prohibitive, though efforts are underway to develop affordable, point-of-care molecular diagnostics, such as loop-mediated isothermal amplification (LAMP) for schistosomiasis (Reuben *et al*., 2013). These advancements hold promise for improving access to accurate diagnosis in endemic regions.

2.11. Treatment and Management of Parasitic Urinary Tract Infections

Parasitic urinary tract infections (UTIs), though less common than bacterial UTIs, pose significant health challenges, particularly in tropical and subtropical regions. The primary parasitic infections affecting the urinary tract include schistosomiasis, caused by *Schistosoma haematobium*, and trichomoniasis, caused by *Trichomonas vaginalis*. Effective treatment hinges on targeting the specific parasite with appropriate antiparasitic drugs.

For schistosomiasis, praziquantel is the cornerstone of treatment. Administered orally, typically at a dose of 40–60 mg/kg in one or two divided doses, praziquantel effectively targets the adult worms of *Schistosoma haematobium* by disrupting their tegument, leading to parasite death. The World Health Organization (WHO) recommends praziquantel as the drug of choice due to its efficacy, safety profile, and minimal side effects, which include mild abdominal pain or nausea in some cases (WHO, 2020). Studies have shown cure rates exceeding 80% with a single dose, though follow-up is critical to ensure complete resolution, particularly in endemic areas where reinfection is common (Gryseels *et al*., 2006).

Trichomoniasis, though primarily a sexually transmitted infection, can occasionally affect the urinary tract, particularly in women. Metronidazole, administered at 2 g as a single dose or 500 mg twice daily for seven days, is the standard treatment. This nitroimidazole antibiotic disrupts the DNA of *Trichomonas vaginalis*, leading to rapid parasite death. Its efficacy is well-documented, with cure rates approaching 95% when taken as prescribed (Workowski *et al*., 2021). However, patient compliance with the multi-day regimen can be a challenge, and single-dose therapy is often preferred for its convenience.

Other parasitic UTIs, such as those caused by *Enterobius vermicularis* or *Filarioidea*, are rarer and often require tailored treatments like albendazole or ivermectin, depending on the parasite. Accurate diagnosis through microscopy, serology, or molecular methods is essential to guide therapy, as misidentification can lead to ineffective treatment.

Treating parasitic UTIs is fraught with challenges, particularly in resource-limited settings. Drug resistance is an emerging concern, especially for schistosomiasis. While praziquantel remains effective, reduced susceptibility has been reported in some *Schistosoma* strains, potentially due to prolonged mass drug administration campaigns (Vale *et al*., 2017). This underscores the need for ongoing surveillance and research into alternative therapies, such as oxamniquine or artemisinin derivatives, though these are not yet widely adopted.

Access to healthcare is another significant barrier. In endemic regions, particularly sub-Saharan Africa, where schistosomiasis is prevalent, limited healthcare infrastructure and high costs restrict access to diagnostics and treatment. For instance, praziquantel is inexpensive (approximately $0.20 per dose), but distribution challenges and lack of trained healthcare workers hinder its reach (Hotez *et al*., 2014). Similarly, metronidazole for trichomoniasis requires clinical evaluation and prescription, which may be inaccessible in rural areas with low healthcare coverage.

Socioeconomic factors exacerbate these challenges. Poverty, lack of education, and cultural stigmas around seeking treatment for genitourinary symptoms can delay care, leading to complications like chronic inflammation, bladder fibrosis (in schistosomiasis), or increased risk of HIV transmission (in trichomoniasis). Additionally, reinfection is a persistent issue in endemic areas due to ongoing exposure to contaminated water sources or sexual transmission, necessitating integrated treatment and prevention strategies.

2.12. Preventive Measures

Prevention of parasitic UTIs requires a multifaceted approach, combining environmental interventions with health education. For schistosomiasis, avoiding contact with freshwater bodies contaminated by *Schistosoma* cercariae is critical. This can be achieved through improved water sanitation, such as providing safe drinking water and constructing latrines to reduce open defecation, which perpetuates the parasite's life cycle. Schools in endemic areas can implement water, sanitation, and hygiene (WASH) programs to reduce transmission.

Health education targeting students is particularly effective, as young people are often at high risk due to recreational activities like swimming in contaminated water. Educational campaigns should emphasize the risks of parasitic infections, the importance of seeking timely treatment, and safe hygiene practices. Interactive methods, such as workshops, peer-led discussions, and visual aids, can enhance engagement. For trichomoniasis, education on safe sexual practices, including condom use, is essential, particularly for older students. School-based programs can integrate these messages into broader reproductive health curricula.

Community involvement is key to sustaining preventive efforts. Engaging local leaders and parents ensures cultural relevance and reinforces messaging. For example, WHO's schistosomiasis control initiatives have successfully used school-based mass drug administration combined with education to reduce prevalence in high-risk areas (WHO, 2020). Empowering students to act as health ambassadors can further amplify these efforts, fostering long-term behavioral change.

CHAPTER THREE

MATERIAL AND METHODS

3.1 Study Design

This study will employ a cross-sectional study to determine the prevalence of parasitic infection in female student in University of Benin, Ugbowo campus. The research design will incorporate both urine sample collection for laboratory-based analyses and administration of standardized questionnaires to assess personal hygiene, health habit, and exposure to urinary tract infection (UTI) of respondent as well as their sociodemographic. A comparative framework will be established between personal hygiene and occurrence of parasitic infection.

3.2 Study Area

This study was carried out at the University of Benin main campus (6.20 ^{o}N and 5.37 ^{o}E) situated in Ugbowo, Benin City which falls within Ovia – North East Local Government Area of Edo state.

3.3 Sample Collection

Urine samples were collected from consenting female students of the University of Benin between 7:00 a.m. and 10:00 a.m. Each participant was instructed to provide a clean-catch midstream urine sample to minimize contamination. A total of 60 samples were collected 45 from students residing in on-campus hostels and 15 from students living off-campus.

Sterile, leak-proof universal containers with a 30 mL capacity were used for the collection. Each container was properly labeled with a corresponding questionnaire number and the date of collection to ensure traceability. The labeled samples were then transported immediately to the

Microbiology Laboratory, Department of Microbiology, Faculty of Life Sciences, University of Benin, for further analysis.

3.4 Sample Analysis

All urine samples were analyzed within one hour of collection to ensure accuracy and minimize degradation.

3.4.1 Physicochemical Examination

The physical characteristics of each urine sample, such as colour and appearance, were first observed and recorded. Chemical analysis was then conducted using commercially available urine reagent strips. The parameters assessed included: blood, glucose, bilirubin, urobilinogen, ketone, protein, nitrite, pH, specific gravity, ascorbate, and leukocytes. Before testing, each urine sample was gently mixed to ensure homogeneity. A test strip was then carefully dipped into the sample and held for approximately one minute, in line with the manufacturer's instructions. The strip was removed and excess urine allowed to drain, after which the colour changes were compared to the standard chart for interpretation (Khurana *et al*., 2018).

3.4.2 Microscopic Examination

For microscopic analysis, 5 ml of urine was transferred into a conical tip centrifuge tube after which the samples were placed in the centrifuge and was centrifuged at 2500 revolutions per minute (rpm) for 10 minutes. The supernatant was gently decanted, leaving the sediment at the bottom of the tube. A drop of the sediment was transferred onto a clean glass slide and covered with a cover slip. Examination was performed using a compound light microscope. The condenser was lowered to enhance contrast, and the sample was first viewed under the low power objective (10x), followed by the high-power objective (40x). Particular attention was paid to the presence of urinary tract pathogens, including parasites, eggs, and ova, as part of the investigation into the parasitic causes of urinary tract infections (UTIs) (Siagian, 2023).

3.5 Data Analysis

IBM SPSS software version 26 and Microsoft excel was used for descriptive statistics and multivariate regression to examine relationships between personal hygiene and occurrence of the parasite.

CHAPTER FOUR

RESULTS

The results of the parasitological investigation of urine samples collected from selected students at the University of Benin are presented in the tables below. A total of 60 urine samples were analyzed microscopically for the presence of parasites associated with urinary tract infections.

The result of the urinalysis conducted on urine samples collected from selected students is presented in Table 4.1. Urine samples collected showed that 24% (n = 14) were positive for leukocytes, indicating possible urinary tract infections. Nitrites were detected in 17% (n = 10) of samples, supporting this finding. Protein was present in 15% (n = 9) of samples, while blood (hematuria) appeared in 10% (n = 6), suggesting urinary tract irritation or damage. Elevated urobilinogen was found in 6% (n = 4) of samples. The urine pH ranged from 5.0 to 8.0, averaging 6.2, and specific gravity varied between 1.005 and 1.030, with a mean of 1.018, reflecting varied hydration levels. Ascorbic acid was high in 7% (n = 4) of samples, which can affect test accuracy. Ketones were detected in 4% (n = 2), possibly due to fasting or diet. Bilirubin and glucose were present in 2% (n = 1) and 3% (n = 2) of samples, respectively, indicating potential liver issues and undiagnosed diabetes. Most samples (72%, n = 43) were pale yellow, 20% (n = 12) amber, and 8% (n = 5) cloudy.

Table 4.2 presents the demographic profile of the 60 participants. The majority were female (62.0%, n = 37), and most fell within the 21–25 years age group (45.0%, n = 27). Participants were mainly in 300 level (30.0%, n = 18) and 400 level (25.0%, n = 15). About 45.0% (n = 27) lived off-campus, and most were single (90.0%, n = 54).

As shown in Table 4.3**,** 55.0% (n = 33) urinated 3–5 times daily, and 65.0% (n = 39) used public toilets. Underwear was changed once daily by 60.0% (n = 36). Most (92.0%, n = 55) practiced proper wiping after toilet use. 58.0% (n = 35) used sanitary pads, and 45.0% (n = 27) had been diagnosed with a UTI, of whom 20.0% (n = 12) had rare occurrences, 17.0% (n = 10) occasional, and 8.0% (n = 5) frequent. Overall, 53.0% (n = 32) experienced UTI symptoms, and 25.0% (n = 15) had a family history of UTI or kidney issues.

Table 4.4 outlines the microscopic characteristics of the parasite isolates observed in the urine samples. Two distinct parasites were identified: *Schistosoma haematobium* and *Trichomonas vaginalis*.

The result showing the prevalence of parasite isolates in all urine samples (n = 60) is presented in Table 4.5. *Schistosoma haematobium* was the most prevalent parasite, identified in 5 samples (8.3%), followed by *Trichomonas vaginalis*, which accounted for 2 samples (3.3%). The total prevalence of parasitic infections in the study population was 11.7% (7/60). This indicates a relatively low but significant occurrence of parasitic urinary tract infections among the students sampled. No other parasitic forms were observed.

The result of parasite distribution by sex is presented in Table 4.6. A higher prevalence of parasitic infections was recorded among female students (13.5%) compared to males (8.3%). Specifically, *Trichomonas vaginalis* was found only in female samples, whereas *Schistosoma haematobium* occurred in both sexes, but with a slightly higher incidence in males.

Table 4.7 presents the distribution of parasitic infection based on age group. The highest infection rate (14.8%) was recorded among the 21–25 age group, which also had the highest number of participants. The lowest infection rate (0%) was observed in the 31–35 age group.

This age-related trend may be associated with varying levels of exposure to parasitic transmission sources such as contaminated water bodies or personal hygiene practices.

Table 4.8 presents the intensity of *Schistosoma haematobium* infection as determined by egg counts per 10 mL of urine in the positive samples. The infection intensity was categorized according to standard thresholds: light infection (<50 eggs/10 mL) and heavy infection (≥50 eggs/10 mL). Among the five positive urine samples examined, four exhibited light infections with egg counts ranging from 18 to 40 eggs per 10 mL, while one samples showed heavy infections with counts of 67 and 90 eggs per 10 mL respectively.

Table 4.1: Urinalysis Test Results for Urine Samples from the Selected Students (N = 60)

Parameter	No. Positive (n)	Percentage (%)	Permissible Limit / Normal Range
Leukocytes (LEU)	14	24.0	0 – 10 WBC/µL (Negative)
Nitrites (NIT)	10	17.0	Negative
Urobilinogen (URO)	4	6.7	0.2 – 1.0 mg/dL
Protein (PRO)	9	15.0	<150 mg/day (≤10 mg/dL in spot urine)
pH			4.6 – 8.0
Blood (BLO)	6	10.0	0 – 5 RBC/µL (Negative)
Specific Gravity (SG)	–	–	1.005 – 1.030
Ascorbic Acid (ASCOR)	4	6.7	<40 mg/dL
Ketones (KET)	2	3.3	Negative (<0.6 mmol/L)
Bilirubin (BILI)	1	1.7	Negative (<0.02 mg/dL)
Glucose (GLU)	2	3.3	Negative (<15 mg/dL)
Color			Pale yellow (43), Amber (12), Cloudy (5)

Table 4.2: General Characteristics of Participants (N = 60)

Characteristics	Category	Number of Students (n)	Percentage (%)
Gender	Male	23	38.0
	Female	37	62.0
Age Range (Years)	16–20	17	28.0
	21–25	27	45.0
	26–30	12	20.0
	Above 30	4	7.0
Level of Study	100	6	10.0
	200	12	20.0
	300	18	30.0
	400	15	25.0
	500	9	15.0
Place of Residence	Hostel (on campus)	24	40.0
	Off-campus accommodation	27	45.0
	Family home	9	15.0
Marital Status	Single	54	90.0
	Married	5	8.0
	Other	1	2.0

Table 4.3: Risk Factors and UTI-related Characteristics of Participants (N = 60)

Variable	Category	Number of Students (n)	Percentage (%)
Daily urination frequency	Less than 3 times	6	10.0
	3–5 times	33	55.0
	More than 5 times	21	35.0
Use of public toilets	Yes	39	65.0
	No	21	35.0
Underwear change frequency	Once daily	36	60.0
	Twice daily	12	20.0
	Twice a week	7	12.0
	Rarely	5	8.0
Wipes from front to back after toilet use	Yes	55	92.0
	No	5	8.0
Sanitary material used during menstruation	Sanitary pads	35	58.0
	Tampons	3	5.0
	Cloth	2	3.0
	Menstrual cup	1	1.0
	Not applicable	19	33.0
Ever diagnosed with UTI	Yes	27	45.0
	No	33	55.0
Frequency of UTI experience (among those diagnosed)	Rarely (once a year)	12	20.0
	Occasionally (2–3 times/year)	10	17.0
	Frequently (>3 times/year)	5	8.0
Experienced any UTI symptoms	Yes (any symptom reported)	32	53.0
	No symptoms	28	47.0
Family history of UTI/kidney problems	Yes	15	25.0
	No	45	75.0

Table 4.4: Microscopic Characteristics of Parasite Isolates Observed in Urine Samples

Parasite	Life Stage Observed	Morphological Characteristics	Motility
Schistosoma haematobium	Ova (Egg)	Oval-shaped with a terminal spine; golden-brown shell; size ≈ 112–170 µm	Non-motile (egg stage)
Trichomonas vaginalis	Trophozoite	Pear-shaped, size 7–23 µm; four anterior flagella & undulating membrane	Jerky, twitching motion

Table 4.5: Prevalence of Parasite Isolates in Urine Samples (N = 60)

Parasites	**Number of Positive Samples (n)**	**Prevalence (%)**
Schistosoma haematobium	5	8.3
Trichomonas vaginalis	2	3.3
Total Positive Cases	**7**	**11.7**

Table 4.6: Distribution of Parasitic Infections in Urine Samples Based on Sex

Parasites	Female (n = 37)	Prevalence (%)	Male (n = 23)	Prevalence (%)
Schistosoma haematobium	2	5.4	3	13.0
Trichomonas vaginalis	2	5.4	0	0.0
Total Infected	4	10.8	3	13.0

Table 4.7: Distribution of Parasitic Infections by Age Group

Age Range (Years)	No. of Samples	No. Positive	Prevalence (%)
16–20	17	1	5.9
21–25	27	4	14.8
26–30	12	2	16.7
31–35	4	0	0.0
Total	**60**	**7**	**11.7**

Table 4.8: Intensity of *Schistosoma haematobium* Infection in Positive Urine Samples (n = 4)

Infection Intensity	No. of Cases	Range of Egg Count (per 10 mL)
Light (1–49 eggs/10 mL)	4	6–13
Heavy (≥50 eggs/10 mL)	1	53

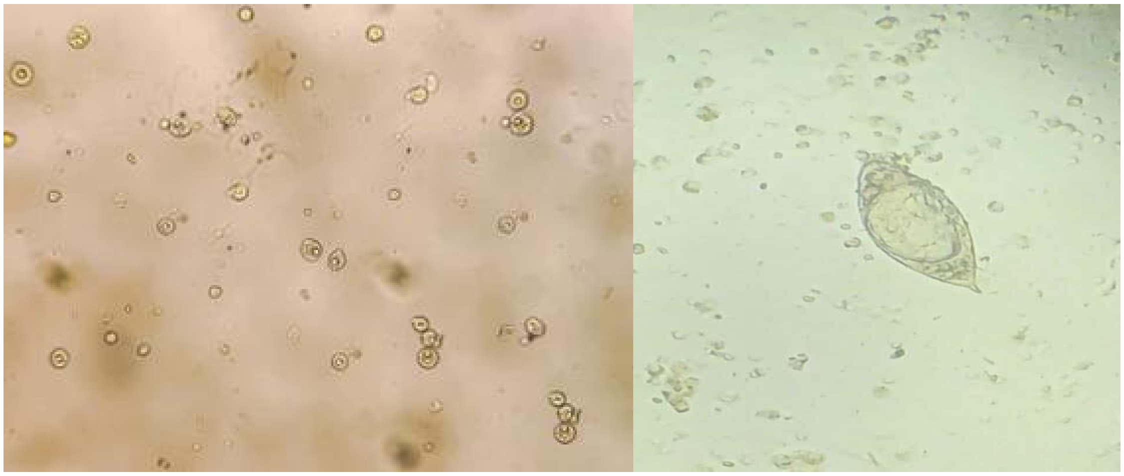

Plate A: Photomicrograph of *Schistosoma haematobium* ova observed under ×100 magnification (Spindle-shaped ova with terminal spine visible).

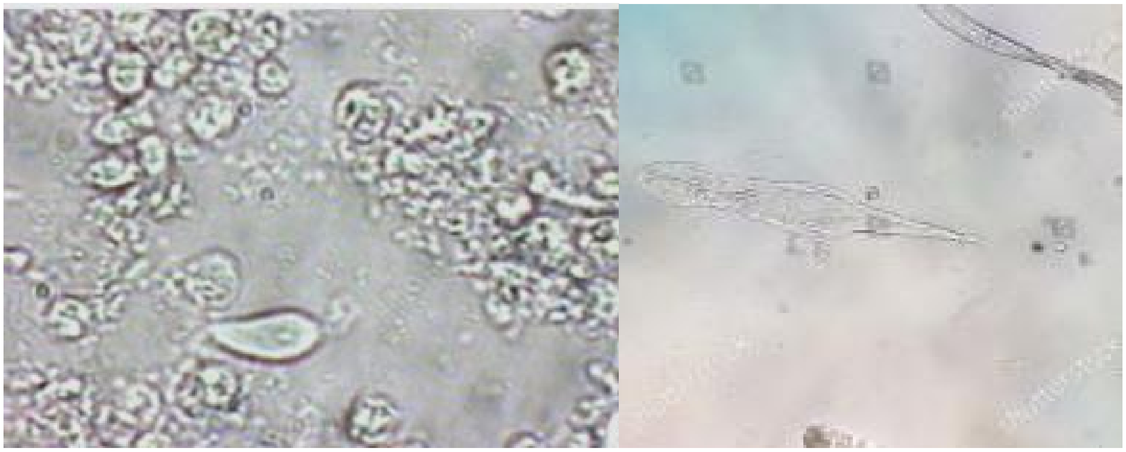

Plate B: Photomicrograph of *Trichomonas vaginalis* trophozoites in wet mount under ×100 (Pear-shaped trophozoite with visible undulating membrane and flagella)

CHAPTER FIVE

DISCUSSION

The urinary tract is a critical component of the human excretory system and is typically sterile under normal physiological conditions. However, it may become compromised by the invasion of bacteria, fungi, or parasites, leading to urinary tract infections (UTIs) or parasitic infestations (Gulomovna *et al*., 2024). Among these, parasitic infections of the urinary system are less common than bacterial UTIs but represent significant public health concerns in endemic regions. This study seeks to investigate the parasitological profiles of selected students at the University of Benin to determine the prevalence of urinary tract infections (UTIs) and urinary parasites.

The urinalysis results showed that 24% of the students had leukocytes in their urine**,** suggesting a high rate of possible urinary tract infections among the population. The presence of leukocytes (pyuria) is an established marker of inflammation or infection in the urinary tract (Wilson & Gaido, 2004; Mattoo and Spencer, 2024). This finding aligns with reports from other Nigerian universities, where leukocyturia has been frequently documented among students due to recurrent UTIs (Oladeinde *et al*., 2011**).** Nitrites were detected in 17% of the samples. This parameter is particularly significant, as the nitrite test is one of the most specific indicators of UTI. Many uropathogens, especially Gram-negative bacteria such as *Escherichia coli* and *Klebsiella pneumoniae*, convert urinary nitrate to nitrite (Sultana *et al*., 2016). Thus, the coexistence of nitrites and leukocytes in a significant proportion of participants strengthens the likelihood of bacterial UTIs in this cohort.

Proteinuria (15%) and hematuria (10%) were also recorded. Proteinuria in otherwise healthy young individuals may indicate glomerular or tubular damage, often secondary to infections or parasitic invasio. Hematuria is especially relevant in this study because it is a hallmark of *Schistosoma haematobium* infection. Previous research in endemic regions of Nigeria has demonstrated that hematuria correlates strongly with urinary schistosomiasis (Ugbomoiko *et al*., 2010; Ekpo *et al*., 2009). Thus, the detection of hematuria in some students could reflect underlying parasitic involvement in addition to bacterial causes (Umoh *et al*., 2020; Isaac *et al*., 2019).. Other abnormalities included elevated urobilinogen (6.7%), bilirubin (1.7%), and glucose (3.3%)**.** These findings, although less common, suggest possible liver impairment or metabolic disorders among a few participants. Hyperglycosuria, for instance, is a common finding in undiagnosed diabetes, a condition known to predispose individuals to recurrent UTIs (Nitzan *et al*., 2015).

The study population was predominantly female (62%), with most students aged between 21–25 years. This demographic distribution is particularly important because females are at greater risk of UTIs due to anatomical factors such as a shorter urethra and its proximity to the anus, which facilitates ascending bacterial colonization (Foxman, 2014). Indeed, the findings of this study revealed slightly higher prevalence rates of infections among females compared to males, which is consistent with patterns reported worldwide (Flores-Mireles *et al*., 2015, Gebremariam *et al*., 2019).

Behavioral risk factors also played an important role. A majority of participants (65%) reported using public toilets, which are often poorly maintained and act as reservoirs for pathogenic microorganisms (Nwadioha *et al*., 2010; Onyebueke *et al*., 2020). Moreover, 60% of respondents reported changing underwear only once daily, while a few changed as rarely as twice a week or less. Poor personal hygiene such as infrequent underwear change and inadequate wiping after toilet use are known to predispose individuals, especially females, to UTIs (Osonuga *et al*., 2024; Vyas *et al*., 2015). Another noteworthy finding is that 45% of the students had a prior diagnosis of UTI, and more than half (53%) reported experiencing UTI-related symptoms. Comparable studies reflect similar or higher prevalence. For instance, Onyebueke *et al*. (2020) reported a UTI prevalence of 40% among female university students, with frequent UTIs linked to crowded hostels, poor sanitation, and sexual behavior—factors relevant in this study population. Furthermore, the overall prevalence of UTI among Nigerian university students has been reported as high as 28% (Gebremariam *et al*., 2019) suggesting that the students here may be engaging in relatively better hygiene or screening practices. These values indicate a relatively high burden of UTIs among university students in Benin City, consistent with findings from other Nigerian higher institutions where prevalence rates between 30–50% have been reported (Okonko *et al*., 2009; Oladeinde *et al*., 2011).

The parasitological analysis revealed the presence of two urinary parasites: *Schistosoma haematobium* (8.3%) and *Trichomonas vaginalis* (3.3%). Together, they accounted for an overall parasite prevalence of 11.7**%** among the study population. Although this prevalence may appear relatively low, it is still significant given that university students are generally assumed to be at lower risk compared to rural populations. The detection of *S. haematobium* eggs in urine samples confirms ongoing transmission of urinary schistosomiasis within this population. The intensity of infection ranged from light (<50 eggs/10 mL) in three cases to heavy infection (>50 eggs/10 mL) in one case. Urinary schistosomiasis remains a major neglected tropical disease in Nigeria, with millions at risk due to regular contact with infested water bodies (Hotez *et al*., 2008). The higher prevalence in males (13%) compared to females (5.4%) could be explained by greater male involvement in outdoor activities such as swimming, farming, and fishing in potentially infested rivers or streams (Ugbomoiko *et al*., 2010). Clinical manifestations such as hematuria and proteinuria observed in some participants may be directly attributable to *S. haematobium* infection (van der Werf *et al*., 2003).

Trichomonas vaginalis was identified exclusively among female participants (5.4%). This parasite is primarily transmitted sexually and is more often symptomatic in women than in men (Kissinger, 2015). Its presence in this student population is concerning because it reflects ongoing sexual transmission among young adults, many of whom may be unaware of their infection status. Trichomoniasis has been linked with adverse reproductive health outcomes, such as vaginitis, infertility, and increased susceptibility to HIV acquisition (Kissinger, 2015). The detection of this parasite highlights the need for sexual health education and routine screening for sexually transmitted infections (STIs) among university students.

The prevalence of urinary parasites varied across age groups, with the highest infection rates among students aged 21–25 years (14.8**%)** and 26–30 years (16.7%)**.** These age groups correspond to the peak of youthful activity, marked by frequent exposure to communal facilities, outdoor water sources, and heightened sexual activity, all of which increase the risk of both schistosomiasis and trichomoniasis (Ekpo *et al*., 2009). The sex distribution also revealed important trends: while *S. haematobium* occurred in both sexes, *T. vaginalis* was confined to females. This agrees with the epidemiological patterns of these parasites, where schistosomiasis affects both sexes but trichomoniasis disproportionately burdens women (WHO, 2020).

The findings of this study have significant implications for public health and student well-being. First, the relatively high prevalence of urinary abnormalities such as leukocyturia, nitrituria, and hematuria calls for routine screening of students for UTIs and parasitic infections**.** Undiagnosed and untreated cases can progress to chronic kidney damage, infertility, or even bladder cancer in the case of schistosomiasis (Mostafa *et al*., 1999). Second, the detection of *S. haematobium* among university students highlights that schistosomiasis is no longer limited to rural communities but persists even in urban populations. This underscores the importance of integrated control strategies, including mass drug administration (praziquantel), improved sanitation, and health education to reduce transmission. Third, the identification of *Trichomonas vaginalis* stresses the need for sexual health education programs and STI prevention campaigns within tertiary institutions. Awareness creation, condom promotion, and regular testing would reduce the burden of trichomoniasis and its complications Furthermore, evidence from related Nigerian studies reinforces the importance of knowledge and behavior in preventing urinary and parasitic infections. For instance, Egbochuku and Atedhor (2025) in their study at the University of Benin reported that knowledge of UTIs substantially predicted preventive behavior among female students. Although 46% of respondents had a moderate level of knowledge about UTIs, preventive practices remained inadequate: only 17.5% wiped the genital area correctly from front to back, 42.3% changed sanitary towels after more than 12 hours, and just 35.5% reported washing the genitourinary area after toilet use. Such findings echo the current study's observation of varied hygiene practices among students and highlight critical gaps in health literacy. Strengthening awareness of urinary and parasitic infections, coupled with behavioral interventions, will therefore be vital in reducing infection risks within university environments.

Overall, while UTIs and parasitic infections among students are treatable, untreated cases may progress to severe complications such as infertility, chronic kidney disease, or bladder cancer. The findings of this study therefore carry significant implications for public health interventions targeting Nigerian university populations, including improved screening, treatment, sanitation, and health education.

5.1 Contribution to Knowledge

This study makes the following contributions to knowledge:

4. **Documentation of Parasitic Prevalence in a University Population**

   It provides one of the few systematic assessments of urinary parasites among Nigerian university students, establishing a combined prevalence of 11.7% for *Schistosoma haematobium* and *Trichomonas vaginalis*. This expands current knowledge beyond school-age children and rural populations, identifying young adults in tertiary institutions as a relevant at-risk group.

5. **Link Between Urinalysis Abnormalities and Parasitic Infections**

   The study demonstrates the co-occurrence of leukocyturia, nitrituria, proteinuria, and hematuria with confirmed parasitic infections. This strengthens evidence that routine urinalysis can serve as a useful, non-invasive screening tool for underlying parasitological and microbial conditions in resource-limited settings.

6. **Gender- and Age-Specific Patterns**

   Findings revealed higher *S. haematobium* prevalence in males and exclusive occurrence of *T. vaginalis* among females, while the highest infection rates were among students aged 21–30 years. These demographic insights contribute to understanding gender- and age-related risks and provide a basis for designing tailored intervention programs in university communities.

7. **Behavioral and Environmental Risk Factors**

   The study highlights the role of behavioral practices such as the use of public toilets, frequency of underwear changes, and exposure to freshwater bodies—in shaping infection risks. This reinforces the connection between personal hygiene, environmental sanitation, and urinary parasitic infections in young adults.

8. **Public Health Significance in Semi-Urban University Settings**

   By identifying parasitic infections and urinary abnormalities in apparently healthy university students, the study challenges the assumption that schistosomiasis and trichomoniasis are confined to rural populations. It establishes university campuses as important foci for surveillance and intervention, contributing new evidence for student health policy.

5.2 Conclusion

This study provides valuable insights into the presence, patterns, and risk factors of urinary abnormalities and parasitic infections among students of the University of Benin. The detection of *Schistosoma haematobium* and *Trichomonas vaginalis* highlights that urinary schistosomiasis and trichomoniasis remain significant concerns, even within young, educated populations. The findings that 24% of participants had leukocyturia and 17% had nitrituria further suggest that bacterial infections coexist with parasitic infestations, creating overlapping health challenges. Demographic trends showed that infection rates were highest among students aged 21–30 years, while gender analysis reflected biological and behavioral risk patterns. The reliance on public toilets, inadequate personal hygiene, and exposure to freshwater bodies were identified as important drivers of infection risk. Given the long-term health consequences of untreated urinary schistosomiasis including chronic bladder disease and increased risk of cancer as well as the reproductive and sexually transmitted health implications of *T. vaginalis*, the findings underscore the urgent need for improved health education, sanitation, and preventive interventions in university settings.

5.3 Recommendations

Based on the findings of this study on urinalysis and parasitological assessment of urine samples from students of the University of Benin, the following recommendations are proposed:

1. **Routine Screening and Early Diagnosis**

   University health services should include regular urine screening for both biochemical abnormalities and parasitic infections. Early detection will facilitate timely treatment and prevent long-term complications.

2. **Mass Treatment Programs**

   In line with WHO recommendations, periodic mass drug administration (MDA) with praziquantel should be implemented in endemic areas, targeting not only school-age children but also university students who remain at risk.

3. **Improved Sanitation Facilities**

   University authorities should ensure the provision of clean, well-maintained toilets and safe water supply within campuses. Public toilet facilities should undergo regular disinfection and monitoring to minimize contamination risks.

4. **Health Education and Awareness**

   Targeted campaigns should raise awareness about urinary schistosomiasis, trichomoniasis, and bacterial UTIs, with emphasis on personal hygiene practices, safe sexual behavior, and risks associated with freshwater contact.

5. **Integration of Sexual and Reproductive Health Services**

   Screening and treatment of *T. vaginalis* should be incorporated into reproductive health programs for students, given its implications for fertility and increased susceptibility to HIV and other STIs.

6. **Behavioral Interventions**

   Students should be encouraged to adopt safe practices such as regular underwear changes, avoidance of contaminated freshwater, and consistent use of protective measures in communal facilities.

7. **Further Research**

   Future studies should expand sample size and incorporate urine cultures for bacterial pathogens, antimicrobial resistance profiling, and molecular characterization of *S. haematobium* and *T. vaginalis*. Longitudinal studies could also track the impact of interventions on infection prevalence over time.

8. **Policy and Institutional Commitment**

   University management and public health authorities should integrate parasitological surveillance into routine student medical services and enforce policies that safeguard sanitation, safe water, and health literacy on campuses.

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