FACULTY OF HEALTH AND ALLIED SCIENCES

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TITLE: THE PREVALENCE OF INTESTINAL PARASITIC INFECTIONS AND THEIR ASSOCIATED RISK FACTORS IN BASIC SCHOOL CHILDREN IN THE ABUAKWA-NORTH DISTRICT

BY:

MARY ASANTE AND HUSSENI SHAMSUDEEN BAMEYISHEALLAH

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SUPERVISOR

MR. MAXWELL HUBERT

DECLARATION

This Thesis is submitted in fulfillment of a Bachelor of Technology in Medical Laboratory Science at Koforidua Technical University and has not been submitted or presented for a degree in any other University and hence affirmed as original.

Signature……

Date 14 OCTOBER 2023

MARY ASANTE

B500210416

Signature

Date 14 OCTOBER 2023

HUSSENI SHAMSUDEEN BAMEYISHEALLAH

B500210433

CERTIFICATION

I confirmed that the work reported in this Thesis was carried out by the candidates under my supervision as a University supervisor.

Signature  ……

Date 14 OCTOBER 2023

MR. MAXWELL HUBERT

Department of Medical Laboratory Science

DEDICATION

We oblige this Thesis to the Lord Almighty and our supportive supervisor who encouraged us to embark on the project. We as team members dedicate this to ourselves for the co-operation and teamwork. We also commit this thesis to our family, whose solid support and help have been our guiding light throughout this project.

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LIST OF ACRONYMS

×g	Gravity
EPRC	Ethics Protocol Review Committee
Cl	Confidence level
g	Gram
GHS	Ghana Health Service
GHSERC	Ghana Health Service Ethics Review Committee
IPIs	Intestinal Parasitic Infections
IPs	Intestinal Parasites
KTU	Koforidua Technical University
MoH	Ministry of Health
OR	Odds Ratiio
RCF	Relative Centrifugal Force
RPM	Revolutions per minute
SAHS	School of Allied Health Science
SD	Standard deviation
STHs	Soil transmitted Helminths
SSA	Sub-Saharan Africa
WASH	water, sanitation and hygiene

ABSTRACT

Background: Intestinal parasitic infections (IPIs) are a major global cause of illness and disease, with helminthic interstitial parasites and parasitic intestinal protozoa causing significant morbidity, discomfort, and even mortality in tropical and sub-tropical regions. Although these parasites can infect people of all ages, children are especially vulnerable.

General Aim: This study aims to determine the prevalence of intestinal parasitic infections and associated risk factors among basic school children in the Abuakwa-North District.

Methodology: The study conveniently sampled 225 children from age 5-15 by using simple random sampling method to collect their stool samples and examined for the presence of various types of parasites using direct wet mount and formol ether concentration techniques. A semi-structured questionnaire was used to collect participants information about participants knowledge, their socio-demographics and their socio-economic parameters. Informed consent was taken from participants parents and participation was fully voluntary. Data was analyzed using SPSS 23, and descriptive statistics was used to determine the prevalence rate of identified parasites.

Results: Among the total 225 study members, females made up 60% while male were 40%. Participants below the ages of 10 years were 24% as compared to those above 10 years of age being the majority 76%. The total prevalence of intestinal parasitosis was 35.6% in the school children that was included in this study. Age and gender were used as the demographic variables in this study but did not show any statistical significance in establishment of any relationship between the variables and this study. The total number of IPIs among male participants for both positive and negative results were 34 (15%) and 56 (24.9) respectively. 46 (20.4%) were positive and 89 (40%) were negative for parasitic infection among their female partners. Giardia lamblia emerged as the most prevalent parasite constituting 15.6% of the total sample. Following closely was Balantidium coli6.2%. Entamoeba histolytica was the third most common parasite 5.3% of the sample and Ascaris lumbricoides had 2.7%. Giardia lamblia and Entamoeba histolytica co-infection was 4% of the total while both Giardia lamblia and Ascaris lumbricoides co-infection and Giardia lamblia and Balantidium coli had 0.9% each of the sample. There was no statistical significance between individual risk factors that expose the participants to parasitic infections and IPIs as a whole. The p-values for all the characteristics were above 0.05.

Conclusion: IPIs is highly prevalent in the study population. Good hygiene and deworming practices must be enforced among the study population to help reduce the burden of such parasitic infection.

CHAPTER ONE

1.0 Introduction.

Intestinal parasites are regarded as a substantial worldwide public health concern, especially in underdeveloped regions. An approximate 3.5 billion individuals are afflicted, and roughly 450 million people currently endure these infections, with a predominant number being children. Protozoa and helminths are two groupings of pathogenic and non-pathogenic parasites that give rise to gastrointestinal tract disorders (Saki *et al.,* 2016). In developing nations, parasitic infections resulting from intestinal helminths and protozoa are among the most widespread infections, contributing significantly to the overall morbidity and mortality rates (Chelkeba *et al.,* 2020; Eyayu, Kiros, *et al.,* 2021). Particularly, economically underprivileged children residing in tropical and subtropical areas, where they have little to no availability of clean drinking water, insufficient sanitation facilities, and poor housing, face the greatest impact (Chelkeba *et al.,* 2020). Intestinal parasitosis has also been linked to a person's socioeconomic status (Curval *et al.,* 2017). Several other factors such as poor sanitation, overcrowding, and inadequate hygiene practices contribute to the persistent infection rates in these regions (Butera *et al.,* 2019). Not all the 3.5 billion people affected by intestinal parasites experience symptoms. Children are particularly vulnerable to polyparasitic infections, which can weaken their immune systems and make them more susceptible to other infections.

Government policies and interventions play a significant role in controlling intestinal parasitic infections. In a suburb of Accra, Ghana, the overall prevalence of intestinal parasites was 15.1%, which was lower than the rates reported in Ethiopia. The variations in findings could be attributed to diverse environmental factors or the implementation of annual deworming initiatives for children under five years by the Ministry of Health in Ghana (Forson *et al.,* 2017)., and also the fact that in Ethiopia, particularly in rural areas, access to reliable sanitation facilities and clean water sources is limited, with only 11% of the population having sustainable sanitation and less than 42% having access to safe water (Azanaw *et al.,* 2023).

Parasitic infections caused by unicellular protozoan parasites can result in various health problems, including abdominal distension, bloody urine, vomiting, diarrhea, lack of appetite, and mental health disorders, which may be fatal in severe cases. Although mortality from these parasitic infections is uncommon, they have several health implications. (Butera *et al.,* 2019).

School-aged children are particularly susceptible to intestinal helminthic infections, which are among the most common types of infections in this age group. Globally, it is estimated that 878 million school-aged children and 386 million preschool-aged children are at risk (Weldesenbet *et al.,* 2019).

1.1 Problem Statement.

Intestinal parasitic infections are a significant public health issue among basic school children, especially those living in underdeveloped regions. These infections increase their susceptibility to various other health problems (Amisu *et al.,* 2023). Intestinal parasitic infections are a worldwide problem, with around 400 million school-aged children being the most affected group. Poor hygiene, lack of knowledge, malnutrition, and poverty are prevalent in areas like Sub-Saharan Africa, making it easier for individuals to contract these infections. (Liao *et al.,* 2016). *Isospra belli*, *Strongyloides*, *Cryptosporidium* and *Microsporidium* are all opportunistic parasites that are commonly seen in children (Gyang *et al.,* 2019).

Parasitic infections are responsible for over one-third of global deaths, making it a significant global issue. Inadequate nutrition, lack of access to clean drinking water, and poor personal hygiene are all recognized as major factors that contribute to the infection of children.(Forson *et al.,* 2017).
The second leading cause of infant mortality in Africa, as stated by the World Health Organization (WHO), is geo-helminths (STH) (Gebretsadik *et al*, 2018).

Several studies have been carried out on intestinal parasitic infections among children in Ghana, but none have specifically focused on the Abuakwa-North District. Furthermore, the Eastern region has very limited epidemiological data regarding the prevalence of intestinal parasitic infections in school-aged children. As a result, there is a pressing need to evaluate the occurrence of intestinal parasitic infections in school children within the Abuakwa-North District.

1.2 Justification

This information will be useful in developing health education programs as part of public health control initiatives for the community, particularly for parents. The study aims to educate parents

on preventative measures that can be taken to minimize the risk of parasitic infections in their children.

Additionally, it will emphasize the importance of screening children for gastrointestinal parasitosis and the need for appropriate medications such as anti-helminthic and anti-protozoa drugs. Proper hygiene practices will also be emphasized to reduce the spread of these infections. Ultimately, the study results will be used to promote better health practices and improve the overall health of the community.

This study will provide recommendations for the development of effective interventions to prevent and control intestinal parasitic infections among basic school children in the Abuakwa-North District.

1.3 Research Questions

1. What is the prevalence of intestinal parasitic infections among basic school children in the Abuakwa-North District?

2. What is the distribution of different intestinal parasites among the study population?

3. What are the demographic characteristics of the study population, and how do they relate to the prevalence of intestinal parasitic infections?

1.4 Aim.

The study seeks to determine the prevalence of intestinal parasitic infections and identify the associated risk factors among basic school children in the Abuakwa-North District.

1.5 Specific Objectives.

The objectives of the study are:

1. To determine the prevalence of intestinal parasitic infections among basic school children in the Abuakwa-North District.
2. To identify the specific types of intestinal parasites that are present in the study population.

3. To determine the risk factors associated with intestinal parasitic infections among basic school children in the Abuakwa-North District, including demographic, environmental, and behavioral factors.

CHAPTER TWO

2.0LITERATURE REVIEW

This chapter thoroughly examines significant articles concerning the present study and presents comprehensive information on numerous interconnected research studies about metabolic syndrome and its associated risk factors, including sedentary and non-sedentary occupations, as well as socioeconomic status. The researchers conducted a systematic search across various sources such as PLOS ONE, WebMD, Medscape, ResearchGate, Google Scholar, MedlinePlus, Scopus, online libraries, and websites of esteemed research institutions like the WHO and American Heart Association.

Some phrases that were used in the search include: thesis, prevalence of intestinal parasites in school children," "parasitic infections among school children," "epidemiology of intestinal parasites in school settings, incidence, risk factors, geographical distribution of intestinal parasitosis, hygiene practices and enteric parasitosis, and diagnosis and treatment of intestinal parasites.

2.1Intestinal Parasitic Infections as a global burden.

Annually, gastrointestinal parasitic infections alone give rise to a substantial number of avoidable fatalities, amounting to hundreds of thousands of lives lost. (Tyoalumun *et al.,* 2016). Intestinal parasitic infections emerge as a momentous etiological factor contributing to widespread morbidity and mortality across diverse populations on a global scale (Kiani *et al.,* 2016).

In regions characterized by the endemic prevalence of soil-transmitted helminths which is a significant contributor to intestinal parasitic infections, there are more than 267 million preschool-age children and an additional 568 million school-age children, collectively totaling an extensive population affected by this health concern (Fauziah *et al.,* 2022).

Intestinal parasitosis encompasses a cluster of illnesses triggered by the presence of one or multiple types of protozoa, cestodes, trematodes, or nematodes, which are widely prevalent across the globe (Assemie *et al.,* 2021). Amoebiasis, ascariasis, hookworm infection, and Trichuris rank among the prevailing parasitic infections frequently encountered (Abere *et al.,* 2023; Assemie *et al.,* 2021)

The impact IPIs reaches beyond mere morbidity and mortality, encompassing a broad range of consequences including nutritional challenges such as restricted growth, deficits in vitamin A and iron leading to anaemia, weight loss, and chronic blood loss, as well as adverse effects on psychological well-being and social functioning. Furthermore, IPIs has the potential to compromise mental development, resulting in impaired growth, reduced school attendance, cognitive impairment, diminished educational achievement, and diminished productivity in adulthood (Assemie *et al.,* 2021).

Intestinal parasitic infections (IPIs) persist as a grave public health concern, with their distribution spanning across nearly every corner of the globe. These infections disproportionately affect the most impoverished and marginalized communities, characterized by prevalent deficiencies in environmental sanitation and personal hygiene practices (Eyayu, Wubie, *et al.,* 2021) with about 1000s deaths occurring annually in some tropical regions (Tyoalumun, *et al.,* 2016).

Intestinal parasites pose substantial burdens on both a global scale and within individual countries, manifesting as notable threats to public health. The potential for food contamination hinges predominantly upon the overall well-being of food handlers, encompassing factors such as their sanitation practices, personal hygiene, familiarity with food hygiene principles, and adherence to such practices. Across the globe, the primary reservoirs of intestinal helminths and protozoa can often be traced back to food handlers who exhibit substandard personal hygiene practices and operate in unsanitary environments, thereby constituting the principal sources of these parasites (Hajare *et al.,* 2021)

Individuals who carry intestinal parasites without exhibiting any symptoms pose a significant risk to public health, particularly if they are employed as food handlers, as they have the potential to serve as a source of infection for others. These parasites, once they enter the human body, can remain undetected for extended periods, evading diagnosis and persisting within the host (Hajare *et al.,* 2021). They play a pivotal role in causing substantial health issues with far-reaching socioeconomic implications, with a pronounced impact observed globally, but notably more pronounced in developing countries located in tropical and subtropical regions (Hajare *et al.,* 2021).

Impoverishment plays a significant role in the acquisition of parasitic infestations, frequently linked to unsanitary dietary practices encompassing the consumption of unwashed uncooked foods, inadequate drainage infrastructures, and substandard personal hygiene habits, with parasitic organisms contributing to a staggering 15% of the intestinal tract total cancer cases (Naveed & Abdullah, 2021) the adoption of nutritious dietary regimens, heightened sanitary measures, food sterilization techniques, and the judicious utilization of antibiotics have substantially curtailed the prevalence of parasitic infections among individuals and the variegation of gut microbial communities (Naveed & Abdullah, 2021).

Creating a foundational understanding of the existing prevalence rates and shedding light on factors that could be altered to mitigate the risk of IPI would provide valuable insights for public health planners, policymakers, and those responsible for implementation. This information would empower them to strategize and formulate appropriate interventions aimed at reducing the resultant health problems and fatalities in preschool children (Wasihun *et al.*, 2020).

2.2Overview of Intestinal Parasites

Intestinal parasitic infections (IPI) encompass a spectrum of diseases caused by diverse species of protozoa (*Giardia intestinalis*, *Entamoeba histolytica*, *Cyclospora cayetanenensis*, and *Cryptosporidium* spp) and helminths (cestodes (tapeworms) (Abere *et al.*, 2023; Assemie *et al.*, 2021; Haque, 2007), trematodes (flukes), or nematodes (roundworms), whereby these parasites establish residency within their hosts in order to ensure their own survival. While some parasites have minimal impact on their hosts, others possess the ability to proliferate, reproduce, or invade vital organ systems, resulting in illness and facilitating the transmission of additional parasites (Abere *et al.*, 2023; Assemie *et al.*, 2021). These infections can be transmitted through the contamination of food and water with fecal matter or through direct penetration of the skin, following a direct life cycle. Despite their significant prevalence, parasitic infections in tropical regions are often disregarded, yet they persist as enduring and consequential infectious diseases, exerting profound and wide-ranging consequences on human populations (Abere *et al.*, 2023; Esiet & Edet, 2017).

Within the category of intestinal helminthic parasites, which are alternatively referred to as geohelminths and soil-transmitted helminths, distinct species can be identified: Ascaris

lumbricoides, commonly known as the roundworm, *Trichiuris trichiuria*, recognized as the whipworm, and *Ancylostoma duodenale* and *Necator americanicus*, collectively referred to as hookworms. Globally, approximately 1.2 billion individuals are affected by roundworm infections, while hookworm infections afflict around 740 million people (Ahiadorme & Morhe, 2020).

The intestinal protozoan parasites *Giardia lamblia, Entamoeba histolytica, and Cryptosporidium spp*. are notable for their prevalence in causing infections. These parasites are specifically linked to giardiasis, amoebiasis, and cryptosporidiosis, respectively, which are characterized by the common occurrence of diarrhea symptoms (Dagne & Alelign, 2021)

Soil-transmitted helminths has fecal-oral route of transmission and spread through the eggs that are excreted in the feces of individuals who are infected. These eggs give rise to adult worms that reside in the intestine and produce a large number of eggs on a daily basis. Furthermore, hookworm eggs hatch in the soil, releasing larvae that develop into a form capable of actively penetrating the skin. Infection with hookworm primarily occurs when individuals walk barefoot on soil that is contaminated with these larvae (World Health Organization, 2023).

Enteric protozoa such as *Giardia lamblia* and *Entamoeba histolytica* spreads by fecal-oral means either by a direct or indirect contact transmission from infected food, water, or animals that carry the infected stage of the parasite. However, *Cryptosporidium* infection is by airborne transmission (Osman *et al.,* 2016). Direct person-to-person transmission or infection through fresh faeces is not possible because the eggs require approximately three weeks to mature in the soil before becoming infectious. *Ascaris lumbricoides, Trichuris trichiura,* and hookworms do not reproduce within the human host and rely on contact with infective stages in the environment for reinfection (World Health Organization, 2023).

Intestinal protozoa and helminths infections can manifest with various symptoms such as diarrhea, abdominal or stomach pain, nausea, vomiting, weight loss, indigestion or dyspepsia, bloating, and constipation (Kiani *et al.,* 2016).

2.3Prevalence and Risk Factors.

Intestinal parasitic infections exhibit higher prevalence rates within populations characterized by low socio-economic status, overcrowding, and inadequate hygiene practices (Tssema *et al.*, 2017) and they annually afflict an astonishing number of approximately 3.5 billion individuals globally, emerge as a significant contributor to the overall burden of illness, as evidenced by the alarming report of over 450 million cases reported each year. Among the extensive range of parasitic diseases, ten notable ones include Amoebiasis, Ascariasis, Hookworm infection, and Trichuriasis. However, drawing specific attention due to their profound implications on global health are the three dominant soil-transmitted helminths, namely *Ascaris lumbricoides, Trichuris trichiura,* and Hookworm, whose collective impact encompasses a staggering toll of over one billion infections, while simultaneously posing an unprecedented risk to an astounding two billion individuals susceptible to contracting these pernicious infections (Tigabu *et al.*, 2019).

Based on a comprehensive study conducted in Nepal, which involved the analysis of 285 stool samples collected from school children, it was found that a significant proportion of 94 samples (approximately 33%) tested positive for parasitosis. Notably, the prevalence of intestinal parasites was observed to be slightly higher in rural schools, accounting for 44.6% of the cases, as compared to urban schools, where the prevalence stood at 30% (with statistical significance denoted by $P < 0.05$). Among the detected parasites, *Giardia lamblia* emerged as the most prevalent, affecting approximately 15.4% of the sampled population, followed by *Entamoeba histolytica* (7.7%), *Entamoeba coli* (7%), *Ascaris lumbricoides* (1.8%), and *Hymenolepis nana* (1.08%). Furthermore, it was observed that children between the ages of 11 and 15 years experienced a higher burden of parasitic infections, with an alarming prevalence rate of 44.2%, as compared to the younger age groups (Gupta *et al.*, 2020).

Further research conducted in Ethiopia focused on the prevalence of intestinal parasitic infections (IPI) among primary school children. The study revealed that *Entamoeba spp* had a prevalence rate of 16.11%, followed by Ascaris lumbricoides at 13.98%, Hookworm at 12.51%, and Giardia lamblia at 9.98%. These findings highlight these particular parasites as the most prevalent infections among primary school children in Ethiopia (Assemie *et al.*, 2021). The overall pooled prevalence of IPI was determined to be 46.09%, aligning with similar studies conducted in Kenya (43%) and Nigeria (42.6%). These results emphasize the significant burden of intestinal parasitic

infections faced by primary school children not only in Ethiopia but also in various other regions, calling for attention and effective interventions to mitigate the impact of these infections on the health and well-being of affected children (Assemie *et al.*, 2021; bdir & Adwan, 2010; Dahal *et al.*, 2019; Kamonge *et al.*, 2020).

Research conducted in the Middle East has revealed a range of prevalence rates for intestinal parasites, highlighting the varying degrees of infection within the region. For instance, prevalence rates were reported as 42.5% in Syria, 33.9% in Qatar, 5.3% in Saudi Arabia, 28.7% in Yemen, 28.5% in Jordan, 74.6% in Palestine, 27.3% in Iran, 17% in Sudan, 12.4% in Lebanon, and 83.1% in Pakistan. These findings underscore the significant regional differences in the prevalence of intestinal parasites across the Middle East, indicating variations in factors such as hygiene practices, access to clean water, sanitation infrastructure, socioeconomic conditions, and healthcare resources.(Assemie *et al.*, 2021; Bakarman *et al.*, 2019; Elmonir *et al.*, 2021; Khan *et al.*, 2017).

Sanitation is a significant contributor to the prevalence of intestinal parasitic infections. A meta-analysis conducted in China found that access to properly treated water was associated with lower rates of geohelminth infections (Yang *et al.*, 2018). Similarly, a study conducted in a rural area of north-western Ethiopia showed that school-aged children living in unsanitary conditions and lacking access to clean water had a high prevalence of intestinal parasites (Amor *et al.*, 2016). Another study in Rwanda indicated that children from families with access to treated water were less likely to have an intestinal parasite infection compared to those without (Butera *et al.*, 2019).

In Hawassa, central of Ethiopia, a study found that the prevalence of intestinal helminth infection among primary school children was 23.1%, which was attributed to poor hygiene habits, lack of good water and lack of deworming practices (Gitore *et al.*, 2020).

During the period of January to April 2018, a cross-sectional study was conducted on a sample of 996 preschool and school-aged children in Gharbia governorate. The purpose of the study was to assess the prevalence of intestinal parasitic infections (IPIs) in this population. Stool specimens obtained from the participants were examined using both direct smear and formol-ether concentration methods to detect the presence of parasites. The study revealed an overall prevalence of IPIs at 46.2% among the children. The most commonly identified parasites were *Entamoeba histolytica* and *Ascaris lumbricoides*, both with a prevalence rate of 12.7%. Following closely were *Enterobius vermicularis* (8.6%), *Giardia lamblia* (7.1%), *Cryptosporidium parvum*

(1.5%), *Heterophyes heterophyes* (1.4%), *Hymenolepis nana* (0.7%), Hookworms (0.6%), *Fasciola hepatica* (0.5%), and *Dipylidium caninum* (0.4%). Interestingly, it was observed that a significant proportion of infected children (26.8%) displayed no symptoms, while those with medical complaints accounted for 19.4% of the cases. This difference in symptom presentation was found to be statistically significant ($P < 0.001$). These findings highlight the substantial prevalence of IPIs among preschool and school-aged children in Gharbia governorate during the study period. It also emphasizes the importance of screening and treating asymptomatic cases, as they contribute significantly to the overall burden of infections. Implementing effective preventive measures and appropriate treatment strategies based on these findings can help improve the health and well-being of the affected children (Elmonir *et al.*, 2021).

In addition to the aforementioned findings, a cross-sectional study that was conducted among patients of a Ghanaian psychiatric hospital revealed a notable prevalence of Entamoeba. histolytica/dispar and Cryptosporidium parvum infections. These two parasites have also been identified by global task forces as having the second and third highest prevalence worldwide, respectively, following Giardia lamblia. Specifically, Cryptosporidium parvum has been found to have the highest prevalence in Africa, making its significant presence in our study population unsurprising. C. parvum and E. histolytica have long been recognized as common culprits of diarrhea in Ghana, aligning with previous report. Among the 111 patients included in the study, it was found that a portion of them (13.5%) carried parasites despite not displaying any symptoms. Interestingly, the prevalence of asymptomatic parasite carriage was higher among males (18.8%) compared to females (4.8%). Furthermore, the study observed a decrease in the carriage of parasites with increasing age. However, there was an increase in parasite carriage with longer duration of hospital admission (Duedu *et al.*, 2015).

Another study that was conducted in Accra also determined that the overall occurrence of intestinal parasitic infections among the students included was 15%. Among the identified parasites, *Giardia lamblia* was the most prevalent, affecting 10% of the students, followed by *Schistosoma mansoni* at a prevalence of 1.7%. Of the students who tested positive for intestinal

parasites, 13.6% had single parasite infections, while 1.3% had double infections involving two different parasites. Analysing the data by age groups, it was found that children between the ages of 4-5 and 6-7 years had the highest rates of parasitic infections, accounting for 20% each. Gender

($p = 0.1451$) and the source of drinking water ($p = 0.8832$) did not demonstrate a significant association with the prevalence of intestinal parasitic infections. However, a statistically significant relationship was observed between children who were infected with parasites and their close proximity to domestic animals or pets ($p = 0.0284$) (Forson *et al.,* 2017).

These findings reveal that various parasites, such as *Giardia lamblia, Entamoeba histolytica, Ascaris lumbricoides, Enterobius vermicularis, Cryptosporidium parvum* and *Schistosoma mansoni,* are commonly found. The prevalence rates vary across different regions and countries, indicating the influence of various factors such as hygiene practices, socio-economic status, and geographical location. It is evident that intestinal parasitic infections pose a considerable health burden on school children, affecting their overall well-being and educational outcomes.

2.4 Risk Factors Associated with Intestinal Parasitic Infections in Basic School Children

Intestinal parasitic infections are notably more common in Sub-Saharan Africa (SSA). Global changes in sociocultural factors have influenced the relationship between parasites and humans. The ongoing transmission of this parasitic disease is influenced by several socioeconomic factors, including income, occupation (especially farming and fishing), number of siblings, age of children, family size, household conditions, level of education, and access to proper health supervision and education (Gizaw *et al.,* 2019). The presence of intestinal parasites is closely linked to inadequate access to safe drinking water and proper sewage systems. Challenges associated with accessing timely diagnosis and treatment for infections, contribute significantly to the prevalence of these parasites (Cociancic *et al.,* 2020).

In a survey involving 397 participants who completed a questionnaire covering socio-economic data and hygiene practices, the risk of parasitosis and Blastocystis sp. infection was found to be higher in individuals living in houses constructed with makeshift materials (with odds ratios (OR) of 2.6 and 1.9 respectively). Similarly, the risk of infection increased for those who shared a bed (with OR of 1.8 and 2.3, respectively). Furthermore, individuals residing in houses without access to a public waste collection service had a greater risk of Blastocystis sp. infection (with an odds ratio of 2.2). For G. lamblia infection, the risk was notably higher for participants whose houses had dirt floors (with an OR of 3.5). Conversely, the risk of E. vermicularis infection was elevated in participants living in houses without piped water (with an OR of 2.1). Also, children residing in non-urban areas experienced a higher prevalence of parasitosis compared to those living in

urban areas (81.2% and 64.3%, respectively). Additionally, participants in non-urban areas exhibited a higher risk factor for infection, with an odds ratio of 2.4 (95% confidence interval (Cl) = 1.5–3.9) (Cociancic *et al.,* 2020).

Intestinal parasitic infections were prevalent infectious diseases that caused numerous health issues and hindered the growth and physical development of individuals. Children under the age of five are particularly susceptible to these infections due to their immature immune systems and their exploratory behaviors related to feeding. In a systematic review that aimed at examining the connection between intestinal parasitic infections and malnutrition in children under the age of 5, it was found that Ascariasis was the most frequently reported infection, with prevalence rates ranging from 10.77% in Ethiopia to 57.14% in Malaysia. This infection was statistically significant in terms of its association with stunting (OR 2.17, p = 0.02). Giardiasis was the second most frequently reported infection, with prevalence rates ranging from 4.43% in Ethiopia to 66.33% in the Central African Republic, and it was linked to an increased statistical significance risk of stunting (with OR 2.34 and p = 0.03), wasting was also statistically significant (with OR 2.90 and p = 0.03), and being underweight was also statistically significant (OR 1.53 and p = 0.04). The third and fourth most common infections were T. trichiura and hookworm infections. These intestinal parasitic infections can manifest at a very early age and result in significant growth retardation (Fauziah *et al.,* 2022).

Similarly, malnutrition associates with gender, age, intestinal parasitosis and family size of the basic school children. In the study involving 2372 students, researchers observed that the prevalence of underweight was 21.96% among female school-age children and 27.13% among male school-age children. An interesting finding was that being female was associated with a 39% lower risk of underweight compared to males. Moreover, children below the age of 13 had a higher prevalence of underweight, reaching 33.24%. Additionally, the study established a significant link between underweight and intestinal parasitic infection. The odds of underweight in school children with intestinal parasitic infections were 2.67 times higher than in children without such infections (95% CI = 2.00–3.55). Furthermore, family size was found to have a direct impact on the nutritional status of children. The odds of underweight in school children from families with more than 4 members were 23 times higher compared to children from families with a size less than or equal to 4 (95% CI = 17.67–30.02) (Feleke, 2016).

2. 5 Impact of Intestinal Parasitic Infections on Basic School Children

In low-income countries, children encounter a multitude of interconnected challenges, including issues like inadequate nutrition, insufficient access to clean water, sanitation, and hygiene (WASH), resulting in infections and impairments in growth and development. On a global scale, approximately 297,000 deaths due to diarrhea each year among children under 5 years are attributed to WASH-related factors. Furthermore, one in every five children experiences stunted growth, one in thirteen is affected by wasting, and one in every seven children is underweight. These statistics highlight the pressing and complex issues affecting the health and well-being of children in such regions (Shrestha *et al.,* 2020). The high prevalence of intestinal parasitosis in school children impacts their nutritional statuses, resulting in stunting and underweight. Numerous experts have established a connection between intestinal parasitic infections, predominantly helminths, and a higher likelihood of experiencing nutritional anemia, protein-energy malnutrition, and growth impairments in children (Ihejirika *et al.,* 2019).

Hookworm infections can have a profound impact on the nutritional status of individuals due to their parasitic nature. These blood-feeding parasites attach themselves to the intestinal wall of the host, where they feed on the host's blood and tissue, including iron and protein-rich substances. As a result, individuals infected with STHs, especially hookworms, may suffer from significant iron and protein loss, leading to nutritional deficiencies and related health issues (Bauleni *et al.*, 2022).

In a study involving 250 basic school children, it was observed that a high proportion of the children, 84.8%, had anemia. The severity of anemia varied, with 12.8% experiencing mild anemia, 46.8% experiencing moderate anemia, and 25.2% experiencing severe anemia. Significantly, the study found a strong association between intestinal parasitic infections and certain factors. Specifically, open-field defecation and inadequate hand-washing practices were linked to a higher likelihood of contracting intestinal parasitic infections. The study revealed a significant association between intestinal parasitic infections and anemia.

Intestinal parasitosis have been established to have an impact on children cognitive function (Shaima *et al.,* 2021), and later behavioral problems (Heikkilä *et al.,* 2021) and academic performances. In this study, a total of 275 schoolchildren between the ages of 5 and 16 were recruited through school and household visits conducted by community health workers. The researchers compared the academic performance of children who had intestinal parasite infections, with a mean score of 53.7 (standard deviation {SD} 11.5), to that of uninfected children, who had a mean score of 59.6 (SD 16.9). The difference in mean academic scores between the two groups was found to be statistically significant (p=0.034). Interestingly, despite having similar nutritional statuses as the uninfected children, those with intestinal parasite infections still exhibited lower academic scores. This finding suggests that, the presence of intestinal parasite infections may have a negative impact on the academic performance of affected school children, independent of their nutritional status (Donkoh *et al.,* 2023).

Overall, the study highlights the importance of addressing and treating intestinal parasite infections in schoolchildren to potentially improve their academic outcomes.

2.6 Prevention and Control Strategies For Intestinal Parasitic Infections

Intestinal parasitic infections represent a significant public health challenge, particularly in developing countries. The prevalence of these infections is influenced by various risk factors that contribute to their transmission and persistence. Promoting access to clean water and sanitation facilities ensures the widespread availability and accessibility of clean drinking water sources and improved sanitation facilities is essential in mitigating the transmission and prevalence of intestinal parasitic infections. Access to clean water reduces the risk of ingesting contaminated waterborne parasites, while proper sanitation facilities aid in the containment and elimination of fecal matter thereby reducing environmental contamination (Njambi *et al.,* 2020).

Health education and hygiene practices targeted at communities, schools, and households play a pivotal role in raising awareness about preventive measures against intestinal parasitic infections. These educational programs aim to instill good hygiene practices, such as regular and thorough handwashing with soap, proper handling and preparation of food, and maintaining personal cleanliness. By fostering a culture of awareness and adherence to these practices, the transmission of parasites through contaminated hands or food is significantly reduced (Gebru *et al.,* 2023)

Implementing structured and recurring deworming initiatives, especially in educational institutions and communities at high risk, is a crucial strategy in managing intestinal parasitic infections. Consistent deworming significantly lessens the presence of parasites that survive by consuming the host's tissues, including its blood, resulting in a depletion of iron and protein. This depletion can lead to chronic intestinal blood loss and subsequent anaemia. Additionally, regular deworming helps reduce malabsorption of essential nutrients, minimizes potential competition for vitamin A in the intestine, and mitigates the occurrence of diarrhea and dysentery (Bauleni *et al.,* 2022).

Food handlers exhibit a high occurrence of intestinal parasites, even among those with a higher level of education. To address this issue, it is essential to implement regular screening for intestinal parasites among food handlers. However, beyond screening, there is a crucial need for educational programs to promote proper hygiene practices, increase awareness of modes of transmission, and emphasize preventive measures against these infections. Creating awareness among food handlers about intestinal infections is paramount. To effectively reduce the prevalence of IPIs in regions where they are endemic, a comprehensive approach is necessary. This approach should encompass improved sanitation practices, increased awareness about intestinal infections, and the appropriate use of chemotherapy when needed. By combining these control measures, we can take significant steps towards reducing the burden of IPIs among food handlers and the communities they serve (Alqarni *et al.*, 2023).

2.7 Summary of Literature Review

Intestinal parasitic infections have emerged as a significant cause of morbidity and mortality worldwide, affecting populations in both developed and developing nations. These infections result from the presence of various types of protozoa, cestodes, trematodes, or nematodes in the intestines. Transmission can occur through contaminated food and water or by direct penetration of the skin during the life cycle of the parasites. It is crucial to note that some individuals may carry intestinal parasites without displaying any symptoms, posing a potential risk to public health, especially if they work as food handlers, as they can transmit the infection to others. Populations with low socio-economic status, crowded living conditions, and poor hygiene practices are more susceptible to higher prevalence rates of intestinal parasitic infections. Shockingly, approximately 3.5 billion people globally suffer from these infections, with over 450 million new cases reported annually. Among the various parasitic diseases, notable ones include

Amoebiasis, Ascariasis, Hookworm infection, and Trichuriasis. In basic school children, risk factors associated with intestinal parasitic infections involve socio-economic factors such as income, occupation, number of siblings, age, family size, household conditions, education level, and access to proper health care and education. These infections can lead to malnutrition, stunted growth, behavioral changes, cognitive impairment, poor academic performance, and anemia. Implementing several preventive measures can effectively control and prevent intestinal parasitic infections among basic school children. Such measures include promoting access to clean water and sanitation facilities, health education, and improved hygiene practices. Regular deworming programs and enhanced food safety measures are also vital components in the fight against these infections.

CHAPTER THREE

Materials and methods

3.1 study design

Selected localities in the Abuakwa-north district were included in a cross-sectional primary study, and samples collected for laboratory analysis.

3.2 study site

The study took place in three different basic schools located in the Abuakwa-north municipality, and the analysis was conducted at Saviour government hospital in Osiem. The study covered the areas of Osiem, Ayinasin, and Etukrom communities.

3.3 Inclusion and exclusion criteria

3.3.1 Inclusion criteria

Only basic school children aged 5 to 15 was included in the study, after obtaining signed written informed consent and filled questionnaires from their parents.

3.3.2 Exclusion criteria

The study excluded children above the age of 15, children who were taking anti-parasitic drugs within 3 weeks prior to the study, and children whose parents did not sign the consent forms.

3.4 Sample size determination

Using a 95% confidence interval, an estimated prevalence (p) of 17.8% (al-abd *et al.*, 2021; muhajir ae *et al.*, 2017) and an allowable margin of error (e) of 5%, the minimum sample size (n) will be determined using the following formula:

$$N = \frac{z^2(p)(1-p)}{e^2}$$

Where z= 1.96, standard normal deviate that corresponds to a 95% confidence interval

$$N = \frac{\mathbf{1.96^2\ (0.178)\ (0.822)}}{\mathbf{0.05^2}}$$

$$N = \mathbf{225}$$

3.5 Sampling technique

The sampling technique for the purpose of this work was simple random sampling. Simple random sampling is a method used in statistics to select a representative sample from a larger population. In this sampling technique, each individual in the population has an equal chance of being chosen for the sample. To conduct simple random sampling, researchers assign a unique identifier or number to each member of the population. They then use a random number generator or a table of random numbers to select individuals for the sample. This process ensures that every individual has an equal probability of being included in the sample. Simple random sampling is often employed when the population is relatively small or easily accessible. It helps minimize bias and allows researchers to make accurate inferences about the population based on the characteristics observed in the sample (kothari, 2019).

3.6 Data collection

A semi-structured questionnaire was utilized to collect data from study participants, which will include parameters such as demographic characteristics (education level), socio-economic parameters (such as income and employment status), and participants' knowledge on the importance of screening for parasites and deworming. The primary languages of communication during the questionnaire sharing were English and Twi. However, the assistance of an interpreter was sorted for any other languages.

3.7 Data analysis

Microsoft office excel 2016 was used to summarize data into frequency distribution tables. Descriptive analysis methods such as charts and graphs were used to analyze and illustrate the occurrence of various factors in the study. Statistical analysis spss and a p-value of <0.05 was considered statistically significant.

3.8 Laboratory analysis

3.8.1 Sample collection

Containers with a wide neck and leak-proof feature will be provided to parents of children. The containers will be labeled with the child's name, age, sex, and school. The parents will be educated

on the proper method of collecting stool samples before they are given the containers to assist with the collection of the samples.

3.8.2 Laboratory techniques

The laboratory techniques that were used to analyze the stool samples for parasitic identification were direct wet mount method and formol-ether concentration method.

3.9 Ethical Consideration

This research project aimed to investigate the prevalence of intestinal parasitic infections and their associated risk factors in basic school children in the Abuakwa-North District. As researchers, we recognized the importance of upholding ethical standards in conducting this study, ensuring the protection, well-being, and confidentiality of the participants. In this regard, we outlined the following ethical considerations:

Informed Consent:

Prior to the commencement of the study, informed consent was obtained from the parents or guardians of the basic school children. They were provided with detailed information about the study's purpose, procedures, potential risks and benefits, and their right to withdraw at any time without any negative consequences.

Confidentiality:

All data collected during the study was treated with strict confidentiality. Personal identifiers were removed and replaced with unique codes to ensure anonymity. Access to data was restricted to authorized personnel only, and the information was used solely for the purpose of the study.

Beneficence:

Measures was taken to minimize any potential harm or discomfort associated with the research.

Protection of Vulnerable Populations:

The research procedures were designed to be age-appropriate and non-invasive. Moreover, the study was conducted in collaboration with relevant education authorities and did not disrupt the participants' regular academic activities.

Data Integrity and Reporting:

The research findings were reported accurately and honestly, and ensured the integrity of the data collected. Results were presented in aggregate form, without identifying individual participants.

Ethical review: Ethical clearance was obtained from the relevant institution ethics committee before commencing the study (World Medical Association, 2013)

3.91 Dissemination of Results

The results of the study were presented through a departmental presentation at the Koforidua Technical University's department of Medical Laboratory Sciences in Koforidua. Additionally, a manuscript was prepared and submitted to a peer-reviewed journal for publication.

CHAPTER FOUR

4.0 Results and Interpretations

The table below shows the respondents' demographic characteristics. Gender and age were the much-focused demographic characteristics in the study. Out of the total 225 study participants, females were 135 (60%) out-numbering the males who were 90 (40%). The age categories in the study were also recorded. Participants below the ages of 10 years were few 54 (24%) as compared to those above 10 years of age being the majority 171 (76%).

Table **4.1: Respondents' Demographic Characteristics**

N=225

Socio-Demographic	Frequencies	Percentage (%)
Gender		
Male	90	40
Female	135	60
Age		
4-5 years	3	1.3
8-9 years	51	22.7
10-11 years	76	33.8
12-13 years	72	32
14-15 years	23	10.2

Source: Field survey, Mary and Husseni (2023)

The figure below shows the results of the parasitic infection among the study participants. Altogether, participants that tested positive to any of the parasitic infection were 80 giving a prevalence of 35.6% for the study. 145 participants did not test positive to any of the parasitic infection and accounted for 64.4% of the study population. The study recorded 35.6% prevalence of parasitic infection among the children who were the target population.

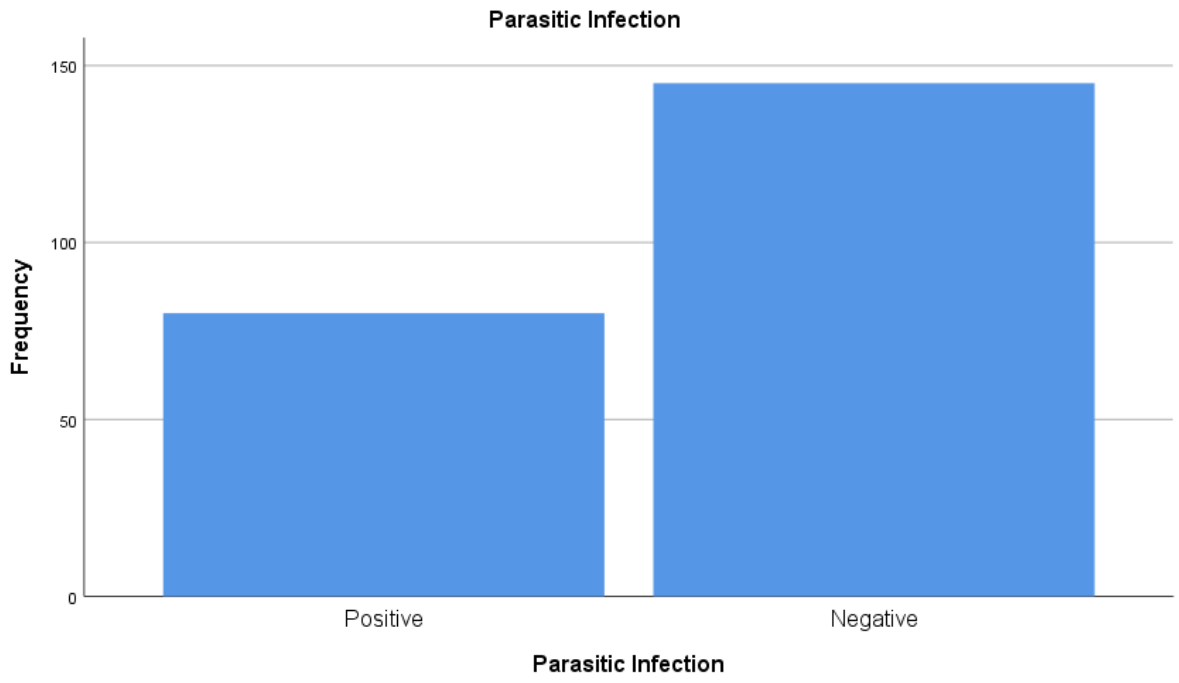

Figure 4.1 Showing the results of the parasitic infection among the study participants.

The table below shows the distribution of parasitic infection among respondents' demographic characteristics. The demographic characteristics used in the study were age and gender. The

distribution of the parasitic infection in general did not significantly see any association between these variables (age and gender). For each of the age categories in years and gender, distribution of the parasitic infection all had p-values >0.05 which is statistically not significant in establishing an association between the infection and the demographic variables used in this study. The total number of parasitic infections among males for both positive and negative results were 34 (15%) and 56 (24.9) respectively. 46 (20.4%) were positive and 89 (40%) were negative for parasitic infection among the female participants

4.2 Distribution of Parasitic Infection among Respondents' Demographic Characteristics

N=225

	Parasitic Infection				
Socio-Demographic	**Positive (%)**		**Negative (%)**		**P-value (X^2)**
Gender	Male	Female	Male	Female	
Age					
4-5 years	1	2	0	0	
8-9 years	1	14	11	25	0.67
10-11 years	14	11	19	32	0.121
12-13 years	9	17	17	29	0.843
14-15 years	9	2	9	3	0.692
Total	34	46	56	89	0.573

Source: Field survey, Mary and Husseni (2023)

The table below shows the identification of the various parasites found in the samples of the participants. Below is the detailed of the various prevalence of parasitic infection among the target population.

4.3: Identification of Parasitic Organisms among the study participants

N=80

	Frequency	Percentage (%)
Gender		
Ascaris *lumbricoides*	6	2.7
Balantidium *coli*	14	6.2
Entamoeba *histolytica*	12	5.3
Entamoeba *histolytica* & Balantidium *coli*	2	0.9
Giardia *lambia*	35	15.6
Giardia *lambia* & Ascaris *lumbricoides*	2	0.9
Giardia *lambia* and Entamoeba *histolytica*	9	4
Total	80	100

Source: Field survey, Mary and Husseini (2023)

The table below shows the risk factors and their odds association with parasitic infection. The risk factors included in the study were; handwashing with soap and water, handwashing before eating, eating unwashed fruits, sucking one's fingers, biting one's fingers, walking barefooted and eating

white clay or sand. The odds of a participant not washing hands with soap and water for possible parasitic infection was 1.104 (05.91-2.062) with p-value 0.757 and also not washing hands before eating was 1.468 (0.819-2.631) with p-value 0.196 which were all not significant with the parasitic infection. Odds for eating unwashed fruits which was 1.347 (0.731-2.481) with p-value 0.339 also saw no significant association with the infection. Equally, there were no significant odds for participant who suck their fingers 0.963 (0.544-1.705) p-value 0.897, those who bite their fingers 1.177 (0.620-2.233) p-value 0.618, those who walked barefooted 0.786 (0.444-1.392) p-value 0.409 and ate white clay and sand 1.683 (0.332-8.542) p-value 0.525 with the infection. None of the risk factors considered in this study saw any significant association for possible parasitic infection.

Table **4.4: Risk factors and their odds association with parasitic infection**

Characteristics	AOR	95% CI	p-value
Hand washing with soap and water			
No	1.0(reference)		
Yes	1.104	(0.591-2.062)	0.757
Handwashing before eating			
No	1.0(reference)		
Yes	1.468	(0.819-2.631)	0.196
Do you eat unwashed fruits			
No	1.0(reference)		
Yes	1.347	(0.731-2.481	0.339
Do you suck your fingers			
No	1.0(reference)		

Yes	0.963	(0.544-1.705)	0.897
Do you bite your fingers			
No	1.0(reference)		
Yes	1.177	(0.620-2.233)	0.618
Do you mostly walk barefooted			
No	1.0(reference)		
Yes	0.786	(0.444-1.392)	0.409
Do you eat white clay or rocks			
No	1.0(reference)		
Yes	1.683	(0.332-8.542)	0.525

Source: Field survey, Mary (2023)

4.5 DISCUSSION

4.5.1 To Determine the Prevalence of Intestinal Parasitic Infections Among Basic School Children in The Abuakwa-North District.

The research involved 225 participants aged 5 to 15, all of whom were elementary school students. The gender distribution among these students showed that 60% were female, while 40% were male. When we examined the age groups, we found that those below 10 years old constituted a smaller portion, accounting for 24%, whereas those above 10 years old made up the majority at 76%. Among the study participants, 80 school children tested positive for parasitic infections, representing a total prevalence of 35.6% for these infections within the group. Remarkably, 64.4% of the study population tested negative for any parasitic infections among the participants. This indicates that less than half of the study population had intestinal parasitic infections, even though the prevalence was relatively high

Similarly, in another study involving 996 preschoolers and school children, their stool samples were examined, revealing a significant prevalence of intestinal parasites. Out of these participants, 460 individuals, constituting 46.2% of the total, were found to be infected with intestinal parasites (Elmonir *et al.,* 2021).

Additionally, there was a lower prevalence than our study in separate research conducted in Iran with a cohort of 203 participants where it was revealed that, approximately 25.1% of the children included in the study had been diagnosed with at least one variety of intestinal parasite, indicating a relatively high prevalence of intestinal parasitic infections within the studied population. (Barazesh *et al.,* 2016).

In another research investigation involving 645 children, a notably elevated prevalence of intestinal parasitic infections (IPIs) was observed. Among the total participants, a substantial 341 individuals, representing a significant proportion of 52.9% were identified as having contracted one or more parasitic organisms, underlining the substantial incidence of these infections within this particular study population (Hailu & Ayele, 2021) and was similar to another research which

was conducted in the Democratic Republic of Sao Tome and Principe, where elementary school children unveiled a strikingly high prevalence rate of 64.7% for intestinal parasitic infections (IPIs) (Liao *et al.,* 2016).

Other findings have also reported a lower prevalence in their population. This includes a study by (Turki *et al.,* 2017) which comprised of 1,465 basic school children with a 6.5% prevalence of IPIs among the participants suggesting a lower prevalence in that population.

Differences in these findings may possibly be due to race, rate of deworming, poor sanitation and inadequate hygiene habits.

4.5.2 To Determine the Distribution of Parasitic Infection among Respondents' Demographic Characteristics

The study employed age and gender as the demographic variables of interest. However, the analysis of the distribution within each age and gender category did not yield statistically significant results in terms of establishing a relationship.

All the available socio-demographic characteristics examined in the study exhibited p-values exceeding the threshold of 0.05, indicating a lack of statistical significance in these relationships. The p-values for the association between age and parasitic infection range from 0.121 to 0.843 for the different age categories. All of these p-values are greater than 0.05, indicating that there is no statistically significant association between age and parasitic infection within these age groups.

There is no statistically significant association between gender and parasitic infection among the respondents in this study. In other words, the likelihood of being positive or negative for parasitic infection does not appear to differ significantly between males and females.

This agrees with a study by (Gbonhinbor *et al.,* 2022) in Southern Nigeria where there was no statistically significant distinction between males and females, as indicated by a p-value of 0.647, which is greater than the threshold of $P < 0.05$. Again, gender difference with a p-value > 0.1451 was not a statistically significant character in another study among school children in Accra-Ghana (Forson *et al.,* 2017) whereas both age and gender categories were all having p-value > 0.05 in a study among some primary school children in Northwest Ethiopia (Getnet *et al.,* 2022) .

4.5.3 To Identify the Parasitic Organisms Among the Study Participants

Table 4.3 presents the types of parasitic species that were positive irrespective of gender among 80 of the 225 participants that tested positive for at least one of intestinal parasites. In total, four different parasites were identified: Ascaris *lumbricoides*, Giardia *lamblia*, Balantidium *coli*, and Entamoeba *histolytica*. Giardia lamblia emerged as the most prevalent parasite, with 35 cases, constituting 15.6% of the total sample. Following closely was Balantidium coli, identified in 14 participants, accounting for 6.2%. Entamoeba *histolytica* was the third most common parasite, affecting 12 individuals, or 5.3% of the sample and Ascaris *lumbricoides* had 2.7% affecting 6 participants. Among the co-infections, Giardia *lamblia* and Entamoeba *histolytica* co-infection was observed in 9 participants, making up 4% of the total. On the other hand,both Giardia *lamblia* and Ascaris *lumbricoides* co-infection and Giardia *lamblia* and Balantidium *coli* had the lowest prevalence, affecting only 2 individuals each, which constituted 0.9% each of the sample. This data underscores the importance of continued efforts in public health and sanitation to reduce the prevalence of these parasitic infections in the target population.

In a separate study, a cross-sectional survey was conducted among school children residing in a suburb of Accra, Ghana. The results revealed that the prevalence of *Giardia lamblia* infection was 10%, affecting 30 participants. Following this, *Schistosoma mansoni* was found in 1.7% of the participants, affecting 5 individuals. *A. lumbricoides* had a prevalence of 1%, affecting 3 schoolchildren, while *E. coli/dispar* also affected 1% of the participants, with 3 individuals being affected. *Hymenolepis nana* had a prevalence of 0.3%, affecting only 1 participant, and *Strongyloides stercoralis* had the same prevalence of 0.3%, affecting only 1 participant. Out of the 45 students who tested positive for intestinal parasites, 41, which represents 13.6%, had a single parasitic infection. Additionally, 4 students, or 1.3%, had dual parasitic infections. Notably, these dual infections were observed in three males and one female (Forson *et al.*, 2017).

In a cross-sectional study conducted in the Northwest of Ethiopia, researchers examined 304 school children to determine the prevalence of intestinal parasitic infections (IPIs). The results revealed that *Hymenolepis nana* infection was present in 42 children (13.8%), followed by *Entamoeba histolytica/dispar* in 28 children (9.2%). *Hymenolepis nana*, *Entamoeba histolytica/dispar*, and *Ascaris lumbricoides* were identified as single infections in 35 children (11.5%), 22 children (7.2%), and 12 children (3.9%), respectively. Moreover, 88 students (28.9%)

had single infections, while 8 students (2.6%) had double infections, and 6 students (2.0%) had triple infections. Double infections consisted of combinations such as *Trichuris trichiura with Hymenolepis nana, Ascaris lumbricoides* with *Hymenolepis nana, Ascaris lumbricoides* with hookworm, and *Giardia intestinalis* with *Entamoeba histolytica/dispar*, accounting for 4 (1.3%), 3 (1.0%), 3 (1.0%), and 4 (1.3%) of the cases, respectively. *Ascaris lumbricoides* and *Trichuris trichiura* were also found in combination with *Hymenolepis nana* and *Entamoeba histolytica/dispar* in triple infections (Gelaw *et al.*, 2013).

In another separate study in southwest of Ethiopia, researchers identified seven species of intestinal parasites. Among them, *Ascaris lumbricoides* was the most frequently found intestinal parasite, followed by *Trichuris trichiura, Giardia lamblia, Schistosoma mansoni, Hymenolepis nana* species, *Entamoeba histolytica/dispar*, and Hookworm, in that order. This study recorded a total of 9.9% (32 out of 323) cases of coinfections. These coinfections included *Ascaris lumbricoides* with *Trichuris trichiura* making 3.4% of the infection, *Trichuris trichiura* with *Schistosoma mansoni* making up to 2.8%, Hookworm and *Ascaris lumbricoides* with 1.5%, *Schistosoma mansoni* and *Entamoeba histolytica/dispar* with 1.2%, and *Entamoeba histolytica/dispar* with Hookworm being the least with 0.9% (Duguma *et al.*, 2023).

These findings contrast with our results although similar parasites were identified in all the studies. These may be due to several factors such geographical location, differences in sample sizes and methods that were used in the sampling.

4.5.4 To Determine the Risk Factors and Their Odds Association with Parasitic Infection

With the risk factors and their odds association with IPIs, our study established that there was no statistical significance between individual risk factors that expose the participants to parasitic infections and IPIs as a whole. The p-values for all the characteristics were above 0.05. However, individuals who do not wash their hands with soap had a 1.104 chance of getting IPIs than those that washes their hands with soap, those participants who do not wash their hands before eating had a 1.468 times higher risk of getting IPIs than those that washes their hands before eating, those who eat unwashed fruits had a 1.347 times higher chance of getting IPIs than those that eat washed fruits, and those who suck their fingers were not at risk of any IPIs or were even protected. However, individuals who bite their fingers had a

1.177 chance of getting IPIs than their participants that do not bite their fingers. Those who eat clay or rocks were at 1.683 times the risk of getting IPIs, and those who mostly walk barefoot were either protected or not at risk of any IPIs.

In contrast to our findings, a separate study involving elementary school children to assess intestinal parasitosis, several factors were examined for their association with the prevalence of these infections. The research revealed that individuals using untreated water had a notably increased risk of intestinal parasites, as indicated by a p-value of less than 0.001 (confidence interval: 3.9-12.1). Furthermore, those who did not practice handwashing after using the toilet and those who had a history of soil contact also exhibited heightened statistical significance for intestinal parasitic infections, with p-values of 0.01 and 0.05, respectively (confidence interval: 1.1-1.8). Conversely, the act of swimming in surface water did not demonstrate any statistically significant correlation (p=0.2). Notably, there was an exceptionally strong statistical association observed among individuals who did not wash vegetables before consumption, with a p-value less than 0.001 (Elmonir *et al.*, 2021).

In another study involving school children, notable adjusted odds ratios (AOR) were observed for various factors related to IPIs. Students who did not practice handwashing toilet had an AOR of 3.137, while those who defecated in open fields had an AOR of 4.747. Consuming unwashed fruits and vegetables was associated with an AOR of 1.77, and drinking unprotected well water resulted in an AOR of 2.054. Furthermore, having dirty untrimmed fingernails had an AOR of 4.2 and those that do not like wearing shoes had an AOR of 6.889. Those that defecate in open fields and those that do not keep their fingernails cleans had higher significant values for IPIs (Sitotaw & Shiferaw, 2020).

This finding although had much higher odds ratio than ours but they all agree to similar trend. Any variations could arise from a range of factors, including geographic location, disparities in sample sizes, and variations in the sampling methods employed.

CHAPTER FIVE

5.1 CONCLUSION

The study encompassed 225 participants, aged 5 to 15, all of whom were elementary school students. Among these students, the gender distribution showed that 60% were female, while 40% were male. The research found a parasitic infection prevalence of 35.6% among the targeted child population. Notably, both age and gender did not demonstrate statistical significance within this study. In total, four distinct parasites were identified, namely Ascaris lumbricoides, Giardia lamblia, Balantidium coli, and Entamoeba histolytica. Among the study participants, Giardia lamblia was the most prevalent at 15.6%, followed by Balantidium coli at 6.2% and Entamoeba histolytica at 5.3%. Co-infection with Giardia lamblia and Entamoeba histolytica was observed in 4% of the cases, while co-infection with Giardia lamblia and Ascaris lumbricoides had a low prevalence of 0.9% among the study participants. None of the risk factors examined in this study showed a significant association with potential parasitic infection.

5.2 RECOMMENDATIONS

- To enhance the comprehensiveness of the study on intestinal parasite infections among basic school children, future research should consider expanding the sample size to encompass a more diverse population, potentially including schools from different geographical regions or socioeconomic backgrounds.
- Investigating the long-term health and educational impacts of intestinal parasite infections on basic school children could be an essential avenue for future research. Longitudinal studies tracking these children's progress could help policymakers and healthcare providers implement more effective intervention strategies.
- Future research should explore the potential risk factors and transmission patterns of intestinal parasites within the school environment. This may involve investigating sanitation practices, water sources, and hygiene behaviors to provide a more comprehensive understanding of the issue

- Examining the effectiveness of different deworming programs and interventions could be a valuable area of research. A comparative analysis of various deworming strategies, including their cost-effectiveness and sustainability, would help inform future public health initiatives.
- To gain a deeper understanding of the prevalence of specific types of intestinal parasites and their variations across different age groups, additional research could be conducted. Focusing on specific age categories within the basic school population could reveal age-related patterns and guide age-targeted interventions.

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APPENDICES

PARENTAL CONSENT FORM.

Title of Study:	PREVALENCE OF INTESTINAL PARASITIC INFECTIONS AND THEIR ASSOCIATED RISK FACTORS IN BASIC SCHOOL CHILDREN IN THE ABUAKWA-NORTH DISTRICT.
Principal Investigators	Asante Mary HUSSENI SHAMSUDEEN BAMEYISHEALLAH
Certified Protocol Number	

Introduction:

We are conducting a research study on the prevalence of intestinal parasitic infections and their associated risk factors in basic school children in the Abuakwa-North District. This study aims to determine the prevalence of intestinal parasitic infections and identify associated risk factors among basic school children in the Abuakwa-North District.

Purpose of research:

The purpose of this study is to gather information about the prevalence of intestinal parasitic infections among basic school children in the Abuakwa-North District, as well as to identify any factors that may be associated with the presence of these infections. This information will help researchers and public health officials better understand the burden of these infections and develop effective prevention and control measures.

Participant's role:

If you decide to participate in this study, your child will be asked to provide a stool sample for laboratory analysis. Additionally, your child will be asked to answer a questionnaire that covers topics such as their hygiene habits and dietary habits.

Benefits/Risks of the study:

There are no direct benefits to participation in this study. However, the information gathered will help researchers and public health officials better understand the burden of intestinal parasitic infections among basic school children in the Abuakwa-North District. There are no known risks associated with providing a stool sample or completing the questionnaire. However, your child may experience mild discomfort or embarrassment when providing the stool sample.

Confidentiality:

All information collected during this study will be kept strictly confidential and anonymous. Your child's name will not be included in any reports or publications arising from this study. Access to the data will be restricted to the research team.

Compensation: There will be no financial compensation for participating in this study.

Withdrawal from Study: Participation in this study is entirely voluntary. If you decide to allow your child to participate, you may withdraw your child from the study at any time without any consequences.

What happens after study or when the participant changes his/her mind?:

After the study is completed, the results will be analyzed and published in a peer-reviewed journal. If you have any questions about the results, you can contact the research team for more information. If your child withdraws from the study or you change your mind about participation, any data collected up to that point will be destroyed and not used in the study.

Contact for Additional Information

Mr. Hubert Maxwell Antwi
Koforidua Technical University,
KF-981, Koforidua.
Department of Medical Laboratory Sciences, KTU

If you have any questions about your rights as a research participant in this study you may contact the Administrator of the Research Ethics Committee of the Department

PARTICIPANT AGREEMENT.

"I have read or have had someone read all of the above, asked questions, received answers regarding participation in this study, and am willing to give consent for me, my child/ward to participate in this study. I will not have waived any of my rights by signing this consent form. Upon signing this consent form, I will receive a copy for my personal records."

_____

Name of Participant

_____ _____

Signature or mark of Participant Date

If participant cannot read and or understand the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

_____

Name of witness

_____ _____

Signature of witness / Mark Date

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

_____

Name of Person who Obtained Consent

_____ _____

Signature of Person Who Obtained Consent Date

CHILD ASSENT FORM

NAME OF INVESTIGATORS:

ASANTE MARY (B500210416)

HUSSENI SHAMSUDEEN BAMEYISHEALLAH (B500210459)

Introduction:

We invite your child to participate in a research study on the prevalence of intestinal parasitic infections and their associated risk factors in basic school children in the Abuakwa-North District. This study is being conducted by researchers from Koforidua Technical University.

Purpose of research:

The purpose of this study is to gather information about the prevalence of intestinal parasitic infections among basic school children in the Abuakwa-North District, as well as to identify any factors that may be associated with the presence of these infections. This information will help researchers and public health officials better understand the burden of these infections and develop effective prevention and control measures.

Participant's role:

If you decide to allow your child to participate in this study, your child will be asked to provide a stool sample for laboratory analysis. Additionally, your child will be asked to answer a questionnaire that covers topics such as their hygiene habits and dietary habits.

Benefits/Risks of the study:

There are no direct benefits to participation in this study. However, the information gathered will help researchers and public health officials better understand the burden of intestinal parasitic infections among basic school children in the Abuakwa-North District. There are no known risks associated with providing a stool sample or completing the questionnaire. However, your child may experience mild discomfort or embarrassment when providing the stool sample.

Confidentiality:

All information collected during this study will be kept strictly confidential and anonymous. Your child's name will not be included in any reports or publications arising from this study. Access to the data will be restricted to the research team.

Child's Consent:

I understand that the purpose of this study is to gather information about the prevalence of intestinal parasitic infections and their associated risk factors among basic school children in the Abuakwa-North District. I have been informed that participation in this study is entirely voluntary and that I may withdraw my child from the study at any time without any consequences.

I have read the above information and have had the opportunity to ask any questions that I may have. I give permission for my child to participate in this study.

Parent or Guardian's Consent:

I have read and understand the above information about this research study. I have had the opportunity to ask any questions that I may have. I give permission for my child to participate in this study.

Signature: _____

Name: _____

Date: _____

VOLUNTARY AGREEMENT

By signing or thumb printing below, it means that you:

- have understood what you will be doing for this study,
- have had all your questions answered,
- have talked to your parent(s)/legal guardian about this project, and
- agree to take part in this research

If you do not want to participate in this study, please **do not** sign or thumb print this assent form.

You and your parents will be given a copy of this form after you have signed/thumb printed it.

Child's Name: _____ **Researcher's Name: _____**

Child's Sign/Thumbprint: _____ **Researcher's Signature: _____**

Date: _____ Date: _____

QUESTIONNAIRE

PREVALENCE OF INTESTINAL PARASITIC INFECTIONS AND THEIR ASSOCIATED RISK FACTORS IN BASIC SCHOOL CHILDREN IN THE HO MUNICIPALITY.

Consent: As a participant in this study, do you give your consent for researchers Asante Mary (B500210416) and Husseni Shamsudeen Bameyisheallah (B500210459) to use your responses for the purpose of the study?

I have given my consent to take part in this study. Yes ☐ No ☐

Code …… Date ……/……/…….

General demographic information of respondents **(please tick those that apply)**		
1	Gender	Male ☐ Female ☐
2	Age	……..
3	Residence	……..
4	Class level	Lower primary ☐ Upper primary ☐ (1-3) (4-6) Others ……..…
5	Parental occupation	……..……..…
Hygiene Habits		
6		Yes ☐ No ☐ Sometimes ☐

	Do you often do you wash your hands with soap and water?	
7	If yes, with what?	Water ☐ Soap and water ☐
8	Do you wash your hands before eating?	Yes ☐ No ☐ Sometimes ☐
9	If yes, with what?	Water ☐ Soap and water ☐
10	Have you ever been taught about the importance of hand washing and tooth brushing?	Yes ☐ No ☐
11	What type of toilet facility do you use?	Water closet ☐ Pit latrine ☐ Nearby bush ☐ Public toilet ☐
12	Do you eat unwashed fruits?	Yes ☐ No ☐ Sometimes ☐
13	Do you suck your fingers?	Yes ☐ No ☐ Sometimes ☐
14	Do you bite your nails?	Yes ☐ No ☐ Sometimes ☐
15	Do you walk barefooted?	Yes ☐ No ☐ Sometimes ☐
16	Do you eat white clay or rocks?	Yes ☐ No ☐ Sometimes ☐
17	If yes, how often?	Everyday ☐ 3-5 times a week ☐ <3 times a week ☐
18	When was your last deworming date?	< or = 3 months ☐ 4 months ☐ 7-12 months ☐ Not at all ☐
Clinical signs and symptoms		

19	Do you experience abdominal pains?	Yes ☐ No ☐ Sometimes ☐
20	If yes, how often?	Everyday ☐ 3-5 times a week ☐ <3 times a week ☐
21	Do you experience fatigue or weakness?	Yes ☐ No ☐ Sometimes ☐
22	If yes, how often?	Everyday ☐ 3-5 times a week ☐ <3 times a week ☐
23	Do you often feel any nausea or feel like vomiting?	Yes ☐ No ☐ Sometimes ☐
24	If yes, how often?	Everyday ☐ 3-5 times a week ☐ <3 times a week ☐
Knowledge about causes of intestinal parasites		
25	Do you know about intestinal worms?	Yes ☐ No ☐
26	If yes, What do you know about them?	……
27	How do you get infected by these parasites?	

		……
28	How can you prevent yourself from being infected?	……
29	Do you visit any facility when you experience nausea vomiting or diarrhea?	Yes ☐ No ☐

Thank you for your participation. Your responses will help us better understand the prevalence of intestinal parasitic infections and their associated risk factors among basic school children in the Abuakwa-North District.

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BY:

MARY ASANTE AND HUSSEINI SHAMSUDEEN RAMEYDHEALLAH

OCTOBER, 2023

SUPERVISOR

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