KOFORIDUA TECHNICAL UNIVERSITY

FACULTY OF HEALTH AND ALLIED SCIENCES

DEPARTMENT OF MEDICAL LABORATORY SCIENCE

INTESTINAL PARASITIC INFECTIONS AMONG CHILDREN IN SELECT SCHOOLS IN GBAWE, GA SOUTH MUNICIPALITY

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I hereby declare that this research is the result of my own original research and that no part of it has been presented for another certificate in this Institution or elsewhere.

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SUPERVISOR'S DECLARATION

I hereby declare that this project work was supervised in accordance with the University's guidelines for supervision of project work.

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DEDICATION

This project is dedicated to God Almighty. We are also grateful to our families and friends who have been of immense support throughout this journey.

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We would like to thank the Management of Koforidua Technical University for the opportunity extended us to transform our lives through education. Our unreserved gratitude also goes to our supervisor, Mr. Seth Tenkorang Boateng for his guidance, supervision and tolerance throughout the writing of this project.

ABSTRACT

Background

Intestinal parasitic infections (IPIs) are primarily caused by helminths and protozoa, with underdeveloped nations experiencing higher prevalence due to factors like poverty, poor hygiene, contaminated water, sanitation issues, overcrowding, and limited education. These infections can result in vitamin and mineral deficiencies, weakened immunity, stunted growth, and cognitive impairment, especially in children. Notably, IPIs can be asymptomatic for extended periods, and the appearance of symptoms depends on the host's age and the infection's intensity. The prevalence of IPIs is a significant health concern in underdeveloped nations, with rates as high as 54.5% to 81% among children of school-going ages.

Objective

The study aimed to investigate intestinal parasitic infections among school children in selected schools in Gbawe, Ga South Municipality.

Methods

This study was conducted in Gbawe, Ghana, to assess the prevalence of intestinal parasitic infections among school children aged 5-10 years. A cross-sectional design was used, and a sample size of 197 participants was selected. Stool samples were collected and analyzed using the wet mount and formalin-ethyl sedimentation procedures. Statistical analysis was performed using Chi-squared and odds ratios to assess the association between exposure variables and infection

Results

The study found that 9.64% of the children had intestinal parasitic infections. The prevalence was higher in older children (7-10 years) compared to younger ones (5-6 years). *Ascaris lumbricoides* was the most common parasite (3.55%), followed by *Entamoeba histolytica* (2.54%). Females had a slightly higher prevalence (12.50%) than males (7.34%). Statistically significant risk factors for infection included consuming unwashed fruits and vegetables, living near a refuse dump, and frequent playing in the soil.

Conclusion

The authors recommend comprehensive public health programs to reduce the prevalence of IPIs, including improved sanitation, hygiene education, and regular deworming.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Intestinal parasites that cause infections in humans belong to two common groups – helminths and protozoa. The most common helminth species are roundworms, also known as *Ascaris lumbricoides*, whipworms also known as *Trichiuris trichiuria*, and hookworms such as *Ancylostoma duodenale* and *Necator americanicus.* Parasites of the protozoa group include *Cyclospora cayetanenensis, Giardia intestinalis* and *Entamoeba histolytica* (Haque, 2007). While helminths are usually soil-transmitted (STHs), consumption of contaminated food or water are the common means by which protozoan intestinal parasites are transmitted (Berhe et al., 2018). Hajare et al. (2021) attribute the prevalence of intestinal parasitic infections (IPIs) to poverty and a lack of personal hygiene. Besides, contaminated water, a lack of proper environmental sanitation, overcrowding and lacking education have also been identified as factors responsible for the prevalence of IPIs (Abate et al., 2013). Climatic factors including humidity and hot tropical weather have been observed in some studies and may be attributed to the prevalence of IPIs (El-Sherbini & Abosdera, 2013).

In both adults and children, IPIs can cause vitamin and mineral deficiencies, weaken the immune system (Alum et al., 2010) and lead to stunted growth (Bisetegn et al., 2023) and cognitive impairment (Ezeamama et al., 2005) in children. Interestingly, Bundy et. al (1992) observed that persons with IPIs may not show symptoms for prolonged periods. Consequently, the manifestation of symptoms depends on age of the host and the intensity of the infection.

Currently, about 24% of the world's total population exhibit symptoms of STHs. Besides, more than 1.16 billion persons at risk of STHs mainly because of their environmental dispositions. Of these, 260 million are less than 5 years old, 654 million are young school-going children, 108 million are adolescent girls and 138.8 million are either pregnant or lactating (*Soil-transmitted helminth infections* 2023). Additionally, some 3.5 billion persons around the world have intestinal infections caused by protozoa (Eslahi et al., 2023). In developed nations, IPIS are commonly caused by protozoa rather than helminths (Siddiqui, 2017). Morgan et al. (1998) observed that the protozoa *Giardia lamblia* is the leading cause of diarrhoea in developed nations. *Cryptosporidium*, which causes impaired intestinal absorption, *Dientamoeba fragilis* which causes varying degrees of abdominal upsets, and *Entamoeba histolytica* which causes colitis, dysentery and liver abscess have also been found in developed nations including Netherlands and parts of Asia.

In underdeveloped nations, IPIs have emerged as a significant health concern, with various studies highlighting their prevalence. For instance, a study conducted in northwestern Ethiopia by Workneh et al. (2014) reported an alarmingly high IPI prevalence of 84% among students at Debre Elias Primary School. In another study, Dejenie et al. (2010) found a comparatively lower overall IPI prevalence rate of 26.53% in Mekelle town, located in the Tigray Region of northern Ethiopia. Additionally, different regions within Ethiopia have also reported varying prevalence rates of IPIs among primary school children, ranging from 54.5% to 81%, as documented in the research by Mathewos et al. (2014). Furthermore, a study by Mirisho et al. (2017) revealed that approximately 15% of children aged 2 to 8 years living in a suburb of Accra, Ghana, were infected with intestinal parasites. These findings underscore the pressing need for effective public health interventions in these areas to combat the prevalence of IPIs and protect the health and well-being of vulnerable populations. This study therefore seeks to supplement existing knowledge by identifying microorganisms associated with infections, as well as prevalence and risk factors among school children in select schools in Gbawe, Ga South Municipality of Accra.

1.2 Statement of the Problem

Sanitation and health issues in Gbawe (Opoku & Ansa-Asare, 2007), and Ghana as a whole have been documented in various literature. Besides personal hygiene practices have also been lacking especially among low-income earners and those with lower levels of education (Odonkor et al., 2019; Oppong et al., 2019). These personal hygiene inadequacies were particularly evident during the recent Covid-19 pandemic when handkerchiefs, headgears and other clothing items were used as substitutes for nose masks (Bonful et al., 2020). Furthermore, Teunis et al. (2016) found out that child behaviour such as spending more time playing on the ground was associated with fecal contamination resulting in childhood-diarrhoea and other environment-related morbidities.

Currently, efforts to deal with IPIs in Ghanaian school children have been primarily carried out by the Ghana Health Service in their "Annual School-Age Deworming Exercise." This program is jointly sponsored by the Ghana Education Service (GES) and the United States Agency for International Development (USAID). The goal of the program has been to improve academic performance by improving children's school attendance which would have otherwise suffered due to worm infestation-related illness (GHS, 2023). However, we believe this intervention falls short of a comprehensive approach to dealing with the problem given the cost and frequency constraints of the current program. There is a risk of long-term cognitive impairment, stunted growth and poor academic performance in children (Hernández et al., 2019; Bisetegn et al., 2023) if IPIs are not tackled in a much more aggressive manner. Thus, both parents and children stand to lose. To this end, it has become imperative to ascertain the prevalence of intestinal parasitic infections among school children in Gbawe – firstly to raise awareness about the problem and secondly, to drive concerted and comprehensive efforts that provide long-term solutions to address the problem.

1.3 Objectives of the Study

1.3.1 General Objective

To investigate intestinal parasitic infections among children in selected schools in Gbawe, Ga South Municipality.

1.3.2 Specific objectives

- To determine the prevalence of intestinal parasitic infections among children in selected schools in Gbawe, Ga South Municipality.
- To identify microorganisms associated with intestinal parasitic infections among the school children.
- To determine the risk factors of the intestinal parasitic infection among the school children

1.4 Research Questions

- What is the prevalence of intestinal parasitic infections among children in the selected schools in Gbawe, Ga South Municipality?
- What microorganisms are associated with intestinal parasitic infections among the school children?
- What are the risk factors associated with intestinal parasitic infections among the school children?

1.5 Significance of the Study

IPIs in children have been linked to long-term cognitive impairments, stunted growth and poor academic performance. Existing literature that discusses the prevalence of IPIs in the Ga South Municipality are severely limited. This study therefore seeks close the gap by determining the prevalence of IPIs in Gbawe, Ga South Municipality. We hope that the study will provide a foundation for the development of concerted and comprehensive interventions towards addressing the problem. Besides, this study may provide supplementary knowledge for future researchers.

1.6 Scope

The study involves the collection of stool samples from school children between the ages of 5 and 10 years in Gbawe, Ga South Municipality to investigate the prevalence of intestinal parasitic infections. The study aims to drive concerted and comprehensive interventions toward improving child health.

1.7 Limitations

We did not directly interview parents of participants on environmental or other hygienic conditions at home. This could have provided more insight on the possible exposures and causative factors of IPIs attributable to the home.

CHAPTER TWO

LITERATURE REVIEW

2.1 Prevalence of Intestinal Parasitic Infections Among Children in Ghana

Abaka-Yawson et al. (2020) performed a study involving 152 children below the age of 5 years. The study participants were selected from Dodi Papase in the Oti region. The Kato-Katz technique was used as the primary method of stool examination. The study found that 44.08% of the children were infected with intestinal parasites, with *Ascaris lumbricoides* being the most prevalent (20.39%), followed by Hookworm (13.16%) *and Trichuris trichiura* (10.53%). The prevalence of parasitic infections varied by age, with the highest prevalence in 4-year-old children. Children living in Muslim-dominated communities had a higher prevalence of infection. The study also examined the relationship between parasitic infection and anemia, and found out that total anaemia prevalence summed up to 35.53% of the children while 17.11% had been diagnosed with both IPI and anaemia.

In the Greater Accra region of Ghana, Forson et al. (2018) investigated the prevalence of IPIs and their relationship with socio-demographic factors in school children living in overcrowded urban slums. The study involved 300 participants selected at random from the Accra Metropolitan area. The study found that the overall prevalence of IPIs in school children aged 2 to 9 years was 15%, with both protozoan (*Giardia lamblia and Entamoeba coli*) and helminth (*Ascaris lumbricoides, Schistosoma mansoni, Taenia species, Hymenolepis nana, Strongyloides stercoralis*) parasites detected. Children aged 5, 6, and 7 years were more commonly infected with IPIs. However, the authors determined that parents' education levels and occupations were not significantly associated with the prevalence of IPIs in their children. Children from families with more household members were more likely to be infected with intestinal parasites, indicating a potential link between overcrowded living conditions and parasitic infections. Most parents lacked knowledge of IPIs, and children from parents with no knowledge of these infections were more often infected.

Similarly, in a study involving 150 children in the Ho Municipality of Ghana, Kpene et al. (2020) observed that the prevalence of IPIs was 14%, with rural communities having a higher proportion of infestations compared to urban communities. The authors identified place of residence, age, ingestion of raw vegetables, and drinking water quality as key risk factors associated with IPIs. Several parasites, including *Cryptosporidium* spp., *Entamoeba spp, C. cayetenensis, A. lumbricoides, S. stercoralis*, and *G. lamblia* were identified in the stool samples of participants. Unlike Forson et al., the authors identified associations between IPIs and the lower educational status of mothers. They also identified associations between IPIs and rural residence. The authors concluded that children living in rural areas were more likely to have IPIs, while those with mothers having higher education had a lower risk.

Furthermore, a polyparasitic study by Orish et al. (2019) involving 550 primary school children between the ages of 6 and 14 years in the Volta Region of Ghana found a high prevalence of *P. falciparum* (69.6%), low levels of intestinal parasites (4.18%), and a 10.36% prevalence of *S. haematobium* infections. Polyparasitic infections were relatively low, with the predominant coinfection being *P. falciparum* and *S. haematobium*. These coinfections were more common in rural areas, particularly among children in the Afegame primary school, and were associated with a high prevalence of anaemia (18.54%).

In another study, Akenten et al. (2022) aimed to assess the historical prevalence of helminth infections in Ghana using real-time PCR from frozen DNA samples collected from children in the Ashanti Region between 2007 and 2008. The study found low overall prevalence rates for most helminths, with *Strongyloides stercoralis* and *Necator americanus* being the most common. Some other helminths were rarely detected, and co-infections were infrequent. Associations between helminth infections and factors like diarrhea and malaria were examined, but the data did not show significant correlations. The study had some limitations, including the lack of microscopic confirmation of results and the absence of comprehensive demographic and socioeconomic data.

In the South Tongu District in the Volta Region of Ghana, Ayeh-Kumi et al. (2016) conducted a study during the annual rainy season from April to July in 2012. The study involved four primary schools and children aged 6-13 years. A total of 404 children participated in the study, and about 94% of them had received anti-helminthic drugs in the previous 3 months. The prevalence of asymptomatic malaria was determined to be 9.2%, with Plasmodium falciparum being the sole causative species while urinary schistosomiasis had a prevalence of 2.5%. Interestingly, intestinal helminths were not identified among the children although some children suffered from malnutrition, stunting, underweight, and anemia. Stunted malnutrition was however significantly associated with both *P. falciparum* and *S. haematobium.*

2.2 Organisms Associated with Intestinal Parasitic Infections in Children

According to Haque (2007), common protozoan parasites include *Giardia intestinalis, Entamoeba histolytica*, *Cyclospora cayetanenensis*, and *Cryptosporidium* spp. The World Health Organization's identification of common STHs includes roundworm (*Ascaris lumbricoides*), hookworms (*Necator americanus and Ancylostoma duodenale)*, and whipworm (*Trichuris* *trichiura*) (WHO, 2022). In Ghana, Abaka-Yawson et al. (2020) observed that *Ascaris lumbricoides* was the most common Intestinal parasite (IP) with prevalence of 20.39%, followed by Hookworm (13.16%) *and Trichuris trichiura* (10.53%). Forson et al. (2018) also found IPs including *Giardia lamblia* (10%), *Schistosoma mansoni* (1.7%), *Ascaris lumbricoides* (1%), *Entamoeba histolytica/dispar* (1%), *Hymenolepis nana* (0.3%), and *Strongyloides stercoralis* (0.3%) in some Ghanaian school children. Kpene et al. (2020) however, found the parasites *Cryptosporidium spp*. (5.3%), *Entamoeba spp*. (3.3%), *Cyclospora cayetanensis* (2.7%), *Ascaris lumbricoides* (1.3%), *Giardia lamblia* (0.7%), and *Strongyloides stercoralis* (0.7%) among some children in the Volta region of Ghana. In Nigeria, Amisu et al. (2023) observed that the most common IP was *Ascaris lumbricoides* (50.8%), followed by *Giardia lamblia* (28.8%), *Entamoeba spp*. (16.9%), and *Dipylidium caninum* (3.4%).

2.3 Risk Factors Associated with Intestinal Parasitic Infections in Children

Several research works associate risk factors of IPIs to sociodemographic and environmental conditions existing around study areas; conditions necessary for the prevalence of IPIs are similar across developing countries. Insanitary environmental conditions, poverty, limited access to healthcare and climatic conditions are some of the major risk factors associated with IPIs in children (Sitotaw et al., 2019). Similarly, Bahrami et al. (2018) cite poor hygiene, overcrowding, limited access to safe water and frequent contact with soil as risk factors associated with IPIs in Iranian children.

In Pakistan, Khan et al. (2022) observed that children’s drinking water obtained from wells and their close proximity to cattle increased their likelihood of IPIs at least four times. These findings are consistent with that of Forson et al. (2017) in Ghana. The authors determined that the p-value of domestic animals or pets in homes as a risk factor was 0.0284. Thus, kept domestic animals may require frequent deworming to minimize transference to children who are particularly more vulnerable. Besides, the authors identified latrine toilet facilities as potential risk factors although association with IPIs was not statistically significant (p-value = 0.1163).

In a study utilizing spatial autocorrelation, Osei and Stein (2017) observed that climatic conditions such as high precipitation increases the probability of IPIs. This observation is consistent with that of Sitotaw et al. 2019. The authors however opined that a culmination of environmental and socioeconomic exposure factors is responsible for IPIs in children. Interestingly, Mehraj et al. (2008) observed that some Pakistani children who lived with their parents in rented accommodations were twice more likely to have IPIs compared to children living with their parents in their own home properties. Perhaps, children are at a higher risk of IPIs compared to adults primarily because of their higher nutritional demands and their less mature immune systems (Savioli et al., 2006).

2.1.1 Symptoms of Intestinal Parasitic Infections in Humans

Individuals with IPIs usually exhibit symptoms of diarrhoea, weight loss, nausea and abdominal pain (Kiani et al., 2016). In children, Al-Fakih et al. (2022) report severe symptoms including malabsorption, indigestion, anaemia, stunted growth, deficiencies in vitamin A, decreased body weight, and other cognitive impairments. IPIs can also cause persistent abdominal symptoms (PAS) to the extent of exposing asymptomatic gastrointestinal infections (Nissan et al., 2017).

2.1.2 Diagnosis and Treatment

Traditionally, the primary method for identifying IPIs has been through microscopic examination of stool samples (van Lieshout & Roestenberg, 2015). However, this approach is limited in sensitivity and is costly due to the need for multiple sample examinations and extensive training of technicians. Thus, in resource-limited settings, where labor costs are low, microscopy has remained a practical choice. Nonetheless, there exists other diagnostic techniques for blood-borne protozoan infections such as serology and molecular-based techniques. Molecular techniques, such as Polymerase Chain Reaction (PCR), Loop-Mediated Isothermal Amplification (LAMP), and other related methods, are increasingly important and effective in diagnosing various parasitic infections. These techniques offer advantages in terms of specificity, speed, and sensitivity, and they can be applied to monitor the progress of treatment and clinical outcomes. Besides, serology-based techniques including dye tests, Card Agglutination Test (CATT), immunofluorescent assays, Rapid diagnostic tests (RDTs) and ELISAs are effective in the detection of Toxoplasma-specific antibodies and blood-borne protozoan infections (Ricciardi & Ndao, 2015).

Treatment of IPIs may include a combination of Tinidazole and broad-spectrum Albendazole or mebendazole administered orally (Nissan et al., 2017; Ngui et al., 2011). Notwithstanding, some households have been known to use plant-based medicines as alternative treatments for IPIs. Aschale et al. (2022) note that plants from the *Asteraceae* family which includes species like *Hagenia abyssinica, Bersama abyssinica, and Embelia schimperi* contain active ingredients that work to improve symptoms.

CHAPTER THREE

METHODOLOGY

3.1 Study Area

The research was conducted at Gbawe, situated within the Ga South Municipality in the Greater Accra Region of Ghana. This municipality was originally delineated from the Ga West District in November 2007, and its official establishment was formalized through Legislative Instrument 2134 in July 2012, with Weija serving as its municipal capital. Gbawe is located in the southwestern sector of Accra, and it shares its borders with several neighboring areas. To the southeast, it abuts the Accra Metropolitan Area and Ga Central, while to the northeast, it is adjacent to Akwapim South. To the east, it shares boundaries with Ga West, to the north with West Akim, and to the west with Awutu-Senya. In the southeast, it connects with Awutu-Senya East, and in the southwest, it meets Gomoa. To the south, Gbawe's border extends to the Gulf of Guinea. This region encompasses a land area of approximately 341.838 square kilometers and encompasses roughly 95 different settlements.

3.2 Research Design

The study follows a cross-sectional design. This involves the observation and the measurement of outcomes and exposure factors, with consideration for any associations (Setia, 2016).

3.3 Population, Sample and Sampling Procedure

3.3.1 Population

The population under study were school children – male and female between the ages of 5 and 10 years. All children of other ages were excluded.

3.3.2 Sample

The total sample size selected for this study is based on the statistical formula by Daniel (2018) for the determination of sample size for estimating proportions. This formula is ideal for sample size determination in prevalence studies (Naing & Rusli, 2006).

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where;

n is the sample size,

Z is the statistic corresponding to a level of confidence,

P is the expected prevalence or proportion

d is the precision corresponding to effect size.

Prior studies conducted by Forson et al. (2017) determined the overall prevalence of intestinal parasitic infections in a survey of some school children in parts of Accra, Ghana to be 15.1%. This prevalence rate will therefore be considered in the current study as a reasonable estimate of P. Furthermore, this study would aim for a 95% confidence level corresponding to a Z statistic of 1.96 and a precision (d) of 5%. The 5% precision is justified on the assumption that the overall prevalence to be determined in this study would be above 10%.

Therefore, sample size $n = \frac{1.96^2 * 0.151(1-0.151)}{0.05^2}$

n = 196.99, rounding to 197

3.3.3 Sampling Procedure

The population under study were stratified into groups based on their ages. Participants were then selected at random from each of the groups until the sample size was achieved.

3.4 Research Institution and Data Collection Procedure

The study participants were selected from the Oblogo public school and the Gonse basic school, both in Gbawe, Ga South Municipality. Anti-leak containers were labelled with the names, sex, and ages of the participants. The containers were then given out to collect stool samples.

3.5 Tools for Data Analysis

3.5.1 Laboratory Analysis

The stool samples were initially analyzed using the wet mount method. In this method, a small amount of stool sample was placed on a glass slide and then stained with Lugol's iodine. The sample was then observed under a microscope using the 10x and 40x objectives. Further analysis was performed using the formalin-ethyl sedimentation procedure as originally pioneered by Ritchie (1948). The technique takes advantage of the high specific gravity of protozoan cysts and other parasitic eggs like helminths versus water, thus allowing the parasitic elements to settle at the bottom of the tube. In performing the technique, about 10 mL of 10% formol-saline was mixed with 1g of stool sample in a container using an applicator to form an emulsion. The sample was sieved through a 350 – 450 micrometer fine mesh into a beaker to obtain a filtrate. About 7 mL of the filtrate was then transferred into a 15 mL centrifuge tube and topped up with 3 mL of diethyl-ether and centrifuged at 1500rpm for 2 minutes.

Three layers of ether, insoluble debris and formol-saline were thus formed at the top and a fourth stool solids and cysts/ eggs formed at the bottom. The first three layers were discarded under tap water and the stool solids and cysts/ eggs was resuspended with three drops of formol-saline. A disposable pipette was used to mix the sediment and a drop was transferred unto a microscope slide. A cover glass was used to cover the slide and examined under microscope at low light (x10) objective.

3.5.2 Statistical Analysis

The data entry process commenced with the input of information into Microsoft Excel 2016, conducted at the study site. Subsequent data analysis was performed using Prism 8 software. Significance levels were determined, with p-values below 0.05 signifying statistical significance throughout the analysis. The Chi squared test was employed to evaluate the relationship between each exposure variable or risk factor and the occurrence of infection. Subsequently, odds ratios were calculated to quantify the strength of this association.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Results

4.1.2 Sociodemographic Characteristics of Participants

A total of 197 school-going children were recruited to participate in the study. Of these, 88 (44.67%) were females while 109 (55.33) were males. Participants aged 5 years made up 17.77% of the sample population. Another 16.24% were aged 6 years and 18.27% were aged 7 years while 17.26% were aged 8 years. Children in the 9 and 10-years age group each made up 15.23% of the sample. The mean age of the children was 7.29 years old. The minimum age group was the 7-year-olds while the maximum age group was the 10-year-olds.

4.1.3 Prevalence of Intestinal Parasitic Infections in Children

Out of the 197 stool samples examined, 8 (7.34%) male children tested positive while 11 (12.50%) female children tested positive for an intestinal parasitic infection (see Table 1). The least age groups infected were from the 5- and 6-year-old age groups representing 5.26% and 10.53% of the infected population. A total of 7 (3.55%) children tested positive for *Ascaris lumbricoides* while 5 (2.54%) tested positive for *Entamoeba Histolytica*. The prevalence of *Enterobius vermicularis* was 1.52% while *Giardia lamblia* was 2.03%. Total prevalence of intestinal parasitic infections among the school children was 9.64%.

Table 1. Prevalence of Intestinal Parasitic Infections Among Children in Selected Schools in Gbawe, Ga South Municipality

Age(years)	Total examined	Ascaris Lumbricoides	Entamoeba Histolytica	Enterobius Vermicularis	Giardia Lamblia	Total no.	%
5	35	1	0	0	0	1	2.86%
6	32	1	1	0	0	2	6.25%
7	36	3	1	0	0	4	11.11%
8	34	1	1	1	1	4	11.76%
9	30	1	1	1	2	5	16.67%
10	30	0	1	1	1	3	10.00%
Total no.	197	7	5	3	4	19	9.64%
%		3.55%	2.54%	1.52%	2.03%	9.64%	
Male	109	5	1	1	1	8	7.34%
Female	88	2	4	2	3	11	12.50%

4.1.4 Association Between Risk Factors and Occurrence of Intestinal Parasitic Infection

About 178 of the children who claimed they ate washed fruits and vegetables tested negative for an intestinal parasitic infection (see Table 2). However, 18 of the of the children who claimed they ate washed fruits and vegetables tested positive for an intestinal parasitic infection. Children who sometimes ate unwashed fruits or vegetables were more likely to contract an intestinal parasitic infection than those who had theirs washed ($p = 0.0022$). A total of 8 children lived near a refuse dump compared to 189 children who did not. The odds of an intestinal parasitic infection were 6.48 times higher for those who lived near a refuse dump than those who did not ($p = 0.0064$, 95% CI 1.575 to 28.26).

All 19 of the children who usually played in the soil tested positive for an intestinal parasitic infection ($p < 0.0001$). There was no statistical significance between the source of water at home and the occurrence of an intestinal parasitic infection ($p = 0.5091$). About 79.1% of the children used KVIP (latrine) or public lavatories, and only 20.81% used water closets at home. Furthermore, there was no statistical significance between the type of toilet facility used and the occurrence of intestinal parasitic infection. In addition, 97.97% of the children had their source of water from pipes while only 2.03% had their source water from boreholes or well. Besides, the source of water was not dependent on the occurrence of intestinal parasitic infection ($p = 0.5091$)

Table 2. Association between IPIs and Risk Factors Among Children in Selected Schools in Gbawe, Ga South Municipality

Risk factors	Positive (n=19)	Negative (n=178)	Total (n=197)	%	p-value	Odds ratio	95% CI
Gender							
Female	11	77	88	44.67%	0.2225	0.5545	0.2156 to 1.441
Male	8	101	109	55.33%			
Either parents' education							
No formal education	2	9	11	5.86%			
Some formal education	17	169	186	94.4%	0.3236	0.4527	0.1002 to 2.239
Source of water							
Bore hole/ Well	0	4	4	2.03%			
Pipe	19	174	193	97.79%	0.5091		
Toilet facility at home							
Water closet	5	36	41	20.81%			
KVIP/ Public lavatory	14	142	156	79.19%	0.5342	1.409	0.5296 to 4.064
Hand wash before meals							
Sometimes	0	2	2	1.02%			
Yes	19	176	195	98.98%	0.6424		

Table 2 (continued)

Hand wash after toilet use							
Sometimes	0	5	5	2.54%			
Yes	19	173	192	97.46%	0.4593		
Wash fruits/ vegetables							
Sometimes	1	0	1	0.51%			
Yes	18	178	196	99.49%	0.0022*	0.000	0.000 to 0.9607
Live near refuse dump							
No	16	173	189	95.94%			
Yes	3	5	8	4.06%	0.0064*	6.488	1.575 to 28.26
Playing in the soil							
No	0	175	175	88.83%			
Yes	19	3	22	11.17%	<0.0001*		

Note* = $p < 0.05$

4.2 Discussion

4.2.1 Prevalence of Intestinal Parasitic Infections in Children

This study determined the overall prevalence of intestinal parasitic infections among some school children in Gbawe, Ga South municipality to be 9.64%. A lower prevalence (2.86% and 6.25%) was observed in children aged 5 and 6 years compared to the more than 10% prevalence in the age groups from 7 years to 10 years. These findings are consistent with that of Ulhaq et al. (2022) who determined a high prevalence of 84.4% in Pakistani children aged 7 to 9 years and a 94.2% prevalence in children aged 10 to 12 years compared to the relatively lower prevalence of 72% in children aged 4 to 6 years. Perhaps, the reason for a higher prevalence in older children is their propensity to engage more in open field playing activities (Sitotaw & Shiferaw, 2020) and their increased exposure to animals and the environment (Nhambirre et al., 2022). Nevertheless, the higher prevalence in females (12.50%) versus males (7.34%) contradict the findings of Forson et. al (2017) who observed an 11.8% in females versus 17.9% in males. They attribute the higher prevalence in males to increased access to playing fields compared to females who spend more time performing house chores. However, various studies have observed higher prevalence in females compared to males in parts of Ethiopia and Nepal (Gelaw et al., 2013; Rijal et al., 2001). Hence, to the extent that gender is a risk factor, further studies in this area could determine which of the two primary genders poses the highest risk in terms of IPIs.

The prevalent organism in this study is *Ascaris lumbricoides* (3.55%) followed by *Entamoeba histolytica* (2.54%). Abaka-Yawson et al. (2020) also determined a high prevalence of *Ascaris lumbricoides* (20.39%) in children around the middle belt area of Ghana. An equally high prevalence of *Ascaris lumbricoides* (28.6%) was observed in among some primary school children in some parts of the Volta region (Orish et al., 2019) However, a low prevalence of *Ascaris lumbricoides* (1.3%) *and Entamoeba histolytica* (3.3%) has been observed in other parts of the Ho Municipality of Ghana (Kpene et al., 2020). Besides, a 37.1% prevalence of the parasite *Ascaris lumbricoides* was observed among adult food vendors in the Ashanti Region of Ghana (Adams & Lawson, 2014), an indication that adults are also at risk of contracting IPIs.

Furthermore, Forson et al. (2017) determined the overall prevalence of IPIs among some school children in the Greater Accra Metropolitan Area to be 15.1%, with the dominant parasite being *Giardia lamblia* (10%) followed by *Schistosoma mansoni* (1.7%). Perhaps, a lower overall prevalence of 9.64% in this study versus 15.1% in a previous study could be due to the recommendations of Forson et al. (2017) stressing the need to continue deworming campaigns among school children in the region, and increased levels of education. Additionally, differences in environmental conditions between the Accra Metropolitan Area and the Ga South Municipality could explain the lower prevalence in this study. Evidently, the fact that Osei & Stein (2017) found high-risk districts surrounding other high-risk districts and high-risk districts surrounding low risk districts in Ghana, may give credence to the differences in prevalence rates within districts even in the same region. Nonetheless, the researchers were of the view that socioeconomic and environmental risk factors were collectively responsible for the prevalence of IPIs.

4.2.2 Association Between Risk Factors and Occurrence of Intestinal Parasitic Infection

The statistically significant risk factors observed in this study were the hand washing habits of the children, specifically washing fruits and vegetables before consumption ($p = 0.0022$), close proximity to a refuse dump ($p = 0.0064$) and frequent playing in soil ($p < 0.0001$). Interestingly, the association between the education level of either parents of the children and intestinal parasitic infection was determined to be not statistically significant ($p = 0.3236$). In contrast, Forson et al. (2017) determined the presence of domestic animals in a home to be a statistically significant risk factor associated with the occurrence of IPIs ($p = 0.0284$). Other important risk factors, although not statistically significant were latrine as a type of toilet facility ($p = 0.1163$) and the female gender ($p = 0.1451$, OR 1.685). Children who did not wash their hands with soap and water prior to eating were at a higher risk of contracting an IPI than those who did wash their hands ($p = 1$, OR = 1.439). In this study also, we determined that the association between children who did not wash their hands prior to having their meals and the occurrence of IPIs was not statistically significant ($p = 0.6424$). In contrast to the findings of Duguma et al. (2023), however, children who did not wash their hands before meals were 7.749 times more likely to be infected with an IPI ($p = 0.001$, AOR = 7.749).

4.2.3 Manifestation of Symptoms of Intestinal Parasitic Infections

None of the children of the 19 children infected in this study showed any symptom of intestinal parasitic infection. This asymptomatic behaviour was evident in a study conducted in the Ho Municipality in the Volta region of Ghana (Kpene et al., 2020). Furthermore, the assertion by Bundy et al. (1992) that the manifestation of symptoms was primarily dependent on the age and intensity of the parasitic infection may yet hold true. Considering that the children who tested positive had only one type of parasitic organism, a more intense form of infection may have to exist for any visible symptoms to show.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.2 Conclusion

This study found out that the prevalence of intestinal parasitic infection in Oblogo Public School and Gonse Basic School, both in Gbawe, Ga South Municipality was 9.64%. Older children between 7 and 10 years old were more vulnerable to these infections. *Ascaris lumbricoides* and *Entamoeba histolytica* were identified as the most common parasites responsible for these infections, with *Ascaris lumbricoides* being the predominant one. Furthermore, statistically significant risk factors associated with IPIs, such as the consumption of unwashed fruits and vegetables, living in proximity to refuse dumps, and frequent soil contact during play. These risk factors underscore the need for targeted interventions to address these sources of transmission and educate both children and their caregivers on proper hygiene practices and prevention strategies.

5.3 Recommendations

In light of these findings, it is imperative that public health authorities and policymakers focus on implementing comprehensive public health programs aimed at reducing the prevalence of IPIs among school children in the region. Such programs should encompass improved sanitation, hygiene education, and regular deworming efforts. By addressing the root causes and risk factors identified in this study, we can work towards improving the overall health and well-being of children in Gbawe and similar underdeveloped regions, ultimately contributing to a brighter and healthier future for these vulnerable populations.

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APPENDIX I

PARENTAL INFORMED CONSENT FORM

The purpose of the research described below is to investigate intestinal parasitic infection among children in select schools in Gbawe in the Ga South Municipality, Greater Accra Region of Ghana. The risks to children in this study are minimal, but the benefits could be improved attention and participation including life-saving benefits.

Our names are ___________________________ and __________________________. Because you are the parent or legally authorized representative of a school child in this community, we are seeking your permission to let your child participate in this research study. Involvement in the study is voluntary, so you may decide whether to let your child participate or not. We will also ask your child if he or she wants to be in the study, and we will only collect information if both you and your child agree.

Details of the Child's Involvement

Your child's main involvement will be to provide a small quantity of their stool. No other sample will be collected from your child.

Participant Rights

You have the right to ask any questions you have before, during or after the study, and I encourage you to do so. If you do not want your child to be in this study, there will be no penalties or loss of benefits that he or she is entitled to.

To be Completed by Parent / Guardian

I have read all of the information on this form, and all of my questions and concerns about the research described above have been addressed. I choose, voluntarily, to permit my child to take part in this research study. I certify that I am at least 18 years of age.

____

Name of child

____

Name of parent or guardian

____ ____________

Signature of parent or guardian Date

To be completed by Researcher

I confirm that the legally authorized representative of the child named above has been given an opportunity to ask questions about the study, and all the questions asked have been answered to the best of my knowledge and ability. A copy of this Consent Form has been provided to the child's legally authorized representative, and I will keep the original for a minimum of three years.

____

Print name of researcher

____ ____________

Signature of researcher Date

APPENDIX II

Questionnaire: Information to accompany stool sample for study on intestinal parasites

Please answer the following questions and submit this information together with your stool sample:

1. What is your gender?

   a. Male b. Female

2. How old are you?

   a. 5 years b. 6 years c. 7 years d. 8 years e. 9 years f. 10 years

3. Have you dewormed in the last 3 months?

   a. Yes b. No c. Not sure

4. When last did you deworm?

   a. Less than 1 month ago b. Less than 3 months ago c. More than 3 months ago d. Never dewormed

5. Did you have any unusual gastrointestinal/stomach symptoms in the week prior to collecting the sample?

   a. Yes b. No c. Not sure

6. Were there any major changes in what you ate or drank in the week prior to collecting the sample?

   a. Yes b. No c. Not sure

7. Highest education of either parent/ guardian

   a. Secondary/ High school b. Tertiary/ University c. NVTI/ vocational d. No formal education

8. What is your primary source of water?

a. Pipe b. Well c. Bore hole d. River/ lake

9. What is your primary means of a toilet?

a. Water closet b. Public lavatory c. Home KVIP d. Other

10. Do you wash your hands before eating?

a. Yes b. No c. Sometimes

11. Do you wash your hands after using the toilet?

a. Yes b. No c. Sometimes

12. Do you wash fruits and vegetables before eating them?

a. Yes b. No c. Sometimes

13. Do you live close to a public refuse dump?

a. Yes b. No

14. Do you play in the soil at home?

a. Yes b. No

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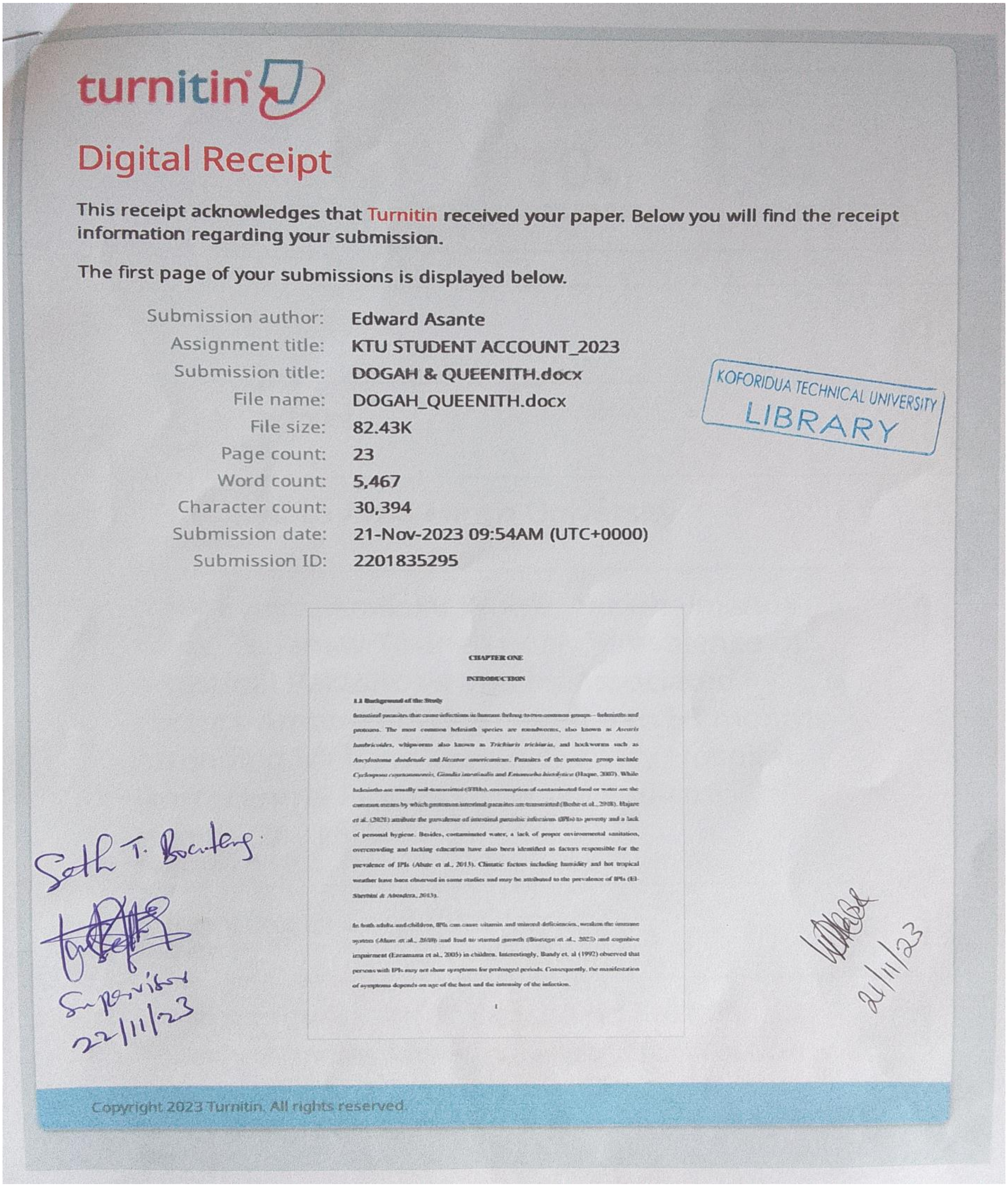

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CHAPTER ONE

INTRODUCTION

Seth T. Boateng

Supervisor
22/11/23

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