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PREVALENCE OF HELMINTH INFECTIONS AMONG PRIMARY SCHOOL CHILDREN IN GUSAU LOCAL GOVERNMENT AREA, ZAMFARA STATE

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ABSTRACT

This study aimed to examine the prevalence of helminth infections in primary school children in Gusau Local Government Area of Zamfara State. Stool samples were collected from 245 pupils and analyzed using the Kato-Katz technique. A total of 130 (53.1%) were positive for helminth infections with Hookworms having the highest rate of prevalence at 56.2%. Stool samples of pupils in primary 1 to 5 were randomly selected and the results show that there was a high prevalence rate in Primary 1 pupils (73.3%) while Primary 3 pupils had the least (34.2%). The prevalence of helminth infections was higher among males (59.3%) than females (47%) ($p = 0.000$). Overall helminth infections were higher in the 5–7 year age group (59.2%) than in the other age groups ($p= 0.064$) Hookworm and *Hymenolepis* eggs co-infection (3%) was the most common mixed infection and were significantly higher in males than females. The total prevalence rate (53.1%) in this study was above the stipulated range (12.5–50.2% for soil-transmitted helminthiases), as reported by the Nigerian Federal Ministry of Health. Holistic control measures must be enforced by the Zamfara State Government to reduce the prevalence rate of helminth infections among school children within the state.

Keywords: Children, Gusau, Helminth Infections, Primary School

INTRODUCTION

Soil-transmitted helminthiases are parasitic diseases caused by nematode worms and transmitted to humans through soil contaminated with faeces. These are among the most common infections among people living in Sub-Saharan African countries. According to the most recent estimates, more than 2 billion people are infected with these parasites (WHO, 2022). The highest prevalence occurs in areas with inadequate sanitation and unsafe water supplies (WHO, 2022).

Ascaris lumbricoides, *Trichuris trichiura*, *Necator americanus*, and *Ancylostoma duodenale* are the major soil-transmitted helminths (STHs) of human concern. In 2010, an estimated 819.0 million people were infected with *A. lumbricoides*, 438.9 million with Hookworm, and 464.6 million with *T. trichiura*, according to reports (WHO, 2022; CDC STH, 2022). Light infections of STHs usually have no symptoms. However, more severe infections result in a variety of symptoms such as malnutrition, malabsorption of nutrients, abdominal pain, cramping, and tiredness, as well as impaired cognitive and physical development. Worms feed on host tissues and blood, causing iron and protein loss (WHO, 2022; CDC STH, 2022). Furthermore, some soil-transmitted helminths cause loss of appetite, resulting in a reduction in nutritional intake and physical fitness. Nutritional deficiency caused by soil-transmitted helminths has been shown to have a significant impact on growth and physical development (WHO, 2021; UNICEF, 2021).

Soil-transmitted helminth infection is widespread throughout the world, with high prevalence rates in tropical and sub-tropical countries with inadequate sanitary facilities, ineffective waste disposal systems, a lack of safe water supply, and low socioeconomic status.

There is no report on a study conducted on helminth infections in school-aged children in Gusau Local Government of Zamfara State. Husainni and lsah (2021) in their work on Geohelminths infection and its risk factors among primary school children in Talata Mafara area of Zamfara State reported a prevalence of 8.3% *Ascaris lumbricoides* to the other geohelminths in the type of infection. Hookworm showed a prevalence of (5.0%) whereas *Trichuris trichiura* showed no infection (0%). *Ascaris lumbricoides*, hookworms (*Ancylostoma duodenale* and *Necator americanus*) and *Trichuris trichiura*, which each account for 807 to 1121 million, 57 to 640 million and 604 to 795 million respectively, of the 1.5 billion individuals worldwide who are infected with soil-transmitted helminths (STHs) (WHO, 2022; CDC STH, 2022). Over 236 million individuals required schistosomiasis preventive treatment in 2019 (WHO Schistosomiasis, 2022). Additionally, estimations suggest that 95 to 135 million people globally have *Taenia species* or *Hymenolepis nana* infections.

The ongoing deworming program's effectiveness must be confirmed, and if necessary, adjustments to the strategy must be made to ensure that the WHO helminth control objectives are met. It is necessary to provide an update on the status of helminth infection and related morbidities, such as anemia, malnutrition, and poor academic performance in children. Furthermore, research findings on the relationship between helminth infections and malnutrition, anemia, and poor academic performance are contradictory. While some studies found helminth infection to be associated with an increased risk of anemia, undernutrition, and poor academic performance in helminth-infected children (WHO, 2021; UNICEF, 2021; DiPasquale, 2020), others found no link between helminth infection and anemia, undernutrition, or poor academic performance. Even some studies found that children infected with soil-transmitted helminths had a lower risk of anemia and malnutrition (Moola *et al.*, 2021). This study aimed to examine the prevalence of helminth infections in primary school children in Gusau Local Government Area of Zamfara State.

Ethical approval was obtained from the Zamfara State Health Research Ethics Committee, Ministry of Health with approval number ZSHREC01062022/099, and the study protocol was approved by the Education Secretary of Gusau Local Government Area of Zamfara State.

MATERIALS AND METHODS

Study Area

The study was conducted in the capital city of Gusau, Zamfara State, Northwest Nigeria. It is also the name of the State's

Local Government Area (LGA), which as of the 2006 census had a population of 383,162 and a 3,364 km2 total area (NPC, 2006). It is located on Latitude: 12.1667, Longitude: 6.66667 12° 10′ 0″ North, 6° 40′ 0″ East.

Map of Zamfara State showing Gusau Local Government

Research Design

The research design used for the study was a cross-sectional study design among children of public primary schools in Gusau Local Government of Zamfara State.

The Population of the Study and Duration

The population of the study comprised selected public primary school children. The eligibility of subjects was ascertained as they provided a stool sample, child assent, and parental consent, and the study duration was for three months (February to April 2022).

Exclusion Criteria

Children attending privately owned primary schools in Gusau metropolis were exempted, failure to submit a stool sample, and history or physical examination findings consistent with the presence of a serious chronic diseases like active tuberculosis and developmental disability were excluded from this study.

Sample and Sampling Technique

A simplified random sampling technique was used to select a Primary school of Gusau Local Government. Ten pupils were selected from each class of primary one to five using systematic random sampling. Stool samples were collected from the selected children in pre-labeled sampling bottles and examined using the formol–ether concentration technique (Samuel *et al*., 2017).

All stool specimens were macroscopically examined for color, consistency, blood, mucous, pus, and parasite stages visible to unaided eyes, such as adult helminths, larvae, and segments of cestodes. They were then examined with a light microscope and the formol-ether concentration method using a direct smear. A drop of emulsified stool sample was placed on both ends of the slide for the direct smear method, and a drop of Lugol's iodine was added to one stool drop while leaving the other drop unstained. Smears were examined under an optical microscope at 100x and then 400x magnification to detect and identify protozoan and helminth diagnostic stages (Cheesbrough, 2009). Because the formol-ether concentration method is the gold standard for examining IPIs, it was used as previously described (Cheesbrough, 2009). It was made by emulsifying 1 gram of stool in 8 mL of 10% formalin and filtering it into another tube before adding 4 mL of diethyl ether to the filtrate. After homogeneously mixing for 1 minute, the mixture was centrifuged at 3000 rpm for 1 minute to remove the supernatant. Finally, a small amount of sediment was examined under a microscope. To detect ova, cysts, trophozoites, and larvae of enteric parasites, well-trained parasitologists examined at least two smears from each stool specimen. Similar to the direct smear, magnifications of 100x and 400x were used, with Lugol's iodine solution added to smears to facilitate identification of cysts of intestinal protozoan parasites (Abou El-Naga, 2014).

Sample size

A total of two hundred and forty-five stool samples of children (5- 9 years) from Primary 1 to 5 whose parents and head teachers consented were randomly collected from six primary schools.

Infection intensity

Parasites' burden was determined by examination of stool samples from each study participant. Stool samples were taken to the Helminthology Laboratory of the Department of Veterinary Parasitology and Entomology, Ahmadu Bello University Zaria for analysis.

Data Analysis

The data collected were analyzed using the Statistical Package for the Social Sciences Version 21.0. Descriptive (frequency, tables, and charts) and inferential statistics were used appropriately with a 99% confidence limit ($P < 0.01$).

RESULTS AND DISCUSSIONS

Prevalence of Helminth Infections in Stool Samples of School Children in Gusau

In this study, the rate of transmission of soil helminth infections in school children in Gusau Local Government was considerable high. Out of 245 stool samples examined, 130 (53.1%) were found to be infected. Eight soil helminthic parasites were detected, including nematodes, cestodes, and protozoans but trematodes were not found in the study. The

prevalence rate of helminth parasites was high in all schools with Pilot Children School having the highest (100%), followed by Ibrahim Gusau Model Primary School (60%), and the least was recorded in Army Children School (15.2%). Hookworm parasite was found to have the highest prevalence rate across the schools sampled with 56.2%, while *Enterobius vermicularis* (2%) and *Taenia* species (2%) were recorded as low in this study. Mixed infections were observed in Army Children School, Ibrahim Gusau Model Primary School and Damba model primary school. There was a significant difference in the prevalence of helminth infections among the schools sampled for this study. ($\chi 2$= 139.924, P= 0.000) Table 1, Figure 1. The overall prevalence of soil-transmitted helminthiasis in Schools in Gusau Local Government Area of Zamfara State was (53.1%) above the stipulated range (12.5–50.2% for soil-transmitted helminthiases) as previously reported by the Nigerian Federal Ministry of Health (Federal Ministry of Health, 2015). The result of this study was similar to the findings of Abera *et al.* (2013) in northwest Ethiopia with a prevalence case of 51.5% of intestinal parasites among primary school children. Houmsou *et al*. (2010) reported 58.5% in Makurdi Benue State. In Oyo and Ogun states; Agbolade *et al.* (2007) and Salawu *et al*. (2014) found a high prevalence of cases of 66.2% and 62.2% among school-age children respectively. The high prevalence rate of soil-transmitted helminth infections may be attributed to a lack of regular deworming procedures, improper management of the dumping sites near the schools, insufficient water supplies, poor drainage systems, undernutrition, poor personal hygiene, inadequate footwear, cultural beliefs, and a dearth of toilet facilities.

Hookworm was the most prevalent among the soil-transmitted helminths (56.2%). According to mapping results from the Ogoja Local Government Area in 2014, hookworm (11.51%) was the most common soil-transmitted helminth. Habits such as not wearing shoes frequently might contribute to hookworm infection (Alelign *et al.*, 2015). Some of the children who were chosen for the study displayed this attitude, and this, combined with the fact that the pupils utilized some of the schools' surrounding areas as toilets, exposed them to hookworm infestation. Agrarian communities have been linked to higher rates of Hookworm infection, according to reports (Ukibe *et al*., 2018). Similarly, Alelign *et al.* (2015) found that in Ethiopian school children, the prevalence of hookworm infection was significantly higher than that of other soil-transmitted helminth infections. This finding was attributed to the fact that the majority of the children in the study walked barefoot over loamy soils and cultivated fields. Hookworm having the highest prevalence corresponded with the findings made by Njoba *et al.* (2022) in Makurdi, Benue State. Since hookworm eggs hatch and quickly penetrate the skin of the host during the rainy season, hookworm infection transmission is very seasonal. The prevalence was further boosted by the children's rate of exposure to risk factors, such as walking barefoot to fields or schools, and the favorable climatic circumstances for the development of the infective stage.

Table 1: Prevalence of Helminth Infections in Stool Samples of School Children in Gusau Local Govt.

School	Number of Examined	Number of Infected	HK n (%)	TT n (%)	SS n (%)	HY n (%)	EV n (%)	IS n (%)	AS n (%)	TA n (%)	MI n (%)	P-value
UBELPS	50	18 (36.0)	15 (83.3)	0 (0.0)	0 (0.0)	2 (11.1)	1 (6.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	***0.000**
ZSUBEBS	21	21 (100)	13 (62.0)	3 (14.3)	2 (10.0)	1 (5.0)	0 (0.0)	0 (0.0)	2 (10.0)	0 (0.0)	0 (0.0)	
PCS	35	35 (100)	18 (51.4)	6 (17.1)	3 (9.0)	2 (6.0)	0 (0.0)	1 (3.0)	4 (11.4)	1 (3.0)	0 (0.0)	
ACPS	46	7 (15.2)	2 (29.0)	0 (0.00)	0 (0.)	2 (29.0)	0 (0.0)	1 (14.3)	1 (14.3)	0 (0.0)	1 (14.3)	
IGM	47	28 (60.0)	12 (43.0)	0 (0.00)	2 (7.1)	10 (21.3)	1 (4.0)	0 (0.0)	1 (4.0)	1 (4.0)	1 (4.0)	
DMPS	46	21 (46.0)	13 (62.0)	2 (10.0)	3 (14.3)	1 (5.0)	0 (0.0)	1 (5.0)	0 (0.0)	0 (0.0)	1 (5.0)	
Total	**245 (100)**	**130 (53.1)**	**73 (56.2)**	**11 (9.0)**	**10 (8.0)**	**18 (14.0)**	**2 (2.0)**	**3 (2.3)**	**8 (6.2)**	**2 (2.0)**	**3 (2.3)**	

Keys: HK- Hookworm, TT- *Trichuiris trichuira*, SS- *Strongyloides stecoralis*, HY- Hymenolepis eggs, EV- *Enterobius vermicularis*, IS- Isospora species, AS- *Ascaris lumbricoides*, TA- Taenia eggs, MI- Mixed Infection, UBELPS- Universal Basic Education Lowcost Primary School Gusau, ZSUBEB- Zamfara State Universal Basic Education Board Schools, PCS- Pilot Children School, ACPS- Army Children Primary School, IGM-Ibrahim Gusau Model Schools, DMPS- Damba Model Primary School

*Significant P-value

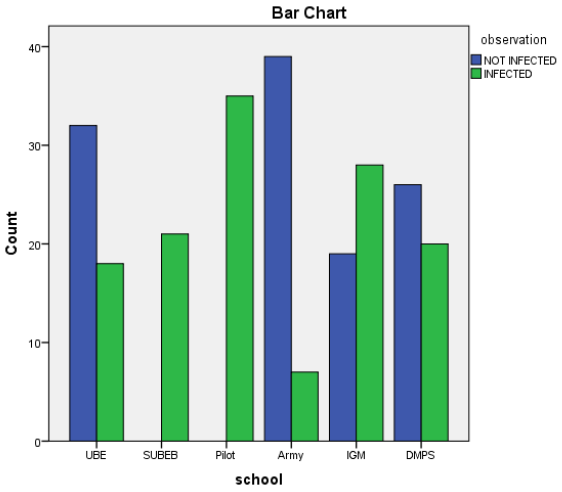

Figure 1: Prevalence of Helminth Infections in Relation to Class of Pupils

In this study, stool samples of children in Classes 1 to 5 were collected. Children in Class 1 were observed with the highest rate of prevalence of 73.3% and Class 4 with 67% followed by Class 2 with 57.4% and the least prevalence was recorded in Class 3 children with 34.2%. In terms of helminthic parasites prevalence among the classes, Hookworm parasites (56.2%) was the most prevalent among helminthic infections while a low prevalence rate was recorded with *Enterobius vermicularis* (2%) and *Taenia Species* (2%) respectively. ($\chi 2$= 20.406, P= 0.00) Table 2. Figure 2, and Figure 3. Most pupils in Class 1 fall between the age ranges of 5 to 7 years old and are the most vulnerable to infections, because of their developing immune systems. (Ygberg *et al.,* 2011). Early childhood is a time of immune system development and underdevelopment. Breastfeeding is frequently continued until the child is two years old, which offers crucial early protection through passive IgG antibody transmission. Food neophobia and fussiness/picky eating, two food-related nondirective feeding habits in toddlers to preschoolers, result in a restricted, poor diet that has an impact on their weight and nutritional status (Wood *et al.,* 2020). Due to their growing sensory systems, which include touch awareness and taste, they are more likely to put things in their mouths, increasing their risk of developing parasite infections (White *et al.,* 2013).

Another factor that may be responsible for the high prevalence of helminth infections is undernutrition. Undernutrition occurs when a person's diet is deficient in both calories and nutrients. A person is said to be "wasting" if they have a low weight-for-height ratio for their age. Stunting refers to a low height-for-age value, whereas underweight refers to a low weight-for-age value. The World Health Organization (WHO) growth standard is frequently used to characterize children who show signs of wasting, stunting, or underweight and report values that are more than two standard deviations below the population standard. (WHO, 2021). There are two types of malnutrition: acute and chronic. Inadequate food intake is the primary cause of acute undernutrition in children. Secondary acute malnutrition results from abnormal nutrient loss, increased energy expenditure, or decreased food intake. This condition is usually associated with underlying chronic conditions such as pediatric cancers or congenital heart disease, persistent infections, chronic liver disease, cystic fibrosis, chronic renal failure, and neuromuscular disorders.

Wasting is the main sign of acute undernutrition (WHO, 2020). Contrarily, chronic undernutrition is brought on by a deficiency in particular nutrients at particular developmental stages in early childhood, which inhibits both physical and mental development. The most common sign of chronic undernutrition is stunting (Elia, 2017). In children aged 5 to 7 around the world, undernutrition is still a common problem. In 2020, there were 149.2 million children who were stunted and 45.5 million who were wasting, representing prevalence rates of 22% and 6.7%, respectively. At least 30% of children under the age of five were stunted in three regions (West and Central Africa, East and Southern Africa, and South Asia), or 33 nations, in 2020.

Table 2: Prevalence of Parasites in Relation to Class of Pupils

CLASS	NUMBER OF EXAMINED	NUMBER OF INFECTED	HK n (%)	TT n (%)	SS n (%)	HY n (%)	E.V n (%)	ISO n (%)	AS n (%)	TA n (%)	MI n (%)	P-value
Pry One	45	33 (73.3)	15 (46.0)	0 (0.0)	3 (9.1)	11 (33.3)	1 (3.0)	0 (0.0)	1 (3.0)	1 (3.0)	1 (3.0)	**(*0.000)**
Pry Two	54	31 (57.4)	24 (77.4)	0 (0.0)	1 (3.2)	4 (13.0)	1 (3.2)	0 (0.0)	0 (0.0)	1 (3.2)	0 (0.0)	
Pry Three	41	14 (34.2)	9 (64.3)	2 (14.3)	1 (7.14)	0 (0.0)	0 (0.0)	1 (7.14)	0 (0.0)	0 (0.0)	1 (7.14)	
Pry Four	36	24 (67.0)	12 (50.0)	8 (33.3)	1 (4.2)	2 (8.3)	0 (0.0)	0 (0.0)	1 (4.2)	0 (0.0)	0 (0.0)	
Pry Five	69	28 (41.0)	13 (46.4)	1 (4.0)	4 (14.3)	1 (4.0)	0 (0.0)	2 (7.1)	6 (21.4)	0 (0.0)	1 (4.0)	
TOTAL	**245 (100)**	**130 (53.1)**	**73 (56.2)**	**11 (9.0)**	**10 (8.0)**	**18 (14.0)**	**2 (2.0)**	**3 (2.3)**	**8 (6.2)**	**2 (2.0)**	**3 (2.3)**	

Keys: Pry- Primary, HK- Hookworm, TT- *Trichuiris trichuira*, SS- *Strongyloides stecoralis*, HY- Hymenolepis eggs, EV- *Enterobius vermicularis*, IS- Isospora species, AS- *Ascaris lumbricoides*, TA- Taenia eggs, MI- Mixed Infection.

*Significant P value

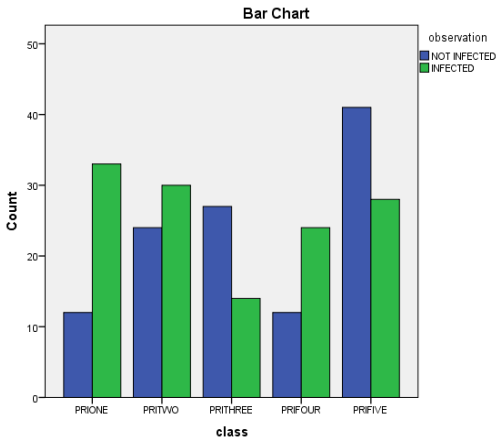

Figure 2

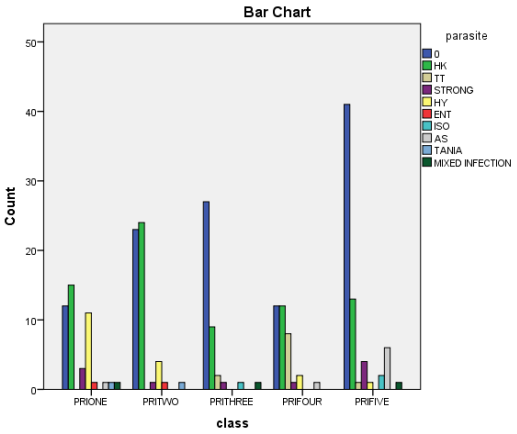

Figure 3

Prevalence of helminthic Infections in relation to Gender and Age of Pupils

Helminthic parasite prevalence was higher in male pupils (59.3%) than in females (47%) ($\chi 2$= 3.430) P= **0.00**). It might be because males spend more time outdoors participating in leisure activities and playing games, whereas female participation is likely lower due to females being required to stay indoors due to religious traditions. Ntonifor *et al.* (2015) in Cameroon and Salawu *et al.* (2014) in Nigeria both reported on similar work. In a study conducted in Ebonyi, Oyibo *et al.* (2011) found that males had considerably higher rates of helminth infection than females, although they recommended that additional research be conducted to determine whether helminth infection is gender-dependent.As regards age, the results also revealed that the prevalence of helminth infections among pupils reduce with age increase, 5-7 years (59.2%), 7-8 years (23.9%) and 8-9years (16.9%) ($\chi 2$= 36.993, P= 0.00). Table 3, Figure 4.

This supports the findings of Salawu and Ughele (2015) and Ukibe *et al*. (2018), which show that children aged 5 to 7 years are active and play with a wide variety of objects and foods. In contrast, Alemu *et al*. (2019) and Alelign *et al*. (2015) discovered in independent research that school-age children aged 10 to 14 years are more active and involved in agricultural activities than younger children, putting them at a higher risk of parasite illness. Mixed infections have been discovered in school-aged children in Nigeria and Uganda. (Ukpong and Agamse 2018; Ojja *et al*., 2018). With a prevalence of 3.0%, the most common mixed infection found in this study was *Hymenolepis nana*, hookworm, and *Ascaris lumbricoides*, with a 3.0% prevalence. Agbolade *et al*. (2007) and Salawu and Ughele (2015) found that A. *lumbricoides* and hookworm were the most common concurrent infections among school-age children in southern Nigeria. Co-infections, rather than isolated infections, are thought to account for the majority of helminthic infections in Africa (Salawu *et al*., 2014). This is supported by common epidemiological factors that promote disease spread. Mixed infections were found to be more common in males (3.0%) than in females (1.0%) in this study. According to Yu *et al.* (2017), a study conducted in Northern Samar, Philippines, produced comparable results. According to Rujeni *et al.* (2017)'s research in Rwanda, soil-transmitted helminth co-infection has been shown to affect morbidity, which can have a negative socioeconomic impact on households.

Table 3: Prevalence of Helminth Infections in relation to Gender and Age of Pupils

Gender	Number of examined	Number of Infected	HK n (%)	TT n (%)	SS n (%)	HY n (%)	EV n (%)	IS n (%)	AS n (%)	TA n (%)	MI n (%)	P-value
Male	123	73 (59.3)	40 (55.0)	5 (7.0)	5 (7.0)	16 (22.0)	0 (0.0)	2 (3.0)	1 (1.4)	2 (3.0)	2 (3.0)	***0.000**
Female	122	57 (47)	33 (58.0)	6 (11.0)	5 (9.0)	2 (4.0)	2 (4.0)	1 (2.0)	7 (12.3)	0 (0.0)	1 (2.0)	
Total	**245 (100)**	**130 (53.1)**	**73 (56.2)**	**11 (9.0)**	**10 (8.0)**	**18 (14.0)**	**2 (2.0)**	**3 (2.3)**	**8 (6.2)**	**2 (2.0)**	**3 (2.3)**	
Age												
5-7	100	77 (59.2)	46 (63.0)	3 (27.0)	5 (50.0)	15 (83.3)	2 (100)	1 (33.0)	1 (12.5)	2 (100)	2 (66.7)	**0.064**
7-8	83	31 (23.9)	16 (22.0)	7 (64.0)	1 (10.0)	2 (11.1)	0 (0.0)	1 (33.0)	4 (50.0)	0	0	
8-9	62	22 (16.9)	11 (15.0)	1 (9.0)	4 (40.0)	1 (5.6)	0 (0.0)	1 (33.0)	3 (37.5)	0 (0.0)	1 (33.3)	
Total	**245 (100)**	**130 (53.1)**	**73 (56.2)**	**11 (9.0)**	**10 (8.0)**	**18 (14.0)**	**2 (2.0)**	**3 (2.3)**	**8 (6.2)**	**2 (2.0)**	**3 (2.3)**	

Keys: HK- Hookworm, TT- *Trichuris trichuira*, SS- *Strongyloides stecoralis*, HY- Hymenolepis eggs, EV- *Enterobius vermicularis*, IS- Isospora species, AS- *Ascaris lumbricoides*, TA- Taenia eggs, MI- Mixed Infection.
* Significant P value

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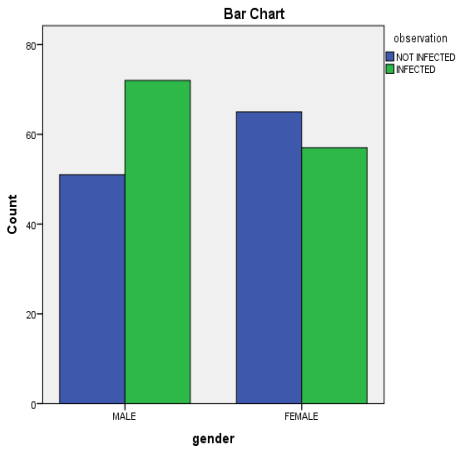

Figure 4:

CONCLUSIONS

The findings from this study show that Gusau Local Area of Zamfara State is highly endemic to helminth infections in varying magnitude among school children. Hookworm has the highest prevalence rate of other parasite infections. The prevalence of helminth infections was more in male pupils than in females. There is a significant decrease in the prevalent rate of helminth infections with age. Holistic control measures including treatment of infected schoolchildren, regular deworming exercise, health education and organization of sensitization, improvement of environmental hygiene and sanitation, and provision of clean water are very important indicators in the control of helminth infection.

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CONFLICT OF INTEREST

There was no conflict of interest.

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