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Prevalence of Gastrointestinal Parasites and Associated Risk Factors among School Children in Biu Local Government Area, Borno State, Nigeria.

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Abstract
Intestinal parasitic infections (IPIs) are among the major public health problems globally, particularly in developing countries like Nigeria. This study was carried out from August to November, 2023 to determine the prevalence of gastrointestinal parasites and associated risk factors among school children in Biu Local Government Area, Borno State, Nigeria. Three hundred and eighty four (384) fecal samples were collected randomly and examined using the standard operating procedure of formol-ether concentration technique. The results showed overall prevalence of 192(50.0%). The prevalence was higher in males 142(60.0%) than in females 50(34.7%). Age group between 11-13 years had the highest prevalence rate of 79(41.1%) followed by 14-16years, 8-10years and 5-7years with 62(32.3%), 37(19.3%) and 14(7.3%) respectively. The difference in infection rate between sexes and age groups were not statistically significant (P>0.05). *Ascaris lumbricoides*had the highest prevalence rate of 73(19.01%) followed by *Giardia intestinalis*, *Entamoeba histolytica*, *Ancylostom aduodenale*, *Trichuris trichiura*, *Enterobius vermicularis* and *Taenia saginata* with 35(9.11%), 27(7.03%), 21(5.47%), 18(4.69%), 12(3.13%) and 6(1.56%), respectively,. The study revealed high prevalence of intestinal parasites in the study area. Factors such as lack of social amenities, poor environmental sanitation and ignorance were observed to enhance the prevalence of gastrointestinal parasites in the area. Therefore, there is need for effective control measures such as massive chemotherapy, provision of adequate social amenities especially portable drinking water, improved sanitation and personal hygiene as well as educating the people on the effects of these parasites.

Keywords: Gastrointestinal Parasite, Prevalence, Faeces Sample, Public Health, Biu.

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Introduction

Globally, intestinal parasitic infections (IPIs) are among the most common infections (Ukpai and Ugwu, 2003). According to Arora and Arora (2014), they affect more than half of the world's population. IPIs constitute a significant global public health concern in under-developed and developing countries (including Nigeria) because of the high morbidity and mortality they cause (Arora and Arora, 2014).They are responsible for over 33% of deaths worldwide (Mulatu *et al.*, 2015). Majority of these diseases caused by the intestinal parasites (helminths and protozoa) have been classified as Neglected Tropical Diseases (NTDs) (Hotez *et al.*, 2014) and as such, they have become a significant public health problem in many developing countries like Nigeria.

In general, majority of the intestinal parasites are transmitted through the faeco-oral route (Alemu *et al.*, 2019). Factors such as

overcrowding, lack of environmental sanitation and safe water, poor hygienic living conditions, severe malnutrition, warm and humid climate, low educational background and lack of personal hygiene are some of the most potential risk factors for IPIs (Tiwari e*t al.,* 2013). The poor hygienic behaviors that influence the infection and transmission of these parasites include indiscriminate disposal of human and animal faeces, which enables contact of faeces and the micro-organisms they harbour with soil or water (Manir *et al.,* 2017); open defecation and walking barefooted. In Nigeria, large amounts of human and animal wastes are dumped into the soil more regularly; causing soil contamination with disease causing organisms like the cysts, eggs and larvae of these intestinal parasites (Udensi and Opara, 2011). In Nigeria, most of the studies on common parasitic infections are mostly carried out in rural areas where lack of proper sanitation and hygiene as well as general ignorance of the disease provide suitable environment for transmission (Damen *et al.,* 2010). Although, most of the infections with parasitic diseases in school children in Nigerian villages may not cause morbidity or mortality, but the disease burden of these infections has been shown to be extremely high (Onyishi and Okafor, 2005).

According to estimates of the World Health Organization, approximately 3.5 billion people are vulnerably exposed to IPIs, and 450 million are already affected; more than half of which are children (Chan, 1997). Usually, a heavy burden is associated with IPIs which is related with 39 million disability-adjusted life years (DALYs), low economic status, high incidence of diseases, and social inequalities. Consequently, these factors lead to financial distress in the family and the community as a whole (Mehraj e*t al.,* 2008).

Ascaris lumbricoides, *Entamoeba histolytica* and *Giardia lamblia* are common public health problems in the developing countries globally. *Ascaris lumbricoides* infects 1.5 billion people worldwide which results in a morbidity rate of 335 million and 60,000 associated mortalities, annually (El-Sherbini and Abosdera, 2013). *Entamoeba histolytica* which is an anaerobic enteric protozoan parasite, is estimated to infect about 50 million people worldwide (Obala *et al.,* 2013). Furthermore, *Giardia intestinalis* which is the most globally common intestinal parasitic protozoan infects more than 200 million people worldwide (Pillai and Kain, 2003).Numerous studies were conducted in different regions and states of Nigeria for the identification of the overall prevalence of IPIs in stool specimens of preschoolers, school children and even post-schoolers which revealed varied prevalence rates which includes Sam-Wobo *et al.* (2012), Adedoyin *et al.* (2015), Samaila *et al.* (2016) and Sanyinna *et al.* (2021). These reports revealed that the majority of IPIs prevalence rates vary from region to region. So, there is a need for periodical assessment of local IPIs to formulate an appropriate control and prevention strategies, especially for the high-risk communities. Furthermore, despite all these studies conducted in Nigeria, there is still dearth of epidemiological information on IPIs in the study area. Therefore, this study was carried out to determine the prevalence of gastrointestinal parasites and associated risk factors among school children in Biu Local Government Area, Borno State, Nigeria.

Materials and Methods

Study Area

The research was carried out in the Biu Local Government Area of Borno State from August to October 2023.Biu LGA is situated in the Borno South Senatorial Zone, Nigeria. Biu is among the largest towns in the region, positioned at approximately latitude 10° 36' 46.26" N and longitude 12° 11' 40.49" E. Nestled on the Biu plateau, the LGA boasts an average elevation of 626 meters above sea level (Britannica, 2009). Geographically, it falls within the Northern Guinea savannah and Sudan savannah regions, experiencing a semi-arid climate with an average temperature of 32˚C 32oC (Kparmwang, *et al*., 1994; Amaza *et al*., 2007). The area exhibits two distinct seasons dry and rainy and spans a landmass of about 3,423.86 km2. The recorded human population stands at

175,760, according to the 2006 census, with Biu located 172 km from Maiduguri, the state capital which serves as the administrative headquarters. Other developed areas within the Local Government include Buratai, Garubula, Miringa, Madara-Girau, Yawi, and Gunda, among others. Biu is home to various tribes, with the Babur (Pabir) tribe being the most populous (Britannica, 2009. Agriculture holds significant economic importance in the region (Amaza *et al*., 2007). The predominant climate elements influencing the study area's climate and impacting the farming system are temperature and precipitation (rainfall). Biu experiences its highest precipitation levels in July, August, and September, with an average of 23 rainy days and 164 mm (6.5 inches) of precipitation per month (Britannica, 2009). Conversely, the driest months are January, February, and December, with an average of 0 mm (0.0 inches) of precipitation during these periods (Britannica, 2009).

Sample Size Determination

Simple random sampling technique was used to select individual from the study area. The sample size was determined by taking 50% expected prevalence and 95% confidence level using the formula described by Thrusfield (2007). Accordingly, a total of 384 students were determined as the sample size for the study.

$N=(Z)^2P_{exp}(1-P_{exp})/d^2$.

Where:

N =required sample size;

d=desired absolute precision;

P_{exp}=expected prevalence.

$N = (1.96)^2*0.5(1-0.5)/0.052=384$ participants.

Sampling Techniques

Three developed areas of Biu Local Government Area, Borno State were randomly selected for the purpose of this research and thirty two (32) faecal samples were collected every week for a period of 12 weeks from September to November, 2023. A total of three hundred and eight four faecal samples were collected from three selected areas namely: Biu metropolis, Buratai and Miringa.

Ethical Consideration

Before the commencement of the study, ethical clearance was obtained from Research and Ethics Committee of Nigerian Army University Biu, Borno State, Nigeria. Introduction letter was signed and approved by the Head, Department of Biology of the University. Upon submission of the introduction letter and other required documents, permission to conduct the study was sought from the managements of the schools. Participants' privacy and confidentiality were strictly observed.

Questionnaire Design and Administration

A structured questionnaire was designed and administered to every volunteer/subject from whom sample was collected. The questionnaire was aimed at obtaining information such as candidate's sex, candidate's age, type of facility used, hand-washing before and after meal, and source of drinking water. It served to gather information on markers of socio-economic status, demographic and geographic variables.

Inclusion and Exclusion Criteria

In this study, any participants among the school children aged 5 to 16 years sampled in the study area who met the criteria and who voluntarily agreed to give informed consent for sample collection were included. However, any participants among the school children sampled in the study area who voluntarily disagreed to give informed consent for sample collection and would not be able to provide accurate information during questionnaire administration even with the interpretation and guidance from their teachers, parents or guardians were excluded.

Sample Collection

Wide mouthed, transparent specimen containers labeled age, sex and location were given to each selected participants in the study area and a structured questionnaire to get the participants data. Prior to this, an introductory letter from the University was submitted to the selected schools which make

the school managements to allow the researchers organize a proper orientation to the students/participants on how and when to collect the samples. The samples collected were transported immediately to the Biology Laboratory of Nigerian Army University Biu for laboratory analysis.

Laboratory Analysis of Faecal Samples

All stool samples collected were analyzed using the standard operating procedure of formol-ether concentration technique for the identification of gastrointestinal parasites according to Cheesbrough (1998) and Ochei and Kolhathar (2007). An applicator stick was used to put 1g of each stool sample into a centrifuge tube containing 7cm^{3}of 10% formal saline. This was emulsified and filtered through a coffee filter into another centrifuge tube. To the faecal suspension, 3cm^{3}of diethyl ether was added and covered using a stopper and shaken vigorously before centrifuging at 3000 revolutions per minute for 3 minutes. After the centrifugation, four distinct layers were formed: sediment, formal saline, faecal debris and ether at the topmost. The faecal debris were dislodged with an applicator stick and the upper 3 layers poured off without disturbing the sediment and examined for the presence of eggs of the parasites. A drop of the deposit was pipetted onto a clean microscope slide and covered with a clean cover slip to avoid air bubbles and over floating. The slides were mounted on the microscope stage and examined with x10 and x40 objective lenses for ova of the parasites as described by CDC (2013).

Identification of the Gastrointestinal Parasites

The gastrointestinal parasites were identified with the aid of World Health Organization Bench Aids for the Diagnosis of Intestinal Parasites – Second Edition (WHO, 2019) and Morphology of Diagnostic Stages of Intestinal Parasites of Humans by Brooke and Melvin (2001).

Data Analysis

The data were all analyzed in Microsoft Office Excel Version 2010. Simple percentage was used to determine the prevalence and chi-square test as the relationships between variables were compared. $P<0.05$ was used to determine the level of significance.

Results

The result showed overall prevalence of 192(50.0%) and a total of seven (7) different species of intestinal parasites recorded. The prevalence was higher in males 142(60.0%) than in females 50(34.7%). Age group between 11-13 years had the highest prevalence rate of 79(41.1%) followed by 14-16 years, 8-10 years and 5-7 years with 62(32.3%), 37(19.3%) and 14(7.3%) respectively. The differences in infection rate between sexes and age groups were statistically significant ($P>0.05$) (Table 1).

The infection was higher among participants whose parents are farmers 82(21.9%) followed by civil servants 57(14.8%), traders 30(7.8%) and others had the least prevalence rate of 23(6.0%). The differences in infection rate between different occupations of the parents of the participants were not statistically significant ($P>0.05$) (Table 2).

Ascaris lumbricoides had the highest prevalence rate of 73(19.01%) followed by *Giardia intestinalis, Entamoeba histolytica, Ancylostoma duodenale, Trichuris trichiura, Enterobius vermicularis and Taenia saginata* with 35(9.11%), 27(7.03%), 21(5.47%), 18(4.69%), 12(3.13%) and 6(1.56%), respectively (Table 3).

Table 1: Prevalence of Intestinal Parasites According to the Age and Gender of the Participants

Parameter	Number Examined	Number Infected (%)	Degree of Freedom	Significance Value	Decision
Age Group					
5-7	96	14(7.3)	3	101.42	Significant
8-10	96	37(19.3)			
11-13	96	79(41.1)			
14-16	96	62(32.3)			
Sub-total	**384**	**192(50.0)**			
Gender			1	21.51	Not Significant
Male	240	142(60.0)			
Female	144	50(34.7)			
Sub-total	**384**	**192(50.0)**			

Table 2: Prevalence of the Gastrointestinal Parasites in Relation to Different Occupational Groups of the Participant Parents

Parent's Occupations	No. Examined	No. Infected (%)	Degree of Freedom	Significance Value	Decision
Civil Servants	103	57(14.8)	3	2.86	Not Significant
Farmers	161	82(21.9)			
Traders	68	30(7.8)			
Others	52	23(6.0)			
Total	**384**	**192(50.0)**			

Table 3: Prevalence of Intestinal Parasites Species Encountered During the Study

Species Encountered	Prevalence (%)
Ascaris lumbricoides	73(19.01)
Giardia intestinalis	35(9.11)
Entamoeba histolytica	27(7.03)
Ancylostoma duodenale	21(5.47)
Trichuris trichiura	18(4.69)
Enterobius vermicularis	12(3.13)
Taenia saginata	6(1.56)
Total	**192(50)**

Discussion

Epidemiological studies on the prevalence of gastrointestinal parasitic infections and associated risk factors in different localities are indispensable particularly among school children to identify high-risk regions and to formulate sufficient prevention and control intervention strategies (Gelaw *et al.,* 2013; Teklemariam *et al.,* 2014; Wale e*t al.,* 2014). This study revealed an overall prevalence 50.0% of gastro intestinal parasites in the area which indicates high endemicity of the parasite in the area. The result of the study is lower than many results earlier reported by Damen *et al.* (2011) who reported 80.9% in Konduga LGA, Borno State, Nigeria, Iduh *et al.* (2015), reported 74.50% among the "Almajiris" in Sokoto metropolis, Sokoto State, Nigeria and Bala *et al.* (2019), reported an overall soil-transmitted helminths prevalence of 60.00% among students in Sokoto State, Nigeria. The results is lower than some of the earlier report of Mohammad *et al*. (2012) on his study the prevalence and associated risk factors of intestinal parasitic infections among school children living in rural and urban communities in Damietta Governorate, Egypt andUsman *et al*. (2017) on prevalence of gastrointestinal parasites and associated risk factors among Patients attending government hospitals in Bauchi State, Nigeria who reported 30.7% and 344.9% respectively.The differences of these results may be attributed by the factors such as lack of good social amenities, poor environmental sanitation, socioeconomic status, geographical zones and ignorance have been observed to enhance the prevalence of intestinal parasites in the area (Usman *et al*., 2017; Usman and Sahura 2023).

Similarly, the higher prevalence rate was found in males (60.0%) than in females (34.7%) counterpart in this study. This finding corroborate with the earlier report of Usman *et al*. (2016), Taiwo *et al.* (2017), Eboh e*t al.* (2022) who all reported higher prevalences gastrointestinal parasite in males than females in Bauchi, Abeokuta and Delta respectively. This observation could be linked to more exposure of males with risk factors such walking barefooted, road side food, playing in an infected environment (swimming and farms) than and their female counterparts. Age-group between 11-13years had the higher prevalence rate (41.1%) than other in this study. This may be due to the fact that children of school-age are more infected with intestinal parasites (Isyaku *et al.,* 2015; Bala *et al.,* 2019; Belete *et al.,* 2021). Although other researchers reported low prevalence in older age groups and are all attributes it to better understanding and more application of proper personal hygiene measures (Gupta *et al.* 2020; Eboh e*t al.* 2022).

Seven different species of parasites were detected in the study area; *Ascarislumbricoides*(19.01%) was the most prevalent parasite followed by *Giardia intestinalis, Entamoeba histolytica, Ancylostoma duodenale, Trichuris trichiura, Enterobius vermicularis* and *Taenia saginata* with (9.11%), (7.03%), (5.47%), (4.69%), (3.13%) and (1.56%) respectively. All these species were detected by other researchers such as; Usman *et al*. 2016; Yuguda *et al.*2018 and Usman *et al.* 2023) in Katagum, Bauchi and Biu Bauchi, Katagum and Biu respectively. The differences in prevalence rate may be due to the favorable conditions, geographical location environmental hygiene, socio-economic conditions, age variations, occupations and application of precautionary control measures among others. Similarly, *Ascaris lumbrucoides* was reported in many studies of gastrointestinal parasite in the country to have the highest prevalence than any other species (Aliyu *et al.,* 2020, and Usman *et al*., 2023). This parasite specie is cosmopolitan usually occurs in a persons or communities with unhygienic habits. The specie affects about 25% of human population worldwide (WHO, 2020).

However, the infection rate was higher among participants whose parents are farmers (21.9%) followed by civil servants (14.8%), traders (7.8%) while others had the least prevalence rate (6.0%). The differences in infection rate between different occupations of the parents of the participants

were not statistically significant (P>0.05). Several Socio-demographic variables such as age, residence, family income and others were previously recorded to predict gastrointestinal parasitic infections among children worldwide (El-Nadi *et al.*, 2017 and Sitotaw and Shiferaw, 2020). Gupta *et al.* (2020) in their study on "prevalence of intestinal parasitosis and associated risk factors among school children of Saptari district, Nepal: a cross-sectional study" also reported that rural schools were more infected (44.6%) than urban schools (30.0%). This could be attributed to several factors such as poor sanitation of the rural environment, low access to clean drinking water, inadequate sewer drainage, and high rate of animal contact; all these factors were previously recorded as risk factors for gastrointestinal parasitic infections (Forson *et al.*, 2017 and Bakarman *et al.*, 2019). Zemene and Shiferaw (2018) reported a higher prevalence in children who had source of drinking water from the river (36.8%), among children from mothers with poor hand washing practice (31.7%), and among children born from illiterate mothers (27.5%). Curiously, previous studies indicated that prevalence rates of gastrointestinal parasitic infections were significantly lower in children belonging to families with high income than those in the middle to low-income families (Radwan *et al.*, 2019; Elmonir *et al.*, 2021). This could be attributed to improved environmental sanitation, efficient food intake, better medical care and a consequent better immune response.

Conclusion

The study revealed high prevalence of intestinal parasites in the study area. *Ascaris lumbricoides*, *Giardia intestinalis* and *Entamoeba histolytica* were the most prevalent parasites. Factors such as lack of social amenities, poor environmental sanitation and ignorance were observed to enhance the prevalence of intestinal parasites in the area. Therefore, there is need for effective control measures such as massive chemotherapy, provision of adequate social amenities especially portable drinking water, improved sanitation and personal hygiene as well as educating the people on the effects of these parasites.

Recommendations

It is highly recommended that periodic screening and treatment of gastrointestinal parasitic infections in school children, deworming of domestic or companion animals to limit zoonotic transmission, public health education about risks and prevention of IPIs particularly concerning contact with stray animal and personal hygiene in the study area. In addition, there is need for government intervention in order to curb the spread of IPIs in the study area. Furthermore, the practice walking barefooted and open defecation should be discouraged among the school children in the study area. These measures may help to prevent or reduce the prevalence and the risks of IPIs to the minimal level in the study area.

Competing Interests

The authors have declared that no competing interests exist.

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