

Investigation of Abiotic Causative Agents of Intestinal Parasitic Infection of School Age Children (6 - 11 Years) in Chikun Local Government Area of Kaduna State

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Abstract

Intestinal parasitic infections are a public health problem for children in rural and urban areas of low-income and middle-income households. Two primary schools were selected from 20 districts in a LGA and a multi-stage sampling technique was used to select 26 pupils comprising of equal numbers of male and female in classes 1 - 6. Questionnaires and sterilized bottle specimen (5 cm³) for stool collection were given out to 1,040 pupils and only 840 respondent specimens were collected and analyzed. Participants were interviewed about sources and use of water and frequency of meal pattern over a seven day period. Stools collected from the respondents were microscopically examined simultaneously as fresh wet mounts using Kato-Katz thick smear and smear from formol-saline concentration techniques. The water samples collected from different sources (well, stream, earth dam, borehole, river and tap) for use within the study area was analyzed following the WHO standard method for sampling water techniques for the presence of microorganisms. The overall prevalence of intestinal parasites abundant in the districts varied significantly ($X^2 = 2.15$; $P < 0.000$). Frequency and percentage analyses of the meal pattern for the school children showed that more number of school children consumed cereal and cereal products food between 4 – 6 times in a week, while the consumption of milk and milk products, meat, fish and eggs were evenly spread within the week. (23.45 and 39.29%, respectively). More number of school children occasionally consumed nuts and legumes and fruits with frequencies range of 47.74 and 53.455, respectively. There was preponderant consumption of vegetables by the school children within the seven day meal pattern recall. The use of well water was found to be a major source of contraction of intestinal parasitic infection as this was statistically significant ($X^2 = 44.18$; $P < 0.05$) when compared to earth dam, borehole, stream and rivers. All the water sources contained different levels of both bacteria and fungi species of intestinal parasites. Based on the findings, it is recommended that the Kaduna State Government should make her presence felt more in Chikun local Government Area by the provisions of portable drinking water, embark on de-worming programme for the school age children. There is the need for the Local Health Authority to give regular health talk to residents and visits to inspect households, environments for proper hygiene and disinfect dug wells periodically.

Keywords: Abiotic causative agents, school age children, intestinal parasitic infection
eyewords: Abiotic causative agents, school age children,

Introduction

Intestinal parasitic worms are macro-organisms that live in the intestine. According to Adekunle (2002) intestinal parasitic infections are among the most prevalent of human parasitic infections worldwide. Infection with intestinal parasitic worms has long been recognized as an important health problem

especially among children worldwide because of their vulnerability (Awogun *et al.*, 1995; Adeyeba and Akinlabi, 2000; Ekundayo *et al.*, 2007; Ogbuagu *et al.*, 2009). Three of the most common kinds of worms infecting children worldwide are roundworm (*Ascaris lumbricoides*), whipworm (*Trichuria trichiura*) and

hookworm (*Ancylostoma duodenale* and *Necator americanus*). These worms live in the intestines and their numbers build up through repeated infections. It is possible to be infected with more than one kind of worm (Ekundayo *et al.*, 2007; da Silva *et al.*, 2016). Parasitic worms are prolific little creatures; they can release tens of thousands of eggs at a time (Miller *et al.*, 2003). The parasite survives by hijacking another 'organism', robbing it of nutrients and "thanking" it by leaving behind toxic waste (Warunee *et al.*, 2007). Their eggs or the freshly hatched larvae are inadvertently transmitted to susceptible human hosts while walking barefooted in the garden or on infected soil contaminated with human faeces or ingested through contaminated water, fruits, vegetables, grains, poultry, fish or meat. The parasite, in addition can be transferred from pets and /or from an infected person (WHO, 2014; Mutapi, 2015).

Despite the efforts of both Federal and State Governments, intestinal parasitic infections has been known to lead to developmental growth problems such as stunting, under weight and wasting especially in Nigeria and Africa at large, disrupting learning ability, school absenteeism among others. The worms can cause malnutrition as they rob the body of food either by reducing appetite or by preventing food from being absorbed properly (Warunee *et al.*, 2007). Heavy infections with roundworm can cause bowel obstruction (WHO, 2014). Intestinal worms-especially hookworm can contribute to anemia by causing intestinal bleeding. The larger the worms the more likely they are to make a person ill. Chronic infections can lead to long-term retardation of mental and physical development and, in very severe infections even death (Terry, 2013).

In Africa, over 90 million school-age children are predisposed and vulnerable

to helminth infections compared to other age groups (Brooker *et al.*, 2006). These are mostly the major problems in rural settlements in Nigeria because of their poor socio-economic status and lack of basic amenities, such as water and toilet facilities (Okon and Oku, 2001; Uchenna *et al.*, 2005).

A total of 40 - 50 million school-age children in sub-Saharan Africa were reported to be infected with hookworm in the year 2009 (Hotez and Kameth, 2009). Multi-parasitism has been reported to be another problem that can exacerbate morbidity in children (Ezeamama *et al.*, 2005; Steinmann *et al.*, 2010). Thomas *et al.* (2014) reported that pupils of age 6 - 13 years in Chikun and Kaduna South Local Government Areas were found to harbor *Ascaris lumbricoides*, 33(52.4%); Hookworm, 14(22.2%); *Taenia spp.*, 12(19.0%) and *Schistosoma mansoni*; 4(6.3%). It was also reported that helminthic infection rate was higher among males (18.5%) than female pupils (13.2%). Pupils within the age group 8 to 9 years had the highest prevalence (42.0%) which decreased with increase in age.

These reports considered the prevalence of intestinal parasites among children using microscopic determinants obtained alone from faecal elements without determining the causes and sources of these intestinal parasites. This study however, was set to underscore some of the precursor to infection by intestinal parasites in children in the study area as there is dearth of information on abiotic factors that could serve as sources of infection to school age children. This research work is therefore, aimed at investigating the intestinal parasitic types and the load in the faeces of the school children (6 -11years) in Chikun Local Government Area (LGA) of Kaduna State, Nigeria as well as

studying some abiotic factors that could lead to school age children being infected by intestinal parasites and also determining the seven day meal pattern of the school age children.

Materials and Methods

Research Design

The research designs used were survey and laboratory analyses. The researcher used the survey design (questionnaire) to collect information on the personal data of the respondents and the laboratory analysis for the stool microscopic examinations in a medical laboratory. This method was used to identify the types and loads of intestinal parasites found in the children's stool.

The Study Area

The study was carried out in the twenty Districts of Chikun Local Government Area (LGA), Kauna State, Nigeria. Chikun LGA is made up of 20 districts namely: Buruku, Chikun, Dutse, Gayan, Gwagwada, Kadi, Kafari, Kakau, Kamazo, Kasarami, Kasaya, Kashebo, Katarma, Kudansa, Kujama, Kuriga, Matagyi, Narayi, Nasarawa and Udawa.

Population of the Study

The population of the study comprised of 72,557 enrolled school children ages 6 – 11 years in public primary schools in Chikun LGA (Chikun LGA Education Authority).

Sample and Sampling Technique

Two schools were purposively selected by picking out of the list of schools from each districts and therefore giving a total of forty public schools that were used for the study. A class register was used to select 26 pupils comprising equal numbers of male and female (13 each) of pupils in primary 1 – 6 within the ages of 6 – 11 years from each of the two schools

selected. A total 840 pupils voluntarily agreed to participate in the exercise and returned their questionnaires. The method of sampling of Fischer *et al.* (1998) was used to determine the prevalence rate of infection among the students as follows:

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

where: n= minimum sample size

z = confidence limit at 95% = 1.96

P= estimated prevalence of parasitic infection among children in Chikun LGA

d= sample error set at 5% = 0.05

Method of Data Collection

A wide mouthed sterile bottle of 5 ml volume was given out by the researcher to the respondents to collect early morning stool for microscopic laboratory evaluation. The stool collected from the respondents were preserved in 10% formalin solution and transported by the researcher to Pinnacle Scan Services laboratory and kept in a metal ice box cooler at a temperature of 4°C until ready for analysis following the method of Alhassan *et al.* (2013) for parasitological examination and analysis for any intestinal parasites. Copies of questionnaire were used by the researcher to obtain information on respondent's personal data, sources of water supply, sanitation and recreation of the respondents including a seven day meal pattern of the respondents. A 5 ml sterile bottle was used to collect water samples from the well, river, stream, earth dam, tap and borehole sources.

Data Analysis Techniques

The data was analyzed using descriptive statistics such as mean, standard deviation, percentages and frequency distribution. The results from stool samples collected from the respondents were analyzed using frequencies and

percentages based on plate count of eggs, ova and larva present in the stools. Water analysis was carried out using the standard plate count method following the method of W.H.O. (2006) to determine mesophilic aerobic bacteria and enumeration of fungi. Chi-square (X^2) statistics was used to test for mean deviations among the population group. The data were analyzed using SPSS Base 16.0 (1999).

Results

Table 1 shows the meal pattern of school children interviewed in the 20 Districts of Chikun LGA, of Kaduna State. The consumption of cereal and cereal product food groups, showed frequencies ranging from 23.33 – 27.90%. Root and tuber consumption was found to be occasionally (24.05%) consumed compared to other days of the week. Most school children consumed milk and milk products occasionally (23.45%), whereas, 17.26% and 12.51% of school children consumed the product once or twice, respectively. 9.76% (n= 82) of the school children responded that they have never taken milk and milk products. The same pattern of

consumption was observed for meat, fish and egg group. Analysis revealed that meat and its allied products were occasionally consumed by 39.29% (n= 330) respondents and this was closely followed by 16.43, 11.90, 7.50, 7.02, 5.12, 4.64, 4.17 and 3.93% for school children who had taken meat, fish and egg products once, twice, never, four, five, six, and seven times, respectively. The frequency of the respondents that consumed products from legume and nuts group was between once to thrice per week (15.0, 13.81 and 11.31%, respectively) and were less than those that consumed the product occasionally (47.74%; n=401). More than 50% of the school children (53.45%; n= 449) ate fruits occasionally while 23.45% (n=197) and 12.14% (n=102) of the school children ate fruits either once or twice, respectively. The consumption of vegetables tends to spread almost evenly (8.45 – 18.81%) within the seven day preceding the study, while only 0.83% (n= 7) of the school children responded that they have not eaten vegetable during the same period. See appendix 1

Table 1: Frequency of Meal Pattern on weekly basis of School Children in Chikun LGA of Kaduna State, Nigeria

Food Group	Once		Twice		Thrice		Four Times		Five Times		Six Times		Seven Times		Occasional		Never		Total	
	*N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Cereal and Cereal Products	0	0	9	1.07	100	11.90	196	23.33	234	27.90	181	21.50	120	14.30	0	0	0	0	840	100
Roots and Tubers	39	4.64	62	7.38	159	18.93	169	20.12	105	12.50	65	7.74	26	3.09	202	24.05	13	1.55	840	100
Milk and Milk Products	145	17.26	105	12.51	82	9.76	65	7.74	66	7.86	48	5.71	50	5.95	197	23.45	82	9.76	840	100
Meat, Fish and Eggs	138	16.43	100	11.90	59	7.02	43	5.12	39	4.64	35	4.17	33	3.93	330	39.29	63	7.5	840	100
Nuts and Legumes	126	15.00	116	13.81	95	11.31	47	5.59	26	3.10	16	1.90	13	1.55	401	47.74	0	0	840	100
Fruits	197	23.45	102	12.14	41	4.88	20	2.38	14	1.67	9	1.07	8	0.96	449	53.45	0	0	840	100
vegetables	158	18.81	149	17.74	142	16.91	122	14.52	104	12.38	87	10.36	71	8.45	7	0.83	0	0	840	100

*= Number of respondents/districts

The distribution of the prevailing intestinal parasites found among school children (6 –11 years) in twenty districts in Chikun LGA, Kaduna State is shown in Figure 1. The intestinal parasites found in the twenty districts varied significantly ($X^2 = 2.15$; $P < 0.000$). *Giardia lamblia*, 45.80% (147), was the

most prevalent parasite found in the districts, followed by *Escherichia coli*, 36.40% (117), which were found to be greater than *Ascaris lumbricoides*, 12.10% (39) and this was found to be more than *Entamoeba histolytica* 4.00% (13); while the least was hookworm, 1.60% (5) as found

in the faecal elements of the school children in the twenty districts of Chikun LGA, respectively. The frequencies and percentages of the different forms of intestinal parasites observed in the study

area are shown in APPENDIX 2: Prevailing Intestinal Parasites found among School Children (6 -11 years) in twenty districts in Chikun LGA,

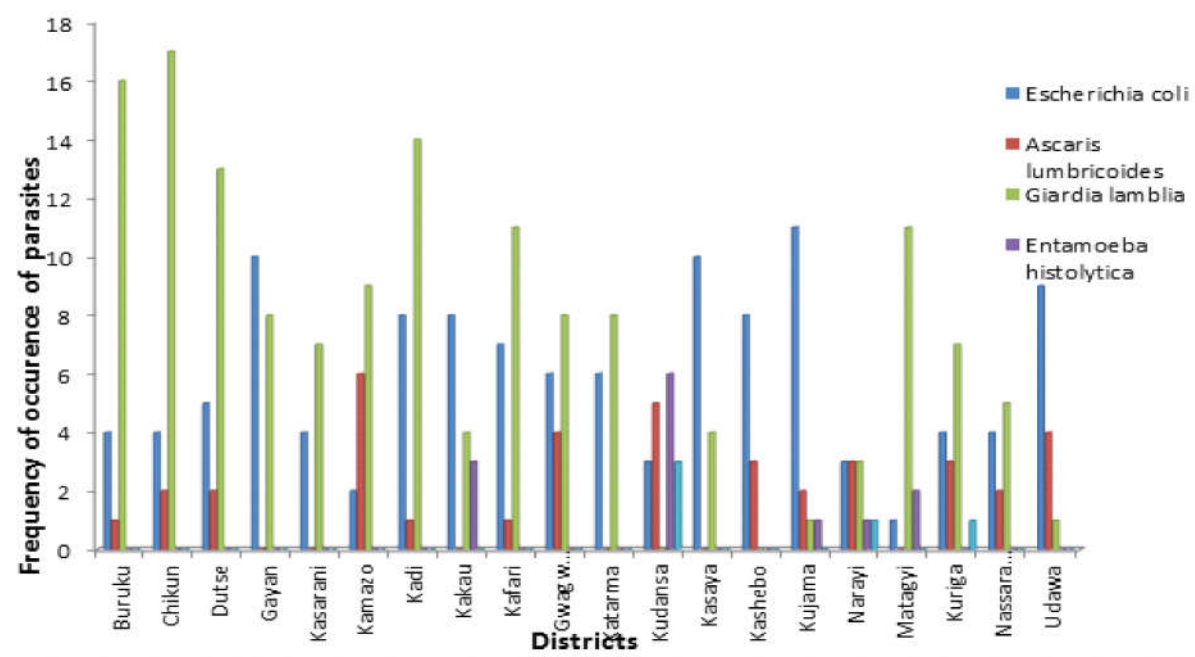


Fig. 1: Frequency and occurrence of intestinal parasites observed in the faeces of the children (6- 11 years) in Chikun LGA, Kaduna State, Nigeria.

*Data represent collections from school age children in two primary schools each in the 20 Districts.

Figure 2. *Giardia lamblia* was the most prevalent parasite (145, 45.31%), followed by *E. coli* (113, 35.31%), Ova of *Ascaris lumbricoides* (17, 5.31%), Ova and Cysts of *Ascaris lumbricoides* (11, 3.44%), Ova of *E. histolytica* (9, 2.81%), Ova of hookworm (6,

1.88%), Cysts of *Ascaris* (5, 1.56%), Cysts of *E. coli* (4, 1.25%), Larva of *Ascaris* (3, 0.94%), Trophozoite of *E. histolytica* (3, 0.94%), *Entamoeba histolytica* (3, 0.94%) and Trophozoite of *Giardia lamblia* (1, 0.31%), respectively.

Prevalence of Intestinal Parasites

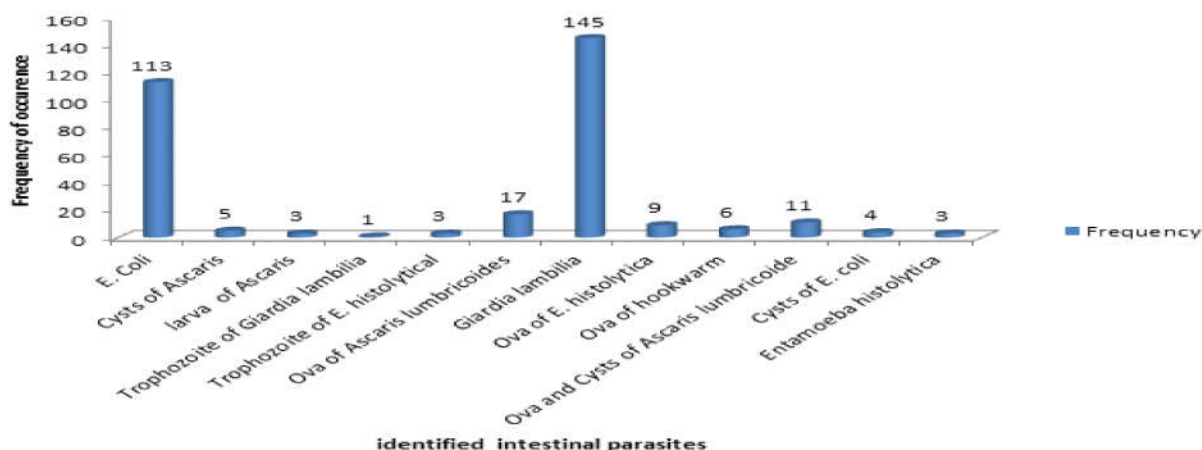


Fig. 2. Frequency of Different Stages of Intestinal Parasites observed in the Faeces of the children (6- 11 years) in ChikunLGA, Kaduna State, Nigeria

The descriptive statistics of the sources of water for drinking and bathing by school-age children examined for intestinal parasitic infection at Chikun LGA, Kaduna State, Nigeria is shown in Table 2. Well water constituted the major source (55.5%) of drinking water, followed by borehole water (33.1%), tap water (5.0%), stream water (3.5%), earth dam water (2.5%) and river (0.5%). Water from the well was also the predominant source for bathing (59.0%) and this was equally followed by borehole water

(29.5%), tap water (5.2%), stream water (3.6%), earth dam water (2.2%) and river (0.5%), respectively. With regard to source of drinking water at home, there were significant ($X^2 = 3.45$; $P < 0.000$) differences between the number of infected pupils and those not infected (Table 2). Well water was a veritable source (80.2%) of parasitic infection. The same was applicable to water from the tap (6.2%), from the stream (5.2%), from the earth dam (2.5%) and from the river (0.9%), respectively.

Table 2. Descriptive analysis of sources of water for drinking and bathing by school-age children (6 – 11 years) examined for intestinal parasitic infection at Chikun LGA, Kaduna State, Nigeria.

Source of Water	Drinking Water		Bathing Water	
	Frequency	Percent (%)	Frequency	Percent (%)
Tap water	42	5.0	44	5.2
Well water	466	55.5	496	59.0
Stream water	29	3.5	30	3.6
Bore hole water	278	33.1	248	29.5
River	4	.5	4	.5
Earth dam water	21	2.5	18	2.2
Total	831	100.0	832	100.0

A similar pattern was observed in the case of sources of bathing water at home. Pupils that bathed using water from the well had the highest percentage of infection (80.2%), followed by those that used tap (6.1%), stream (5.5%), earth dam (2.0%) and river (0.9%), respectively (Table 3). The asymptomatic relationship between swimming activities and different types of water sources for swimming by the school age children (6

– 11 years) in contraction of intestinal parasitic infection is shown in Table 4. Whether the pupils liked swimming or not did not have any significant ($X^2 = 1.14$; $P = 0.567$) relationship with parasitic infection. The same was applicable to sources of water for swimming (stream, river and earth dam) which did not significantly ($X^2 = 1.056$; $P = 0.590$) affect parasitic infection.

Table 3. Association between sources of water for drinking and bathing in relation to prevalence of intestinal parasitic infection among school age children (6 – 11 years) in Chikun LGA, Kaduna State, Nigeria

Parameter	Tap	Well	Stream	Bore hole	River	Earth dam	Total (%)	Pearson Chi-Square (X ²)	P-value
Source of Drinking Water at Home									
Number of pupils infected	27(6.2%) [#]	352(80.2%)	23(5.2%)	22(5.0%)	4(0.9%)	11(2.5%)	439(100.0%)	3.45	0.000**
Number of pupils not infected	15(3.9%)	112(28.9%)	6(1.6%)	253(65.4%)	0(0%)	1(0.3%)	387(100.0%)		
Source of Bathing Water at Home									
Number of pupils infected	27(6.1%)	353(80.2%)	24(5.5%)	23(5.2%)	4(0.9%)	9(2.0%)	440(100.0%)	2.84	0.000**
Number of pupils not infected	16(4.1%)	141(36.4%)	6(1.6%)	223(57.6%)	0(0.0%)	1(0.3%)	387(100.0%)		

** = highly significant at p<0.000

[#] Figures in parentheses are percentage values

A clear pattern was not obtained as regards the materials used for washing hand. For the pupils that were infected, 43.8% claimed to use only water to wash their hands while 56.2% used water and soap (Table 7). With respect to the non-infected pupils, 99.3% used only water while 0.7% used water and soap to wash their hands (X²= 7.38; P<0.000). Washing of hands before eating also did not take a definite pattern as 100% of the pupils were infected

despite the fact that they washed their hands before eating (X²= 62.43; P<0.000). Type of toilet at home did not significantly (X²= 7.01; P= 0.136) affect parasitic infection. It did not really matter whether the children used Water cistern system, Pit latrine or None of the two. Type of toilet at school (Water cistern system, Pit latrine or None of the two) did not also significantly (X²= 6.41; P=0.171) influence parasitic infection.

Table 4A: Effect of personal hygiene by school age children (6 – 11 years) in the prevention of infection by intestinal parasites at Chikun LGA, Kaduna State, Nigeria

Parameter	Total	Pearson Chi-Square (X ²)	P-value
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Materials used for washing hands

	Just water	Water plus soap		
Number of pupils infected	168(43.8%) [#]	216(56.2%)	384(100.0%)	
Number of pupils Not infected	437(99.3%)	3(0.7%)	440(100.0%)	7.38 0.000**

Table 4B: Effect of personal hygiene by school age children (6 - 11 years) in the prevention of infection by intestinal parasites at Chikun LGA, Kaduna State, Nigeria

Parameter				Total	Pearson Chi-Square (X ²)	P-value
Washing of hands before eating						
	Yes		No			
Number of pupils infected	387(100.0%)		0(0.0%)	387(100.0%)		
Number of pupils Not infected	434(98.6%)		6(1.4%)	440(100.0%)	62.43	0.000**
Type of toilet at home						
	Water cistern system	Pit latrine	None of the two			
Number of pupils infected	11(2.9%)	370(96.1%)	4(1.0%)	385(100.0%)		
Number of pupils Not infected	23(5.2%)	404(91.8%)	13(3.0%)	440(100.0%)	7.01	0.136 ^{ns}
Type of toilet at school						
	Water cistern system	Pit latrine	None of the two			
Number of pupils infected	1(0.3%)	378(97.9%)	7(1.8%)	386(100.0%)		
Number of pupils Not infected	3(0.7%)	416(94.5%)	21(4.8%)	440(100.0%)	6.41	0.171 ^{ns}

** = highly significant at $p < 0.000$; ns = not significant at $p > 0.05$.

Figures in parentheses are percentage values

Discussion

The prevalence, frequency and distribution of the prevailing intestinal parasites found among the school age children (6 -11 years) in the twenty districts of Chikun LGA, Kaduna State are shown in Figure 1 and Figure 2. In the results, 12 different forms of intestinal parasites were identified. In this study, *Giardia lamblia* and *E. coli* were found to be more than predominant than *Ascaris*

lumbricoides, Ova and Cysts of *Ascaris lumbricoides*, Ova of *E. histolytica* and Ova of hookworm. In some related studies involving determination of prevalence of intestinal parasitic infections Alhassan *et al.* (2013) reported that *Schistosoma* spp. was the prevalent intestinal parasites among primary school children in Birnin-Gwari Local Government Area of Kaduna State, Nigeria. Houmsou *et al.* (2009) had

also reported that Hookworm, *Ascaris lumbricoides*, *Entamoeba histolytica* were among other intestinal parasites found among primary school children in Makurdi, Benue State, Nigeria. *Entamoeba histolytica*, *Ascaris lumbricoides* and *Schistosoma mansoni* were very prevalent among rural Fulani children in Vom, Plateau State, Nigeria (Okolo and John, 2006). In all these studies, it was established that primary school children do harbour various types of intestinal parasites. Similarly, high prevalence of intestinal parasitic infection has been consistently reported in a number of other countries among school children (Okuyay *et al.*, 2004; Mumtaz *et al.*, 2009). The result of this study is in agreement with all these authors who have proposed that several risk factors are the precursor predisposing children to infection by intestinal parasites.

The results of the sources of water used for drinking and bathing and the association between factors and infected pupils are presented in Tables 1, 2 and 3. The results showed that water from well sources constituted the major source of water for drinking and bathing; and this source seems to be one of the major sources of intestinal parasitic infection for the school age children. Well water is dug through the soil until the water table is reached and thus water is made available for use. At the same time, obtaining water from the well is often through a conveyor which could be a bucket tied to a rope. It is unlikely that the way the buckets which is used to convey water from the well which in most cases are always thrown or put on the ground without care could be the means through which intestinal parasites get to the well water. This has been postulated by Polderman (1975) and Chandiwana (1986) who suggested that it is possible that viable eggs may wash off from the body or from soiled clothing or

materials into the well water. It is possible that it could be through this means that the well is having higher load of intestinal parasites than other sources of water for both drinking and bathing. The results from the present study however, is in agreement with the study of Karan *et al.* (2012) who reported that contaminated well can serve as a source of parasite infection to the community. Also, Nyantekyi *et al.* (2014) reported that contaminated water was a major source of intestinal parasitosis in Ethiopia. Although, the type of hygiene practiced by respondents did not differ significantly, an earlier report has suggested that household who had no habits of washing their hands with soap/detergent had the more likelihood to acquire the parasitic infection than those who had the habit of washing their hands with soap/detergents regularly (Okuyay *et al.*, 2004). Kuete *et al.* (2015) also reported that systematic hand washing practice after defecation significantly lowered *E. histolytica*, *E. dispar* and *E. coli* prevalence rates as well as helminth infection prevalence rates among children.

Conclusion and Recommendation

School age children are vulnerable to exposure to intestinal parasitic infection. The following intestinal parasites were found to be prevalent; *Giardia lamblia*, *Ascaris lumbricoides*, hookworm, *Escherichia coli* and *Entamoeba histolytica*. The following microorganisms such as *Aspergillus* spp., *Penicillium* spp., and *Fusarium* spp. including the following bacteria, *Coliform* spp., *Bacillus* spp., *Streptococci* spp. and *Streptobacilli* spp. were present in the water sources used for drinking and bathing. Based on the findings, the following recommendations are made.

1. Government should make provisions of portable drinking water and embark on de-worming programme for the school age children.
2. Regular health talk to residents and visits to inspect households, environments for proper hygiene and disinfect dug wells periodically.

References

- Adekunle, L. (2002). Intestinal parasites and nutritional Status of Nigerian Children. *African Journal of Biomedical Research*, 5: 115-119.
- Adeyeba, O. A. and Akinlabi, M. A. (2000). Intestinal parasitic infection among school children in rural community, southwest Nigeria. *Nigerian Journal of Parasitology*, 28: 11-18.
- Alhassan, A., Luka, S. A., Balarabe, M. L. and Kogi, E. (2013). Prevalence and Selected Risk Factors of Intestinal Schistosomiasis among Primary School Children in Birnin-Gwari Local Government Area, Kaduna State, Nigeria. *International Journal of Applied Biological Research*, 5(1): 72 – 81.
- Awogun, I. A., Okwerekwu, F. E., Ogawoye, O. A. & Bello A. B. (1995). Helminthic infection and anaemia among pregnant women attending antenatal clinic in Ilorin, Nigeria. *Nigeria Bioscience- Res. Comm.*, 7: 41-45.
- Brooker, S., Clements, A. C. and Bundy, D. A. (2006). Global epidemiology, ecology and control of soil-transmitted helminth infections. *Advance Parasitology*, 62: 221-261.
- Chandiwana, S. K. (1986). How *Schistosoma mansoni* eggs reach natural waterbodies. *Trans R Soc Trop Med Hyg.* 80: 963 – 964.
- da Silva, J. V. L., Fontes, G., dos Santos, C. D., dos Santos, R. V. and da Rocha, E. M. M. (2016). Factors Associated with Gastrointestinal Parasitic Infections among Young Population in Northeast Brazil. *Canadian Journal of Infectious Diseases and Medical Microbiology*, Retrieved from Article ID 6239434, Retrieved from <http://dx.doi.org/10.1155/2016/6239434> 6pp.
- Ekundayo, O. J., Muktar H. Aliyu, M. H. and Pauline E. Jolly, P. E. (2007). A review of intestinal helminthiasis in Nigeria and the need for school-based intervention. *Journal of Rural and Tropical Public Health*, 6: 33-39.
- Hotez, P. J. and Kamath, A. (2009). Neglected Tropical Diseases in Sub-Saharan Africa: Review of Their Prevalence, Distribution, and Disease Burden. *PLoS Neglected Tropical Diseases*, 3(8): 1-10.
- Houmsou, R., Amuta, E. and Olusi, T. (2009). The Prevalence of Intestinal Parasites among primary school children in Makurdi, Benue State, Nigeria. *The International Journal of Infectious Diseases*, 8(1): 1 – 5.
- Karan, A. A., Chapman, B. G. and Galvani, A. (2012). The Influence of Poverty and Culture on the Transmission of Parasitic Infections in Rural Nicaraguan Villages. *Journal of Parasitology Research*, Vol. 2012. Article ID 478292, 12 pp. <http://dx.doi.org/10.1155/2012/478292>
- Kuete, T., Yemeli, F. L. S., Mvoa, E. E., Nkoa, T., Somo, R. M. and Ekobo, A. E. (2015). Prevalence and Risk Factors of Intestinal Helminth and Protozoa Infections in an Urban Setting of Cameroon: the Case of Douala. *American Journal of Epidemiology and Infectious Disease*, 3(2): 36 – 44.

- Miller, S. A., Rosario, C. L., Rojas, E. and Scorza, J. V. (2003). **Intestinal parasitic infection and associated symptoms in children attending day care centres in Trujillo, Venezuela.** *The European Journal of Tropical Medicine and International Health*, 8(4): 342-347.
- Mumtaz, S., Siddiqui, H. and DASHFAQ, T. (2009). Frequency and risk factors for intestinal parasitic infection in children under five years age at a tertiary care hospital in Karachi. *Journal of Pakistan Medical Association (JPMA)*, 59: 216-219.
- Mutapi, F. (2015). Changing Policy and Practice in the Control of Pediatric Schistosomiasis. *Pediatrics*, 135(3): 536 DOI: 10.1542/peds.2014-3189
- Nyantekyi, L., Legesse, M., Medhin, G., Animut, A., Tadesse, K., Macias, C., Degarege, A. and Erko, B. (2014). Community awareness of intestinal parasites and the prevalence of infection among community members of rural Abaye Deneba area, Ethiopia. *Asian Pacific Journal of Tropical Biomedicine (APJTB)*, 4(Suppl. 1): S152-S157.
- Ogbuagu, C. N., Eneanya, C. I., Chukwuma, C., Ogbuagu, E. N. and Oguoma, V. M. (2009). High Prevalence Of Intestinal Parasites In A Nigerian Tertiary Health Institution. *The Internet Journal of Parasitic Diseases*, 4 (2). Retrieved from <https://print.ispub.com/api/0/ispub-article/3778>
- Okolo, S. N. and John, C. (2006). Nutritional status and intestinal parasitic infestation among rural Fulani children in Vom, Plateau State. *Nigerian Journal of Paediatrics*, 33(2): 47-55.
- Okon, O. E. and Oku, E. E. (2001). Prevalence of intestinal parasites among school children in two contrasting communities in Cross River State. *Nigerian Journal of Parasitology*, 22(1and2): 115-120.
- Okyay, P., Ertug, S., Gultekin, O. O. and Beser, E. (2004). Intestinal parasites prevalence and related factors in school children, a western city sample-Turkey. *BMC Public Health*, 2004:64 Retrieved from DOI: 10.1186/1471-2458-4-64.
- Polderman, A. M. (1975). The transmission of intestinal schistosomiasis in Begemder Province, Ethiopia. *Acta Leiden*, 42: 1 - 193.
- Terry, S. (2013). Stomach Parasites in Children. Retrieved from livingstrong.com/diseasesandconditions
- Thomas, H. Z., Jatau, E. D., Inabo, H. I. and Garba, D. D. (2104). Prevalence of intestinal helminths among primary school children in Chikun and Kaduna South Local Government areas of Kaduna state, Nigeria. *Journal of Medicine and Medical Research*, 2(2): 6-11.
- Uchenna, C. O., Nwora, A. O. and Samuel, A. (2005). Helminthiasis in Pregnancy in Enugu, Nigeria. *Journal of Health Science*, 51(3): 291-293.
- Warunee, N., Choomanee, L., Sataporn, P., Rapeeporn, Y., Nuttapong, W., Sompong, S., Thongdee, S., Bang-on, S. and Rachada, K. (2007). Intestinal parasitic infections among school children in Thailand. *Tropical Biomedical Journal*, 24 (2): 83-88.
- WHO (2014). Worldwide prevalence of anaemia 1993 – 2005. World Health Organization, Geneva. Retrieved from http://whqlibdoc.who.int/publications/2008/9789241596657_eng.pdf 51pp.