South Asian Journal of Parasitology

1(2): 40-53, 2018; Article no.SAJP.42363

Prevalence and Predictors of *Entamoeba histolytica* Infection among School-age Children in Wamakko Local Government Area, Sokoto State Nigeria

K. Mohammed[1*], I. Tijjani[1], T. H. I. Spencer[1], A. B. Mohammed[2], M. K. Garba[1], S. U. Nataala[1], A. U. Imam[1] and O. F. Aschroft[1]

[1]Department of Medical Microbiology, Faculty of Medical Laboratory Sciences, Usmanu Danfodiyo University, Sokoto, Nigeria.
[2]Department of Medical Microbiology, Aminu Kano University Teaching Hospital, Kano State, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Authors KM, and IT designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors THIS, ABM and MKG managed the analyses of the study. Authors SUN, AUI and OFA managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/SAJP/2018/42363
Editor(s):
(1) Dr. Sirigireddy Sivajothi, Department of Veterinary Parasitology, College of Veterinary Science, Sri Venkateswara Veterinary University, Andhra Pradesh, India.
Reviewers:
(1) Oti Baba Victor, Nasarawa State University, Nigeria.
(2) Shamala Moodley, Mangosuthu University, South Africa.
Complete Peer review History: http://www.sciencedomain.org/review-history/25421

Original Research Article

Received 17th April 2018
Accepted 28th June 2018
Published 6th July 2018

ABSTRACT

Entamoeba histolytica is an important protozoan of man, it is the third most common and widespread parasitic cause of death world-wide.
Aims: The study was aimed at determining the prevalence and predictors of *Entamoeba histolytica* among primary school children in Wamakko Local Government area of Sokoto state.
Study Design: This was a cross-sectional, descriptive study
Place and Duration of Study: This study was conducted among school-aged children, in Wamakko Local Government Area, Sokoto State, between May 2016 to November 2017.
Methodology: Faecal samples were collected from three hundred and seventy-one (371) pupils and analysed using direct wet smear and Formol Ether Concentration Technique.
Results: The overall prevalence was found to be 211 (56.9%). Although more males pupils are

Corresponding author: E-mail: kmohd1970@yahoo.co.uk;

infected with 50.5% than a female with 49.6%, the difference was not statistically significant (*p-value* = 0.330). The higher prevalence of infection obtained from males pupils might be attributed to male children being more engaged in extracurricular activities such as recreational activities and games. With regards to age groups used in the study, 29 pupils within age group of 14-15 years, 19 (65.5%) were found to be infected with *E. histolytica* and has the highest prevalence of infection, this was attributed to the fact that being older they engaged in activities such as assisting their parent in farming like irrigation, taking manure to farm etc.

Conclusion: The findings of the study reveals that there was a high prevalence of *E. histolytica* in the study area and is still a major public health problem in north-western Nigeria. This also showed that personal hygiene, environmental sanitation and poor access to safe water contributes to transmission of *E. histolytica* in the study area.

It also reveals that the control measures taken are not effective and this could be among the difficulties encounter for the control of amoebiasis in the study area.

Great success toward the control of the infection can be achieved through the integration of complementary strategies by government agencies and non-governmental organisations such as disease surveillance, mass chemotherapy, health education, construction and use of toilets in all primary schools, religious centres, markets and the general public sanitation.

Keywords: Prevalence; predictors; Entamoeba histolytica; school children; Wamakko; Sokoto State; Nigeria.

1. INTRODUCTION

Entamoeba histolytica is an intestinal protozoa of humans. Several species of the genus Entamoeba infect humans. These include: *Entamoeba histolytica, Entamoeba dispar, Entamoeba coli, Entamoeba hartmani, Entamoeba polecki, and Entamoeba gingivalis* [1]. Among these, only *E. histolytica* is considered pathogenic and the disease it causes is called amoebiasis or amoebic dysentery [2]. *Entamoeba histolytica* is an enteric parasite that colonizes the human intestinal lumen and has the capacity to invade the epithelium. Amoebic dysentery occurs when *E. histolytica* trophozoites invade the walls of large intestines and multiply in the mucosa, forming ulcers. Most frequent manifestations of infection are dysentery, colitis, flatulent stomach, weight loss, fatigue and abdominal pain. A common outcome of the invasion of the amoeba into tissues is liver abscesses which can be fatal. The pathogen secretes histolysin [3], which digest the gut of the infected individual hence the Latin name, *histo* (tissue) *lytica* (destruction) [4].

Amoebiasis is a condition due to the infection by *Entamoeba histolytica* and is known to cause about 450 million infections per annum in developing countries, with an incidence of about 50 million and 100,000 deaths [5]). Intestinal Amoebiasis is said to be the world greatest cause of death attributed to parasitic infection after malaria and schistosomiasis [6]. The infection is acquired through the feacal-oral route by consumption of food, water or drinks contaminated with cysts of the parasite. Licking or sucking of faecal contaminated hands have been documented to introduce the infection to humans [7]. *E. histolytica* is an aerobic parasitic protozoan belonging to Genus Entamoeba and an etiology agent of Amoebiasis. *E. histolytica* is pathogenic in the caecum and colon of human being. The term ‘histolytica literally means “Tissue dissolving’’ referring to the carnivorous habit of the organism. *E. histolytica* is the most unique among the amoebas because of its ability to hydrolyse host tissue. It can become a highly virulent and invasive organism causing diarrhoea. Acute infection of Amoebiasis may be presented with other infection apart from bloody diarrhoea such as ulceration of the colonic mucosa, abdominal pain and a palpable mass in corresponding areas of the abdomen. Amoebiasis may give rise to amoebic liver abscess and intestinal pathologies [7]. Amoebiasis is widely spread in its distribution, occurring in all parts of the world. The invasive amoebiasis is more prevalent in certain areas of the world including West and South-East Africa, China, Mexico and Western portions of South America, and the India subcontinent [8].

Ingestion of contaminated food or water containing infectious cysts leads to encystation in the intestine. Each cyst produces eight motile trophozoites which colonise the host's colon. In those cases where the infection is not self-limiting, amoebic dysentery and liver abscesses formation can occur. Ninety percent of infections with *E. histolytica* are asymptomatic and self-limiting. [1] reported that an estimated 50 million cases of invasive infection occur twice annually. According to [9], amoebiasis is ranked the third most important parasitic disease and that 100,000 deaths occur annually due to the disease. Intestinal parasites infections (IPIs) are globally endemic and have been described as constituting the most significant single worldwide causes of illness and diseases [10].

2. MATERIALS AND METHODS

2.1 Study Area

Sokoto state, which is in the extreme Northwest of Nigeria between longitude 05º11¹ to 13º East and latitude 13º00¹ to 13º06¹ North. The state shares borders with the Republic of Niger to the North, Kebbi to the West and Southeast and Zamfara to the east. The state covers a land area of about 60.33 km², and based on 2006 census, the state has a population of 3,696,999. Sokoto state has an annual average temperature of 28ºC (82.9ºF). Sokoto is, on a whole, a very hot area. However, maximum daytime temperatures are most of the year generally under 40ºC (104.0ºF). The warmest months are February to April when daytime temperature can exceed 45ºC (113.0ºF). Wamakko is a Local Government Area in Sokoto State, North Western Nigeria. Its headquarters is in the town of Wamakko. It has both urban and rural settlement. It lies between latitude 13º2′ 16″ N longitude 5º5′ 37″ E with annual average temperature of 28.3ºC (82.9ºF). It has an area of 697 km² and a population of 179,619 at the 2006 census [11]. The concentration of wealth, prestige, the political power and religious learning centres in Wamakko attracted large numbers of rural-urban migrants, both from the neighbouring state and from distant regions. Hausa-Fulani people mainly dominate Wamakko Local government.

2.2 Study Population

The study population consists of 371 school aged children, Sokoto, North-Western, Nigeria. Aged range between 6 to 15 years.

2.3 Study Design

This is an observational cross sectional study aimed at determining the prevalence and predictors of *Entamoeba histolytica* among primary school children in the study area. The research was conducted during the raining season from May, 2016- November, 2017. The procedure was explained to all participants and were each given the consent forms to sign. Questionnaires were distributed to generate information on their bio-data

2.4 Inclusion and Exclusion Criteria

2.4.1 Inclusion criteria

1. Pupils within the age range between 6 to 15 years of age were included in the research. These are the ages most at the risk of infection with intestinal parasites [12].
2. Pupils who gave their consent to participate in the study
3. Pupils who were present during the initial day of the study.

2.4.2 Exclusion criteria

1. Pupils that do not fulfil the above age range were excluded in the research.
2. Pupils who refused to give consent in the study.
3. Pupils who were absent during the initial day of the study will be excluded.

2.5 Sample Size Determination and Sampling Techniques

2.5.1 Sample size determination

The sample size was calculated using the prevalence rate of *E. histolytica* in Akure, Ondo State, Nigeria (prevalence = 67.6%, 67.6 /100 = 0.676) [13]. A standard epidemiological formula is used to calculate the sample size as follows;

$$n = \frac{z^2pq}{d^2} \quad [14]$$

Where;

n = Sample size,
z = standard normal distribution at 95% (1.96) confidence interval p = prevalence rate 67.6% (0.676), [13]
q = 1-p,
1 = is the maximum value of probability,
d = allowable error taken as 5% (0.05)

$$n = \frac{(1.96)^2 \times 0.676 \times (1-0.676)}{(0.05)^2}$$

$$= 336.6 \approx 337 \text{ subjects}$$

Drop out 10%. Therefore, 337 +(0.1×337)
Actual sample size=371 subjects

2.5.2 Sampling techniques

Wamakko Local Government area has a total of 92 primary schools. A cluster random sampling was used to sample the schools. The schools were clustered into two (2) zones (Wamakko South and Wamakko North) and then two schools were picked randomly from each zone. The selected schools are; Dundaye model primary School, Bakin Gulfi primary school, Kalambaina primary school and Wajeke primary school. 93 pupils were selected randomly from each of the three sampled schools (279 pupils) and 92 pupils from one sampled school to fulfil the sample size (371).

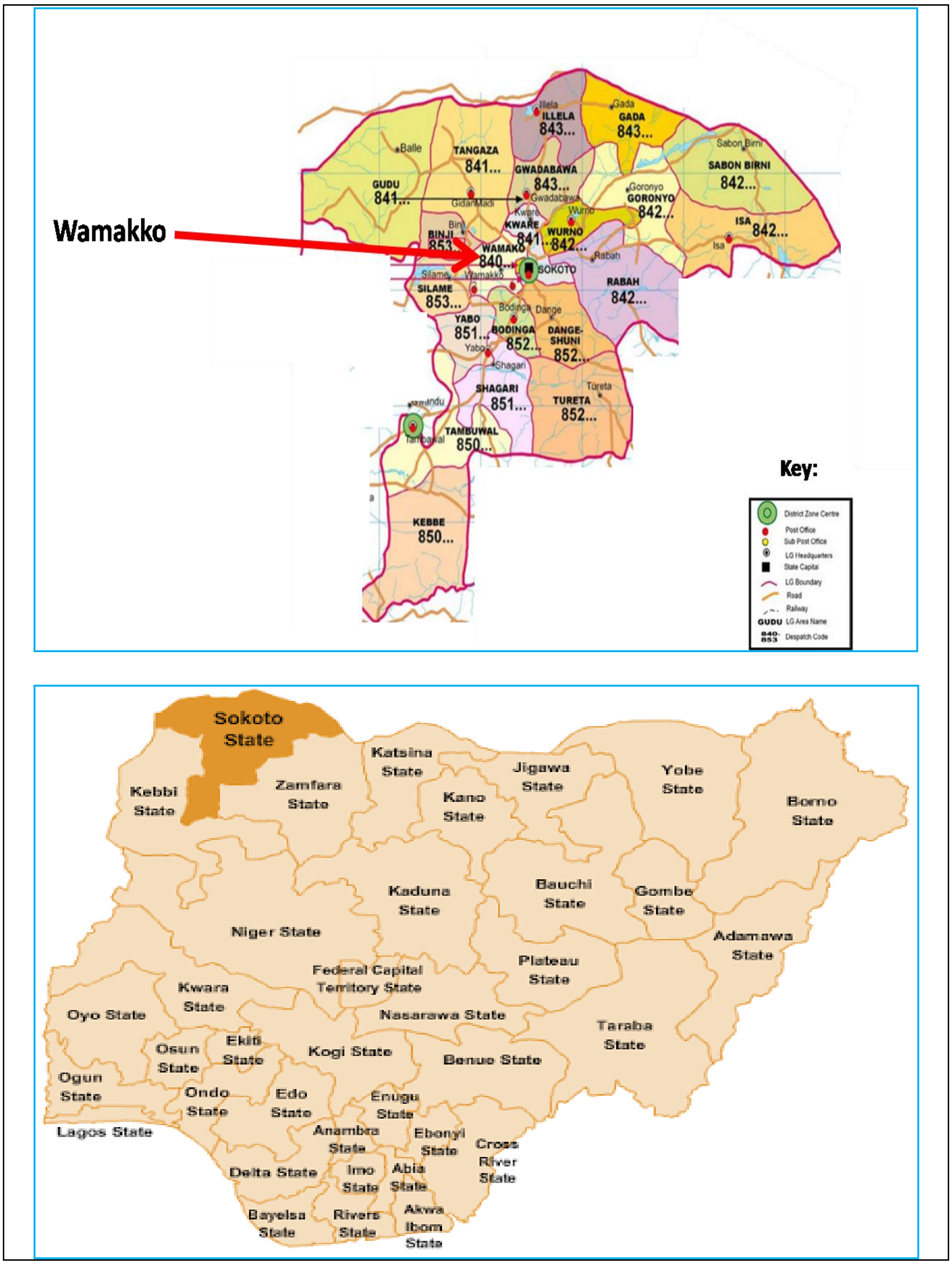

Fig. 1. Map of Nigeria and Sokoto state indicating Wamakko local government
Source: *https://www.maps-streetview.com*

2.6 Sample Collection

A total of 371pupils aged between 6 to 15 years were enrolled in the study. Clean, labelled wide mouth faecal plastic specimen container were given to the pupils and they were instructed on how to introduce sample (stool) into the sample containers. Applicator sticks and tissue papers were given to them as apparatus for sample collection. Two days were allocated to each school for the sample collection. Stool samples were collected and transported to the School of Medical Laboratory Science UDUS, Department of Medical Microbiology for parasitological examination.

2.7 Laboratory Techniques

2.7.1 Macroscopy

The collected stool specimens were first observed physically for consistency, presence of blood stains, mucous and any macroscopic parasites [15].

2.7.2 Microscopy (Preparation of faecal smears and identification of parasite)

2.7.2.1 Wet preparation (Saline and Iodine)

i. Drop of lugol iodine was place at a centre of a clean microscope glass slide.
ii. Small portion of stool specimen was emulsified on the iodine using an applicator stick, and was covered with a cover slip.
iii. It was examine under microscope for cysts and eggs of the parasites systematically using 10X and 40X objectives lens.
iv. The same procedure was used to examine for the Trophozoite, but normal saline was used in place of Lugol's iodine.

This method was used because iodine stains the nucleus of *E. histolytica* properly for easy identification [15].

2.7.2.2 Formol-ether concentration technique

Concentration technique was also employed in analysing the faecal samples.

Procedure:

i. Using an applicator stick, about 1 g (pea-size) of faeces was emulsified in about 4 ml of 10% formol saline contained in a screw-cap bottle or tube.
ii. A further 3ml of 10% v/v formol saline was added and the bottle capped, then it mixed well by shaking.
iii. The emulsified faeces was sieved and the sieved suspension was collected in a beaker.
iv. The suspension was transferred to a conical (centrifuge) tube made of strong glass followed by addition of 3–4 ml of diethyl ether.
v. The tube was stoppered and mixed for 1 minute. And with a tissue or piece of cloth wrapped around the top of the tube, the stopper was loosen.
vi. The tube was centrifuged immediately at 3000 rpm for 1 minute.
vii. Using a stick, the layer of faecal debris was loosen from the side of the tube and the tube *inverted* to discard the ether, faecal debris, and formol water. The sediment remained.
viii. The tube was returned to its upright position and the fluid from the side of the tube was allowed to drain to the bottom. The bottom of the tube was tapped to re-suspend and mix the sediment.
ix. The sediment was then transferred to a slide, and covered with a cover glass.
x. The preparation was examined microscopically using the 10X objective with the condenser iris *closed sufficiently* to give good contrast. Using the 40X objective to examine small cysts and eggs [15].

2.8 Research Tools

2.8.1 Questionaire

Questionnaire were used in this study to obtain data on both Socio- Demographical characteristic and risk factor. Socio-Demographic characteristic include age and sex while risk factor include; source of drinking water, type of toilet used, personnel hygiene etc.

2.8.2 Validation of the questionnaire

The questionnaire was made valid by passing it through research experts.

2.8.3 Domain of the questionnaire

The questionnaire has three domains. This includes;

Section A: this consists of the socio demographic data such as age, sex, gender, etc.

Section B: this consists of the Risk factors associated to the subject matter (*Entamoeba histolytica*) source of drinking water, type of toilet used etc.

Section C: Laboratory diagnosis result for *Entamoeba histolytica.*

2.9 Statistical Analysis

Data collected was analysed using the Statistical Package for Social Science (SPSS) Version 21.0. Chi-square test was used to determine the association between variables. Simple and multiple logistic regression analysis were used to determine the associated risk factors of the infections. Values were considered statistically significant at $P < 0.05$.

2.10 Ethical Approval

Permission to conduct the research was obtained from the Ethics and Research Committee of the Ministry of health Sokoto State and Local Education Authority of Wamakko Local Government Area of Sokoto State. Participation of the pupils was voluntary. All respondents were asked to give an informed consent through their parents or legal guardians.

3. RESULTS

The result of our findings shows that a total of three hundred and seventy one (371) pupils were examined for *E. histolytica* infection and are within aged range of 6-15 years old. All the participants are from Wamakko local government area of Sokoto State, Nigeria. Out of the number examined, two hundred and eleven (211) pupils (56.9%) were found to be infected with *E. histolytica*.

i. **Table 1 and Table 2 Socio-Demographic Characteristic of the Respondents**

Result shows that out of the three hundred and seventy one (371) pupils enrolled and participated in this study, 50.3% were male pupils and 49.6% were females pupils. Within the five age groups used in the study 26.3% are between aged 6-7 years, 25.8% are between aged 8-9 years, 19.4% are between aged 10-11 years, 20.4 are between aged 12-13 years and 7.8% are between aged 14-15 years. Out three hundred and seventy one (371) pupils responded water sources 45.7% consume borehole/ tap water 37.9% consume well water and 16.1% consume river/stream water out of three hundred and seventy one pupils (371) respond to presence latrine 60.4% have latrine at home while 53.1% do not have latrine at home (Table 1).

Table 1. Socio-demographic characteristic with respect to age group, gender, sources of water, presence latrine, open defecation, washing of hand before and after eating

Variables	Frequency (F)	Percentage (%)
Age group (years)		
6-7	98	26.3
8-9	96	25.8
10-11	72	19.4
12-13	76	20.4
14-15	29	7.8
Gender		
Female	184	49.5
Male	187	50.3
Sources of water		
Bore hole/tap water	170	45.7
Well water	141	37.9
River/stream	60	16.1
Presence of latrine		
Yes	179	48.1
No	192	51.6
Open defecation		
Yes	192	51.6
No	179	48.1
Washing of hand before and after eating		
Yes	185	49.7
No	186	50.0

Source: Field data.

Result also shows that out of 371 pupils respond to open field defecation toilet system 51.6% respond to yes while 48.1% respond to No. Out of the 371 pupils respond to washing of hands before and after eating 49.7% respond to Yes while 50.0% respond to No. Similarly, out of 371 pupils that responds to washing of hands before and after defecation 47.3% responds Yes while 52.4% responds to No. out of three hundred and seventy one pupils responds to how the dispose refuse at home, 7.8% dispose their refuse in garbage pit, 64.5% dispose their refuse outside their compounds and 27.4% dispose their refuse in dust-bin. Out of 371 pupils respond to level of income of parents/guardians, 9.4% are from the parents/guardians of high level incomes, 53.5% are from the parents/guardians of low level incomes and 36.8% are from the parents/guardians of medium level incomes. Out of the 371 pupils respond to treating drinking water at home, 36.1% responds to yes while 63.9% responds to No (Table 2).

ii. Table 3 prevalence of *E. Histolytica* Infection

Prevalence and distribution of intestinal amoebiasis with regard to age group, gender, sources of water, presence of latrine, open defecation, washing hands before and after eating. The result distribution based on age groups shows that, out 98 pupils age between 6-7 year, 59 (60.2%) are found to be infected with *E. histolytica*, out of 72 pupils aged between 10-11 years, 38 (52.8%) are found to be infected with *E. histolytica*, out of 76 pupils aged between 12-13 years 19 (56.6%) are found to be infected with *E. histolytica*. (P-value =0.716) (Table 3).

The result distribution based on gender shows that out of one hundred and eighty seven (187) male pupils, 111 (59.4%) are found to be infected with *E. histolytica*, out of184 female pupils, 100 (54.3%) are found to be infected with *E. histolytica,* this shows that female has the lowest prevalence of infection compared to their male counterpart, (P-value =0.330).

The result based on water source shows that those who used river/stream water source has the highest prevalence rate of 71.7% followed by those that consume well water with prevalence rate of 62.2% and those that drink borehole /tap water has the least prevalence rate of 47.1% (*p-value*=0.001).

The result based on the presence of latrine shows that those who have latrine at home has the lower prevalence infection of 55.3% while those that do not have the highest prevalence rate of 58.6% (P-value=0.523).

Result based on the defecation in an open source show that out of 192 pupils that defecate in an open source 116 (60.4%) pupils were found to be infected with *E. histolytica*, while out of 129 pupils that do not defecate in an open sources, 95 (53.1%) pupils were found to be infected with *E. histolytica*, and it shows the lower prevalence infection (P-value=0.154). With regards to the washing hands before and after eating shows that out of 185 pupils that washes their hands before and after eating 91 (49.2%) pupils are found to be infected with *E. histolytica*, while out of 186 pupils that do not washes their hands before and after eating 120 (64.5%) were found to be infected with *E. histolytica,* and show the highest prevalence of infection (P-value=0.003).

Table 2. Socio-demographic characteristics with respect to washing of hands before and after defecation, refuse disposal, level of income of parent/guardian and treating drinking water at home

Variables	Frequency (F)	Percentage (%)
Washing of hand before and after defecation		
Yes	176	47.3
No	195	52.4
Refuse disposal		
Garbage pit	29	7.8
Outside compound	240	64.5
Dust bin	102	27.4
Level of income of Parent/guardians		
High	35	9.4
Low	199	53.5
Medium	137	36.8
Treating drinking water at home		
Yes	134	36.1
No	237	63.9

Source: Field data

Table 3. Prevalence and Distribution of intestinal amoebiasis among study population with respects to variables studied

Variables	*Entamoeba histolytica*		Total N (%)	p-value[a]
	Infection N (%)	No Infection N (%)		
Age group (years)				0.716
6-7	59 (60.2)	39(39.8)	98(100.0)	
8-9	52(54.2)	44 (45.8)	96 (100.0)	
10-11	38 (52.8)	34 (47.2)	72 (100.0)	
12-13	43 (56.6)	33 (43.4)	76 (100.0)	
14-15	19 (65.5)	10 (34.5)	29 (100.0)	
Gender				0.330
Female	100 (54.3)	84 (45.7)	184 (100.0)	
Male	111 (59.4)	76 (40.6)	187 (100.0)	
Sources of water				0.001
Bore hole/tap water	80 (47.1)	90 (52.9)	170 (100.0)	
Well water	88 (62.2)	53 (37.6)	141 (100.0)	
River/stream	43 (71.7)	17 (28.3)	60 (100.0)	
Presence of latrine				0.523
Yes	109 (55.3)	88 (44.7)	197 (100.0)	
No	102 (58.6)	72 (41.4)	174 (100.0)	
Open defecation				0.154
Yes	116 (60.4)	76 (39.6)	192 (100.0)	
No	95 (53.1)	84 (46.9)	129 (100.0)	
Washing of hands before and after eating				0.003
Yes	91(49.2)	94(50.8)	185(100.0)	
No	120 (64.5)	66 (35.5)	186 (100.0)	
Washing of hands before and after defecation				0.034
Yes	90 (51.1	86(48.9)	176(100.0)	
No	121(62.1)	74(37.9)	195(100.0)	
Refuse disposal				0.052
Garbage pit	16(55.5)	13(44.8	29(100.0)	
Outside compound	147(61.2)	93(38.8)	240(100.0	
Dust bin	48(47.1)	54(52.9)	102(100.0	
Level of income of parent/guardian				0.001
High	11(31.4)	24 (68.6)	35 (100.0)	
Low	136(68.3)	63 (37.1)	199 (100.0)	
Medium	64(46.7)	73(53.3)	137 (100.0)	
Treating drinking water				0.034
Yes	80(59.7)	54 (40.3)	134 (100.0)	
No	131 (55.3)	106 (44.7)	237 (100.0)	

Key: a = Pearson chi-square test
Source: Field data

With respect to washing of hands before and after defecation, refuse disposal, level of income of parents /guardians. Those washing hands before and after defecation shows that out of 176 pupils, 90 (51.1%) pupils are found to infected with *E. histolytica*, while out of 195 pupils that do not washes their hands before and after defecation 121 (62.1%) pupils are found to be infected with *E. histolytica*, and shows the higher prevalence infection (P-value=0.034) Table 3. With regards to refuse dispose at home shows that, out 240 pupils that dispose of refuse outside their compounds 147 (61.2%) are found to be infected with *E. histolytica* and shows the highest prevalence of infection, out of 29 pupils that dispose refuse in garbage pit 16 (55.5%) pupils are found to be infected with *E. histolytica,* out of 102 pupils that dispose refuse through dust-bin 48 (47.1%) are found to be infected with *E. histolytica*, and show the least prevalence infection (P-value=0.052) Table 3.

Result based on level of income of parents /guardians show that out of 199 pupils with parents/guardian of low level incomes 136 (68.3%) pupils are found to be infected with *E. histolytica*, and shows the highest prevalence infection, out of 137 pupils with parents/guardians of medium level incomes 64 (46.7%) pupils are found to be infected with *E. histolytica*, out of 35 pupils with parents /guardians of high level incomes 11 (31.4%) pupils were found to be infected with *E. histolytica*, and shows the least prevalence infection (P-value=0.001). Result based on treating drinking water at home show that out of 134 pupils that treat drinking at home before consuming 80(59.7%) were found to be infected with *E. histolytica*, while out 237 pupils that do not treat drinking water 131 (55.3%) were found to be infected with *E. histolytica,* and shows the lower prevalence infection (P-value=0.034) Table 3.

iii. Table 4 and Table 5 Simple and Multiple Logistic Regression Analysis

The result from Table 4 shows that there is a strong association between washing of hands before and after eating and *E. histolytica* infection. However, those that do not washes their hands before and after eating are at high risk of infection 1.87 times (OR; 95% CI, 1.24, 2.84, P- value <0.003) compared those that washes hands before and after eating, and *statistically* significant different was observed p< 0.05. the strong association recorded in the study might linked to the hands can act as conduits to transfer cysts from surface in or outside the home, currency, food and animals (pets of wild). Also the result shows that there is a strong association between washes hands before and after defecation and *E. histolytica* infection. However, those that do not washes their hands before and after defecation are at high risk of infection 0.45 times (OR; 95% CI, 1.03, 2.36 P- value <0.034) compared to those that washes their hands and a statistically significant difference in the variable observed P <0.05.

Table 4. Shows simple logistic regression analysis with respect to intestinal amoebiasis in relation to risk factors studied

Variables	* b	** Exp (B) OR (95% CI)	Wald statistic	*p- value*
Sources of water				
Bore hole/tap water	0	1.00		
Well water	0.625	1.86 (1.18, 2.94)	7.25	0.007
River/stream	1.046	2.84 (1.50, 5.38)	10.34	0.001
Washing of hands before and after eating				
Yes	0	1.00		
No	0.63	1.87 (1.24, 2.84)	8.81	0.003
Washing of hand before and after defecation				
Yes	0	1.00		
No	0.45	1.56 (1.03, 2.36)	4.47	0.034
Level of income of parents/guardians				
High	0	1.00		
Low	1.550	0.47 (2.17, 10.2)	15.4	0.001
Medium	0.649	1.91 (0.86, 4.20)	2.59	0.107
Treating drinking water				
Yes	0	1.00		
No	-0.181	0.83 (0.53, 1.28)		0.408

Table 5. Shows multiple logistic regression analysis with respect to intestinal amoebiasis in relation to the risk factors studied

Variables	* b	** Exp (B) OR (95% CI)	Wald statistic	*p- value*
Sources of water				
Bore hole/tap water	0	1.00		
Well water	0.532	1.702(1.055,2.745)	4.759	0.029
River/stream	1.064	2.897(1.493,5.622)	9.885	0.002
Level of income of parent/ guardians				
High	0	1.00		
Low	1.483	4.317(1.497,9.575)	12.955	0.001
Medium	0.623	1.855(0.828,4.17)	2.266	0.132

*Key: *Regression co-efficient*
*** Crude odds ratio*

The result from Table 5 above shows that there is strong association between source of water and *E. histolytica* infection. However, those that consume river/stream water are at high risk of infection 2.897 times (OR 95% CI 1.493, 5.622 P- value < 0.002) compared to those that consume borehole/tap water and statistically significance difference in the variable observed P< 0.05. This might be attributed to the fact that human and domestic /wild animals use these (River/stream) a situation that could lead to contamination with faeces and subsequent infection of exposed individuals. Also result shows that there is strong association between level of income of parents/guardians and E. histolytica infection. However those pupils with parents/guardians of low level income are at high risk of infection 4.317 times (OR 95% CI 1.493, 5.622, P-value< 0.001) compared to those pupils with parents/guardians of high level incomes and statistically significant difference in the variable observed P< 0.05.

4. DISCUSSION

The result of the present study showed that the overall prevalence of intestinal amoebiasis among primary school children in Wamakko Local Government Area of Sokoto State was 56.9%. This high prevalence infection was attributed to poor water source. The finding is line with finding by [16]. With 56.8% in Lere Kaduna State, North Western Nigeria. The high prevalence could also be linked to poor sanitary condition within both urban and rural settlements of the study area. The prevalence obtained in this study was higher compared to study carried out by [17]. With 54.2%. [18]. With 46% in Bosso town Niger State North central Nigeria, [19], with 30.8% [20] With 42.1% the high finding might be attributed to resistant cyst of *E. histolytica* in the study area which can withstand adverse condition [17]. The prevalence obtained in this study was lower compared to study carried out by [21] with 72% in Abeokuta Ogun State South western Nigeria, [22] with 80.9% in konduga Borno State North eastern Nigeria, [23] with 64.1% in Akonkwo Imo State South Eastern Nigeria,[13] with 67.6% among primary school children in Akure Ondo State South Western Nigeria.

The results based on age groups indicate that prevalence of *E. histolytica* among pupils of 14-15 years shows the highest infection rate of 65.5%, this was attributed to the fact being older they engaged in activities such as assisting their parent in farming activities such irrigation, taking manure to farms. This agreed with the research carried out by [24] among primary school children in Kyuso Zone, Kyuso district of Kenya, which recorded highest prevalence in older pupils then the younger ones. However this finding is not in line with the prevalence infection of research carried out by [13] which recorded highest prevalence infection among children aged 4-6 years, also [25] reported that children below 14 years has high prevalence infection.

Our finding in this study based on gender, showed that males pupils were more infected (111 infected) with *E. histolytica*. than female pupils (100 infected) with *E. histolytica*. 59.4% and 54.3% respectively higher prevalence obtained from male pupils might be due to fact that males are more engaged in extracurricular activities such as recreational activities and games. The lower prevalence in females may be due to cultural practices which require females to be indoors most of the time while males take part in many outdoor activities also the higher prevalence in male might due to males mostly engaged in water contact activities like summing and bathing, fishing farming and watering cattle could lead to higher exposure among males.[26] and [27] made similar observation in south Eastern Nigeria.

The results based on water sources revealed that prevalence infection *E. histolytica* showed that there is significance differences, those that consume river/stream water has the highest prevalence infection of 71.7% this might be because human and domestic /wild animals use these (River/ stream) as source of drinking water especially during dry season in local Communities. A situation that could lead to contamination with faeces and subsequent infection of exposed individuals, then followed by the those that consume well water with 62.2% this may be due to some well in the community are dug close to pit latrine and poor sanitation around the well enhances the transmission of the infection and those that consume borehole /tap water has the least prevalence infection. This agreed with the research carried out by [13] on intestinal amoebiasis among primary school children in Akure, ondo State South Western Nigeria, were they recorded highest prevalence infection among those pupils that consume stream water 94.3% followed by those that consume well water with 74.4% and those that consume tap water has the least prevalence infection. Also our finding is in line with the research on intestinal amoebiasis carried out by [28] were they reported significance infection rate for laser of surface water and unprotected well water, while they recorded low prevalence infection for tap water and protected borehole water. However the finding of this study is not in line with report of [29] and [30] reported the prevalence *E. histolytica* was not associated with type of water supply but was seemingly influenced by storage of household supplies.

Based on our finding in this study, the prevalence of *E. histolytica* in relation to use of latrine indicated that those pupils that do not have latrine at home has a higher prevalence of infection 58.6% than those that have latrine at home having lower prevalence rate with slight differences (Table 3), this could be due to poor sanitation which may encourage flies and cockroaches to spread the cysts of *E. histolytica* [31]. Also must of the people that do not have latrine at home involved in open defecation which can lead to washing away of the faeces contaminants into community water source during raining season, this practice could also enhance the transmission of cysts [32]

Findings based on open field defecation revealed that the prevalence of *E. histolytica*, shows that pupils who practice open field defecation toilet system has the highest prevalence of infection (table) while those that do not practice open field defecation toilet system has the lower prevalence infection, similar observation were made among those that use open field defecation toilet system by [26]. This could be due to poor sanitation which might encourage flies and cockroaches to spreads the cysts of *E. histolytica* [31].

Results finding in relation to washing of hands before and after eating revealed that, prevalence of *E. histolytica* showed that those pupils who practice washing of hands before and after eating has a least infection rate compared to those pupils who do not practices, the high prevalence infection obtained by those pupil that do not practices washing of hands before and after eating might linked to hands can act as conduits to transfer cysts from surfaces in or outside the home, currency food and animals (pets or wild). The finding is in line with the research finding carried out [33] which reported high prevalence on people that do not practices washes hands before and after eating has the higher prevalence infection.

Based on our finding in this study, in relation to washing hands before and after defecation shows that those pupils that do not washes their hands before and after defecation infection due to *E. histolytica* shows higher infection rate, this might attributed to the fact that most children used their hands to eat which easily transmit the resistance cysts [34]. This study also agreed with research carried out by [35] where identified lack of washing hands as being significant to high prevalence infection.

With regards to those who refuse disposal shows that pupils who dispose of refuse outside their compounds has the highest prevalence of infection compared to those who do not, this might attributed to the fact that erosion may wash away the faeces contaminants in to the community or home water source during raining season [24].

Finding from our study shows that *E. histolytica* in relation to level of incomes of parents/guardian indicate that those pupils whose parents /guardians are of low-level incomes were found to have highest infection rate, followed by pupils whose parents/ guardians are of medium level incomes and pupils with parents/guardians are of high-level income was found to have least prevalence of infection. This finding is in line with that of Al-Harti [36]which reported that rate of infection is higher in poor community. Also in a similar research conducted by [37,38] linked the high prevalence infection obtained with poverty.

Based on our finding in this study, prevalence of *E. histolytica* infection in relation to treating drinking water at home showed higher prevalence for does that treats drinking water at home. This outcome may be due to improper treatment of drinking water. Apart from improper treatment must of the pupils that responds to Yes they use chlorine the treatment of drinking water and they are ignorance that chlorine does not completely kill the cyst of *E. histolytica.* This finding is in line with the research finding conducted by [31] where they recorded high prevalence infection among people that treats drinking water and they link the high prevalence obtained with improper water treatment.

5. CONCLUSIONS

The finding of this study showed that infection with *E. histolytica* among primary school children in Wamakko Local Government Area are found to be high. This also showed that personal hygiene, environmental sanitation and poor access to safe water contributes to transmission of *E. histolytica* in the study area; therefore the null hypothesis is rejected and alternative hypothesis is accepted.

The result findings of this study indicate that intestinal amoebiasis is a public health concern in the study area. It also reveals that the control measures in the study area are not effective and this could be among the difficulties encounter for the control of amoebiasis in the study area.

ACKNOWLEDGEMENTS

We gratefully acknowledge the contributions made by the Wamakko Community. The Headmaster, parents, as well as district head of Wamakko town, were very cooperative during the period of this study. We would also want to thank Ministry of Health and Ministry of education Sokoto State, Nigeria for their generous cooperation during this study. We also thank the participants for their voluntary participation in this study. The authors also thank the entire members of the community in the study area for their cooperation during this study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ash L, Orihel C. Atlas of human parasitology. American society of Clinical Pathologists, Chicago 2nd Edition. 1980;22-32.
2. Sateriale A, Huston C. A sequential model of host cell killing and phagocytosis by *Entamoeba histolytica*. Journal of Parasitology Research. Hindawi publishers Corporation, University of Vermont, USA. 2011;1: 1-10 .
3. Stanley S. Amoebiasis. The Lancet. 2003; 361:25-34.
4. Luaces A. Affinity purification and bio-chemical characterization of histolysin, the major cysteine protease of *Entamoeba histolytica*. Strangeways Research Laboratory. 1988;250:903-909.
5. Ravdin JL, Petri WA. *Entamoeba histolytica* (Amoebiasis), Principles and practice of infectious diseases, 4th edition. Churchill Livingstone, New York. 1995; 2395-98.
6. Walsh JA. Prevalence of *Entamoeba histolytica* infection in: Ravdin J. ed. Amoebiasis: Human infections by *Entamoeba histolytica.* New York Churchill Livingstone. 1985;93-105.
7. Aribodor DN, Anidebe AO, Eneanya AO, Emelummadu OF. *Entamoeba histolytica* infection in children aged 0-12 years in rural communities in Anambra State, Nigeria. Niger. J. Parasitol. 2012;33(2): 129-132.
8. Ravdin J. Amoebiasis: Human infection by *Entamoeba histolytica.* NewYork John Wiley and Sons. 1988;105-109.
9. World Health Organization (WHO). Kenya-arid and semi arid lands sector wide programme project. 2010;1:1-4.
10. Steketee RW. Pregnancy, nutrition and parasitic diseases. Journal of Nutrition. 2003;133:1661-1667.

11. National Population Commission. NPC; 2006.
12. Mamadou O, Nicaise O, Guessan N, Ahoua Y, Eliezer K. Prevalence and spatial distribution of *Entamoeba histolytica/ dispar* and *Giardia lamblia* among School children in Agboville area (Côte d'ivoire). PLOS Neglected Tropical Diseases. 2010;4(1):1-30.
13. Simon-Oke IA, Ogunleye E. Prevalence of *Entamoeba histolytica* among primary school children in Akure, Ondo State, Nigeria. Journal of Public Health and Epidemiology. 2015;7(11):346-351.
14. Bashir M, Aliya SM. Studies on sero prevalence of hepatitis B and among patient attending some hospital in Kano Bayero Journal of Pure and Applied Science. 2010;8(1):19-23.
15. Cheesbrough M. District laboratory practice in tropical countries. Part 1, 2nd Edition, Cambridge. 2010;200-208.
16. Luka SA, Ajogi I, Umoh JU. Helminthosis among primary school children in Lere Local Government Area, Kaduna State, Nigeria. Nigerian Journal of Parasitology. 2000;21:109-116.
17. Kabiru M, Mohammed RA, Julia O. Intestinal parasitic infection and assessment of risk factors in North-Western, Nigeria: A community based study. International Journal of Pharma Medicine and Biological Sciences. 2015;4: 2.
18. Nasiru Usman Adabara, Amos Olorunsola Ige, Bokhan Otone, Abubakar Momohjimoh. Prevalence of intestinal helianthus among primary school children in Bosso, North Central Nigeria. International Journal of Biomedical and Advance Research IJBAR. 2011;02(12).
19. Ahmed A, Oniye SJ, Nock IH. Intestinal parasitoses in relation to growth and academic performances of students in Katsina State, Nigeria. Journal of Tropical Biosciences. 2003;3:42-47.
20. David MKB. Prevalence of *Entamoeba histolytica* infections among children attending primary school in Kyuso zone, Kyuso district, Kitui County, Kenya. A thesis of MSC. Applied parasitology. School of Pure and Applied Sciences and Kenyatta University; 2009.
21. Idowu OA, Rowland SA. Oral faecal parasites and personal hygiene of food handlers in Abeokuta, Nigeria. Afr. Health Sci. 2004;6(3):160-164.
22. Damen JG, Luka J, Biwan EI, Lugos M. Prevalence of intestinal parasites among pupils in rural North Eastern, Nigeria. Niger Medical Journal. 2011;52:4-6.
23. Egbuobi RC, Dike-Ndudim JN, Nwagbaraocha MA, Nnodim JK. Intestinal parasitic infection among pupils in Umuezeaga autonomous community, Akokwa in Ideato North Local Government Area, Imo State, Nigeria. International Research on Medical Sciences. 2013;1(1): 005-009.
24. Simon-Oke IA, Ogunleye E. Prevalence of *Entamoeba histolytica* among primary school children in Akure, Ondo State, Nigeria. Journal of Public Health and Epidemiology. 2015;7(11):346-351.
25. Amuta EU, Houmsou RS, Mker SD. Knowledge and risk factors of intestinal parasitic infections among women in Makurdi, Benue State. Asian Pac. J. Trop. Med. 2010;3:993-996.
26. Uneke C, Eze K, Oyibo P, Alu N, Ali E. Soil-transmitted helmith infection in school children in South-Eastern Nigeria. The Internet Journal of Third World Medicine. 2006;4(1):1-11.
27. Kalu MK, Eugene CN, Ifeanyi AO. Intestinal nematode parasites amongst school children attending some primary schools in Mbaitoli Local Government Area, Imo State, Nigeria. Journal of Biological Sciences and Bioconservation. 2013;5(1):102-110.
28. Amuga AG, Onyeka JOA. Prevalence of *Entamoeba histolytica* among rural community in Bassa Local Government Area of Plateau State, Ngeria, J. Pest Dis. Vector Manag. 1995;2:89-92.
29. Dawet A, Yakubu DP, Remkyes MS, Daburum YH. Prevalence of *Entamoeba histolytica* and *Entamoeba dispar* among School Children in Jos L.G.A., Plateau State, Nigeria, Nigeria J. Parasitol. 2012; 33(1):77-83.
30. Oyerinde JP, Alonge AA, Adegbite-Hollist AF, Ogunbi O. The epidemiology of *Entamoeba histolytica* in a Nigeria urban population. Int. J. Epidemiol. 1979;8:22-29.
31. Absar A, Joseph RR, Khalid MI. The global war against intestinal parasites-should we use a holistic approach? International Journal of Infectious Diseases. 2010;14: e732-e738.
32. Audu DP. Prevalence of gastrointestinal parasites among primary school children in Bosso Local Government area of Niger

State, Nigeria. Msc. Research, ABU Zaria; 2015.
33. Ngonjo T, Kihara J, Gicheru M, Wanzala P, Njenga S, Mwandawiro C. Prevalence and intensity of intestinal parasites in school age children in Thika District, Kenya. Africa Journal of Health Science. 2012;21(3-4): 155-157.
34. Ademiluyi IA, Odugbesan JA. Sustainability and impact of community water supply and sanitation programmes in Nigeria. An overview: Afr. J. Agric. Res. 2013;12:811-817.
35. Kinuthia G, Afolayan F, Ngure V, Anjili C. Selected practices among rural residents versus the prevalence of Amoebisis and Giardiasis in Njoro District, Kenya. African Journal of Health Sciences. 2012;20:11-20.
36. Al-Harthi S, Jamjoom M. Diagnosis and differentiation of *Entamoeba* infection in Makhah Al Mukarramah using microscopy and stool antigen detection kits. World Journal of Medical Sciences. 2007;2:15–20.
37. Adeyeba OA, Akinlabi A. Intestinal parasitic infections among school children in a rural community, Southwest Nigeria. Nigerian Journal of Parasitology. 2002;23: 11-18.
38. Mbanugo JI, Onyebuchi CJ. Prevalence of intestinal parasites in ezinifite community in Aguata LGA of Anambra State, Niger. Journal of Parasitology. 2002;23:27-3.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history/25421