Comparative Epidemiological Studies of Polyparasitism in Some Rural and Urban Settlements of Nasarawa State, Nigeria

Alaku I. A., Galadima A.A. and Sani Danladi

Department of Basic Sciences
College of Agriculture, Lafia, Nasarawa State,

ABSTRACT

This study investigated the prevalence of polyparasitism in some urban and rural communities in Nasarawa State and factors influencing such infections. A total of 1048 urine and stool sample were randomly collected and taken to Dalhatu Araf Specialist Hospital Laboratory for examination. Urine samples were collected between 10:00am and 2:00pm and were processed for urinary *schistosomiasis*. Urine sedimentation technique method was used. Findings showed that parasite infections were more prevalence in rural areas than urban areas with age group 21 – 30 having the highest rate of infection of 64(50%). For stool examination, wet preparations were made using normal saline, iodine solution and formal ethyl concentration techniques method used. Intestinal parasites were identified, but *Entamoeba histolytical* were commonly observed. Statistically there was no significance in the occurrence of parasites trends (P>0.05). Female had the prevalence (46.42%) than the males (38.88%) and age specific prevalence showed that those age 11 – 15 years of had the prevalence (42.30%). In the whole, 398 (37.97%) were infected while 650 (62.02%) were freed. This study justified the need for early intervention measures such as community based treatment campaigns and health education (df=1 P<0.05).

Keyword: Polyparasitism, prevalence, epidemiology, intervention

INTRODUCTION

Polyparasitism with intestinal parasites is now globally recognized to be the norms for many residents of parasite endemic regions and particularly among children of school age and adults. Infact about one third of the world, more than two billion people are infected

ISSN: 2277-0097

with intestinal parasites, *Ascaris lumbricoldes*, *Trichuris trichiura* and Hookworms, collectively referred to as soil transmitted helminthes (STH), are the most common intestinal parasitosis (Florey, 2009). Morbidities are also likely to be compounded in people harbouring multiple parasites. For example, co-infections with helminthes and *plasmodium* species have been shown to increase negative health effects, including organomegaly (Omudu, *et al*; 2012; Pullan, 2008 and Shapiro *et al*., 2005) as compared to single infections. This study was conducted to examine the parasitic infections and co-infection in some communities in Nasarawa State and to ascertain the reasons of polyparasitism in Nigeria. The research objectives were to investigate the prevalence and intensity of single and multiple infections and to determine the role of genders and occupation in the prevalence of polyparasitism in individuals.Parasite is an organism that resides on or within another organism, the host, in other to find the environment and nutrients required for its own growth and production (Ochei and Kolhatkar, 2000). The prevalence of these parasites is promoted by several epidemiological factors such as poor sanitation, environmental degradation ignorance, poor personnel and community hygiene, climate condition and other socio-cultural practice such as the use of might soil for fertilizer (Eneanya and Njom, 2003). In Sub-Sahara Africa (SSA), the prevalence of soil transmitted helminth (STH) (example; *Ascaris spp, Hookworm, Trichuristrichura*) is believed to have remained relatively constant, whereas it has declined and diminished in some developing world other than SSA and today between one quarter and one third of SSA population is affected by one or more STH infections (Hotez and Kamath, 2009). The urinary parasite, *Schistosoma haematobium*, is an infestation in humans by a parasite of bloodworm with fresh water gastropod snails as intermediate host vector. The worst cases schistosomiasis will cause bladder cancer, caused by the parasite *Schistosoma haematobium*, about 38, million people are infected in 16 Africa countries (WHO, 2007).

MATERIALS AND METHODS

Study Areas

This study was conducted in Lafia, Nasarawa Eggon, Agyaragu and Alogani urban and rural communities of Nasarawa State respectively, Lafia and Agyaragu are located at the southern part of the state with latitude 8^{o}33N and longitude 7^{o} 32E while Nasarawa Eggon and Alogani are in the northern part of the state with latitude 8^{o}32N and 7^{o} 31E respectively. The mean monthly temperature in Lafia and Agyaragu ranges between 30^{o}C in March and about 25^{o}C in December. The hot weather is a regular features of these areas, the discomfort being greater with rising humidity in March – April before the cooling effects of rains. The mean annual rainfall is about 1270 – 1540mm mainly received over seven months to eight months (April to October) of rainy season with four months of dry season. The socio-cultural and economic survey revealed that there are about 58,000 households and this gives a population size of 615, 800. The economic activities of the people of these areas are farming and trading with some few into public services.

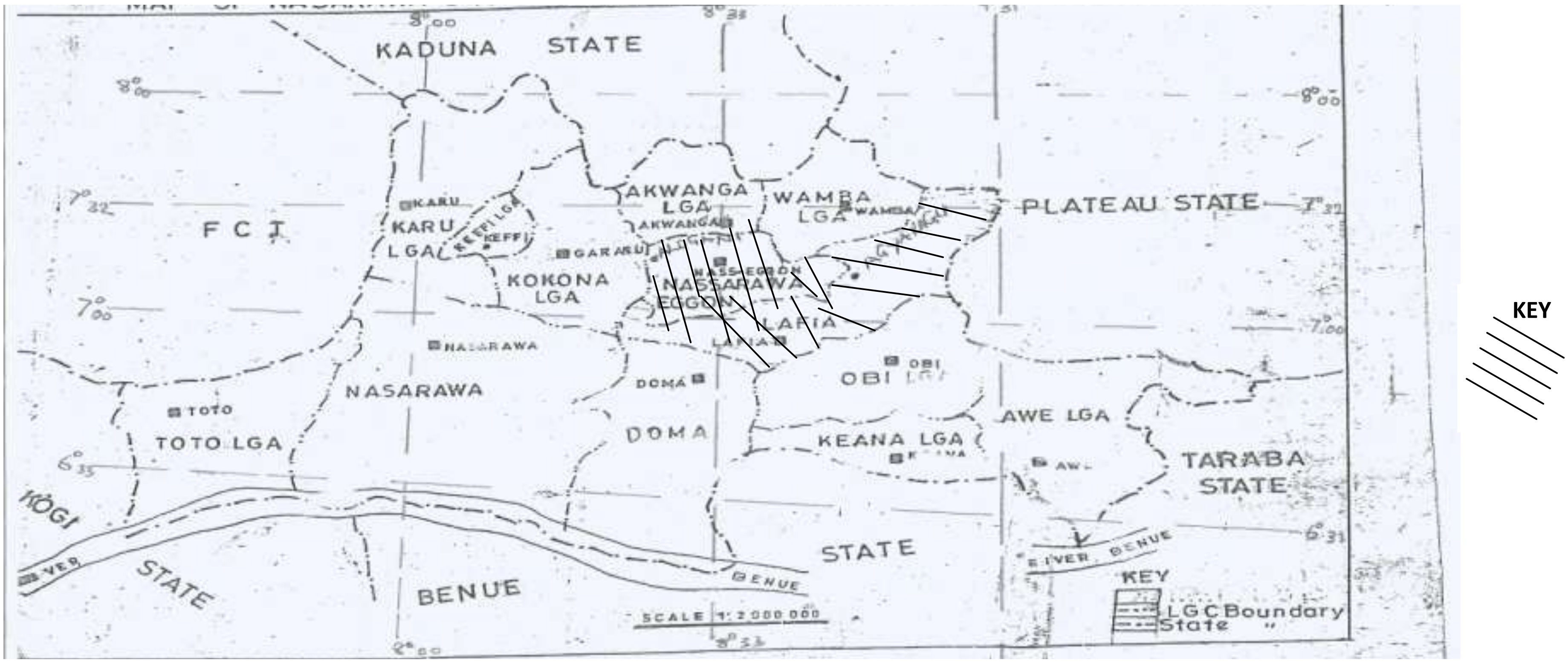

FIGURE 1: MAP OF NASARAWA SHOWING STUDY AREA

Ethical Clearance

The ethical clearance for this study was given by the Hospital Management Board of Nasarawa State. Consent from participating individuals was sought through verbal discussion given the importance of medical examinations. For children, parental permission was obtained before the study. After permission was obtained, a questionnaire was administered to the participants to get information on sex, age, source of water, types of toilet and other indices.

Sample Collection

Before collection of sample, official consent was obtained from the hospital management board of Nasarawa State and all the adults participating in the study through household survey and workplace. The participants were informed on the purpose of the study (that is, research) that could be of health benefits, and they were assured of safety and confidentiality of the results. They were told on how to collect the samples and avoid contamination with the sample. Two containers plastic bottles with wide mouth and tight cover, well labeled; name, sex age and date (Barnabas *et al.*, 2011) was given to the participant for the collection of urine and stool samples in each containers. The samples were collected not later than 10am, it was immediately taken to medical laboratory of Dalhatu Araf Specialist Hospital for examination.

Laboratory Procedure

The stool and urine samples were investigated for possible parasites using direct examination (normal saline and lugols iodine, for stool) methods (Chlesbrough, 2006). Small portion of the stool sample was picked using sterile applicator sticks and emulsified with a drop of physiological saline (0.85%) on a clean slide covered with cover slide and examined unstained (Fleck and Moody, 1992), and an iodine stand was prepared and examined under 10x and 40x objectives (Nock and Tanko, 2000). The urine samples were left for some hours to sediment by gravity after which the supernatant was drawn out using a stringe and the sediment stained with Lugol's iodine and examined under the microscope for urinary parasites. The intestinal and urinary parasites ova, cysts, and larvae were identified using the guide by (Cheesebrough, 2006).

Statistical Analysis

Simple percentage and differences in proportion were evaluated using chi-square test and statistical significance was considered when $P<0.05$.

RESULTS

A total of 1048 individual were screened, out of which 398 were infected with parasites which represents 398 (37.97%), while 650 (62.02%) were not infected which is statistically significant ($P<0.05$).
In table 1, a total 200 (38.16%) males out of 524 examined and females 198 out of 524 (37.78%) had co-infections. There was no significant differences obtained between the sexes in the whole communities at ($P>0.05$). The study related areas are: Lafia an urban area had 158 out of 524 (42.47%), Nasarawa Eggon an urban area had 128 out of 524 (34.04%), Agyaragu a rural area 63 out of 524 (39.37%) and Alogani a rural area 49 out of 524 (35%). There was significant differences among the communities (X^2 9.26 $P>0.05$).

Table 1: Prevalence parasitic infection in relation to sex

Location	Male		Co-infection					Female		Co-infection					Total Co-infection				
	No. exam	No. infec.	(Sing.)	(Dou. Infec)	(Tri.Inf)	(quad.infec)	Prev. %	No. exam	No. infec.	(Sing.)	(Dou. Infec)	(Tri.Inf)	(quad.infec)	Prev. %	No. infec	I	II	III	IV
Lafia (urban area)	186	74	24	28	13	9	(39.78)	186	84	47	23	13	1	(45.16)	372	71	51	26	10
Nassarawa Eggon (urban area)	188	61	31	17	12	1	(32.44)	188	67	37	13	10	7	(35.63)	376	68	30	22	8
Agyaragu (rural area)	80	37	20	10	4	3	(46.25)	80	26	11	10	3	1	(32.5)	160	31	20	7	4
Alogani (rural area)	70	28	10	9	8	1	(40.0)	70	21	13	5	3	0	(30)	140	23	14	11	1
Total	524	200	85	64	37	14	(38.16 %)	524	198	108	51	29	9	(37.78)	1048	193	115	66	23

In table 2 a total of 524 participants out of the 1048 examined were co-infected with multiple parasitic infections. There was statistical differences obtained between the sexes at (P>0.05). The age related prevalence in the study area: 0 – 5 years 30 (13.04%), 5 – 12 51(26.58%) and for age group 13 – 19 64 (50%), 20 – 40 59(31.05%), 41 – 59 30(16.12%), 60 and above years 18(14.75%), for both sexes. Age group, 1 – 10 and 51 above years had the least prevalence of parasitic infections of 30 (13.04%) and 18(14.75%) while age group 21 – 30 years 64 (50%) had the highest prevalence. These prevalence was how ever significantly associated with age group at (X^2 43.8, df = 7 >0.05).

Table 2: Distribution of polyparasitism in relation to age and sex on study areas

Age group	Male							Female									Total				
	No. Exam.	No. Infect.	Co-infection					No. Exam.	No. Infection	Co-infection						Prevalence	Co-infection				
			Single I	Double II	Triple III	Quad IV	%			Single I	Double II	Triple III	Quad IV	%	No. exam	No. infec	Single I	Double II	Triple III	Quad IV	%
0– 5	115	20	9	5	4	2	17.39	115	10	6	2	2	0	8.69	230	30	15	7	6	2	13.04
5 – 12	96	35	27	5	3	0	36.45	96	16	9	4	3	0	16.66	192	51	36	9	6	0	26.56
13 – 19	64	30	19	8	2	1	46.87	64	34	26	6	2	0	53.12	128	64	45	14	4	1	50
20 – 40	95	33	22	7	3	1	35.48	95	26	21	4	0	1	27.36	190	59	43	11	3	2	31.05
41 – 59	93	14	7	4	3	0	15.05	93	16	12	3	1	0	17.20	186	30	19	7	4	0	16.12
50 and above	61	11	8	2	1	0	18.03	61	07	5	1	1	0	11.47	122	18	13	3	2	0	14.75
Total	524	143	92	31	16	4	27.29	524	109	78	20	9	1	20.80	1048	252	171	51	25	5	24.04

Table 3 a total of 459 participants had single infection for both the urban and rural dwellers with percentage prevalence of 459 out of 1048 (43.79%). Multiple infections with two or more parasites were recorded in 762 out of 1048 (72.70%) of the participants. The differences in the occurrence showed there was significant differences in the association of parasites among 54 out of 1048 individuals groups (X^2, 19.25%; df = 2, p>0.05).

Table 3: Combination of parasitism in the study areas.

Combination of parasites	No. exam	Urban	Rural	Total	Prev. %
Single infection					
Schistosoma haematobium	1048	209	250	459	(43.79)
Double infection					
Schistosoma haematobium + Hook worm	2048	19	31	50	(4.77%)
Ascaris lumbricoids + Schis Haemo		26	29	55	(5.24%)
HW-Hookworm + *Ascaris lumbricoides*		17	25	42	(4.00%)
Eh-Entamoeba hystolitica + *Taenia saginata*		28	26	54	(5.15%)
Tr-Trichuris trichiura + *Entamoeba lystolitica*		25	24	39	(3.72%)
Triple infection					
Ascaris lumbricoids + *Entamoeba hystolitica*		09	11	20	(1.90%)
Tr-Trichuris trichiura + Hookworm + *Entamoeba hystolitica*		15	13	28	(2.67%)
Ascaris lumbricoids + Schis Haemo + *Trichuris trichiura*		19	10	29	(2.76%)
Ascaris lumbricoids + Schis Haemo + Hook worm		12	15	27	(2.57%)
Quadruple infection					
Tr-Trichuris trichiura Ascaris lumbricoides + Hook worm + *Entammoeba hystolitica*		02	04	06	(0.57%)
HW-Hookworm + *Tr-Trichuris trichiura* + *Schistosoma haematobium* + *Eh-Entamoeba hystolitica*		04	03	07	(0.66%)

Prevalence of Polyparasitism in relation to source of drinking water

Table 4 showed the prevalence of polyparasitism in relation to source of drinking water among the various individuals sampled. Those who use well as source of drinking, water had the highest prevalence of 71 out of 524 (44.37%), while those who use pipe borne as source of water had the least prevalence of 141 (37.90%). Individuals that use bore hole had infections rate of 160 (42.55%) and other source of drinking water like stream had prevalence rate of 61 (43.57%). There was significant difference in the sources of drinking water (X^2 14.1% df = 3 p-value >0.05).

Table 4: Prevalence of polyparasitism in relations to sex and source of drinking water in study area.

Source of drinking water	Urban No. Exam.	No. Infect.	Co-infection Single I	Double II	Triple III	Quad IV	Prev. %	Rural No. Exam.	No. Infection	Co-infection Single I	Double II	Triple III	Quad IV	Prev. %	Total No. exam	Prevalence No. infec	Co-infection Single I	Double II	Triple III	Quad IV	%
Pipe borne	186	74	24	28	13	9	39.78	186	67	23	24	13	7	36.02	372	141	47	52	26	16	37.90
Bore hole	188	91	41	27	15	8	48.40	188	69	29	20	14	6	36.70	376	160	70	47	29	14	42.55
Well	80	47	19	14	9	5	58.75	80	24	16	4	3	1	30	160	71	35	18	12	6	44.37
Stream	70	38	16	12	7	3	54.28	70	23	19	3	1	0	32.85	140	61	35	15	8	3	43.57
Total	524	260	100	81	44	25		524	183	87	51	31	14		1048	433	187	132	75	39	41.31

Prevalence of Polyparasitism in relation to type of toilets

Table 5 shows the prevalence of polyparasitism in relation to the type of toilet used in study areas. Participants that used open air (bush) as toilet had the least prevalence of polyparasitic infections of 288 out of 524 (50.34%) and those using water system toilet had the highest prevalence of 89 (76.72%). Both urban and rural had areas the prevalence of 191 (53.05%) for using pit toilets. There was statistical difference among the different types of toilets used in the study area at (X^2 27.9, df = 3, p-value >0.05).

Table 5: Prevalence of polyparasitism in relation to sex and Types of toilets used in the study area

Types of toilet used	Urban							Rural							Total						
	No. Exam.	No. Infect.	Co-infection					No. Exam.	No. Infection	Co-infection				Prevalence			Co-infection				
			Single I	Double II	Triple III	Quad IV				Single I	Double II	Triple III	Quad IV	%	No. exam	No. infec	Single I	Double II	Triple III	Quad IV	%
Water system	58	53	25	14	01	00	91.5	58	36	23	7	4	00	62.06	116	89	48	21	5	0	76.72
Pit toilet	180	132	52	41	02	00	73.33	180	59	56	45	6	1	32.77	360	191	108	86	8	1	53.05
Open air defecation	286	142	54	46	3	02	49.65	286	146	27	22	10	0	51.04	572	288	61	68	13	2	50.34
Total	524	327	132	112	6	2		524	231	106	74	20	1		1048	568	217	175	25	3	54.19

Prevalence of Polyparasitism in relation to occupation of the individuals in the study areas.

Table 6 shows the prevalence of polyparasitic infections in relation to occupation in the study area. The civil servant had the prevalence of 106 (61.62%) of infection for both urban and rural communities. Students and business individuals had the prevalence of 108 (54%) and 118 (62.72%) respectively. Farmers had prevalence of 133 (44.93%) parasitic infections. Unemployed in this case, had least prevalence of 71 (36.97%). There was significant difference among the different occupational background of individuals in the study areas of P-value >0.05.

Table 6: Prevalence of polyparasitism in relation to occupation of the people in the study area

Occupational status	Urban							Rural									Total				
	No. Exam.	No. Infect.	Co-infection					No. Exam.	No. Infection	Co-infection						Prevalence	Co-infection				
			Single I	Double II	Triple III	Quad IV	%			Single I	Double II	Triple III	Quad IV	%	No. exam	No. infec	Single I	Double II	Triple III	Quad IV	Prev %
Civil servant	86	58	25	23	16	00	64.44	86	48	22	21	05	00	55.81	172	106	47	44	15	00	61.62
Business	94	69	41	20	8	00	73.40	94	49	23	19	07	00	52.12	188	118	64	39	15	00	62.72
Student	100	69	33	26	10	00	69.90	100	38	15	20	03	00	38.90	200	108	48	46	13	00	54.90
Farmer	148	62	26	20	16	00	41.89	148	71	31	24	16	00	47.97	296	133	57	44	32	00	44.93
Unemployed	96	44	27	17	00	00	45.83	96	27	19	5	03	00	28.12	192	71	46	22	0	00	36.97
Total	524	302	152	83	44	00		524	253	110	88	38	0		1048	536	262	195	75	00	51.14

DISCUSSION

The results obtained from this project work on the comparative epidemiology of polyparasitism in urban and rural settlements areas of Lafia, Nassarawa Eggon, Agyaragu and Alogon of Nassarawa state, Nigeria showed that the prevalence of polyparasitism in the human population at these locations in Nigeria does actually exist. The result made available showed that there is higher level of polyparasitism infection among the rural dwellers than urban dwellers. This means that the rural dwellers recorded higher rate of infection than the urban dwellers. This may be due to difference in level of education, sanitation and personal hygiene among the dwellers. Despite the fact, the prevalence rates of infection observed in this study were considerably lower than prevalence rates observed in similar studies conducted in the rural areas of south-eastern Nigeria (Florey, 2009), the rates of the infections are however, of public health significance. Polyparasitism isolated according to (sex), males recorded higher rate of polyparasitism infection than do the females. This implies that males in the study area suffer polyparasitism infection more than the females. According to (Hotez and Kamath, 2009) reported a prevalence of 31.8% of female suffer polyparasitism. These studies have associated higher prevalence to poor environmental and personal hygiene, storage of food, water supply and indiscriminate defecation. The distribution of polyparasitic infection according to age groups indicated that there was a significant differences in the rate of polyparasitic prevalence among the children than the adults. This indicates a common pattern of behavior and susceptibility for these age groups. They probably spend more time playing on polluted grounds and working barefooted. They may also spend more time in cercaria infected waters (Florey, 2009). They may also have more contact with soils and eat indiscriminately with unwashed hands. The adults age group recorded the least prevalence due to the fact that individuals in this group may be less exposed to epidemiologic factors that enhances sustainability to co-infection by parasites. They are also more conscious of their personal hygiene, hence they are able to avoid as much as possible what would lead to one being infected. According to (Hotez and Kamath, 2009), portable drinking water is associated with less prevalence of polyparastism. The results from this study show that participants level of infection vary according to the source of drinking water.

It means therefore that infection of polyparasitism among females is determined by source of their drinking water. The difference in prevalence of polyparasitic infection among males and females according to toilet used showed that the male participants differ in their level of infections based on type of toilet used than females. This means that the toilet type pit water system or open air determines the rate of infection among the males tested. It further implies that the use of water system, pit toilet, and open air defecation among users for the females, did not determine the rate of polyparastitism infection in the study area. These further means that infection rate does not depend on toilet types. Differences in the prevalence rate of infection among males and females based on occupation show that males did not differ in the rate of polyparasitic infection according to occupation. It means that occupational background of the males have nothing to do with the degree of polyparastic infection. Thus this hypothesis has been rejected. On the other hand, based on occupation, females differ significantly in their levels of infection. It means therefore that occupational background of the males determine the rate of infection among them. The highest infection rate recorded among children could be attributed to the fact that school children normally play in or around defecation areas and most of the schools lack proper toilet facilities. The vector of *S. haemotobium, Planorbid snails, Bulinus spp* are found in natural bodies of water used for drinking, domestic purposes and recreation by the communities. The higher prevalence of schistosomiasis in this study area is attributed to the fact that male children in the area are more frequently exposed to infected water bodies, where they usually play, Swin, bathe or wash (Akogun and Badaki, 1998) reported similar findings and attributed it to the fact that males have fewer restrictions than females. *Schistosoma haematobium* (urine with blood) conditions which can eventually lead to kidney failure if untreated. The parasites eggs can cause a substantial damage to the liver, intestine bladder and kidney and cause death in some cases (WHO, 1991).

In this study the following intestinal parasites were observed *Entamoeba histolytica, Trichuris trichiura, Giardia camblia*, Hookworm, *Taenia species, Ascaris lumbricoides*, and strongy loides stercoralis. However the protozoan parasites *Entamoeba histolytica* and *Giardia lamblia* occurred more frequently than the helminth parasites. Common helminth parasites like *Trichuris trichiura* and *Ascaris lumbricioides* were seen only among few children respectively. Some studies have reported that in urban and semi-urban *areas Entamoeba histolytica* and *Giardia lambia* are more common intestinal infections than intestinal helmenths among children (Akogun and Badaki, 1998).

The transmission of *Ascaris, trichuris* infections are known to generally occur more in rural areas than urban or semi-urban areas, however, in urban slums, the transmission is probably related to poor sanitary conditions or contaminated water supplies and perhaps Trichuris and other soil-transmitted helminthes cannot successfully complete their life cycles in the absence of a more soil rich rural environment and may well be less adapted to conditions in urban or semi-urban areas for successful transmission (Ighoboja and Ikeh, 1997).

Evidently polyarasitism is wide spread throughout the tropic, correctly estimating the magnitude of the problem remains a major epidemiological challenge. Further research on this topics is clearly needed due to the importance of polyparasitism to public health evidenced both high prevalence of polyparasitism and deteriorating sanitary conditions (Nock and Tanko, 2008) more studies on polyparasition in areas endemic for tuberculosis and HIV/AIDs may aspirer to investigate the synergistic consequences of these diseases in sub-saharan African. It is accepted that polyparasitism is wide spread throughout the tropic especially the study area correctly estimating the magnitude of the problem is major epidemiological challenge.

REFERENCES

Akogun O.B, Badaki OF. (1998). Intestinal helminth infection in two communities along the Benue river valley, Adamawa state. *Nigerian J Parasitol*; *19:* 72–8.

Ashford, R.W., Craig, P.S. and Oppenheimer, S.J., (1993). Polyparasitism on the Kenya Coast. 2. Spatial heterogencity in parasite distributions Ann Trop Med. Parasiyotl; 87:283-293.

Barnabas B.B., Mann A., Nma E., Obi P.U., and Ezeako I.A. (2011). Prevalence of Schistosomiasis and other intestinal helminth parasites among school children in Bida, Niger State. Nigeria. Europ J. Sci. Res. ISSN 1450-216X. 48:621-628.

Cheesbrough M. (2006). District laboratory practice in tropical countries: Part 1. University Press, Cambridge, Pp. 192-239.

Eneanya, C.I., Njom VS (2003). Geohelminth contamination of some common fruits and vegetable in Enugu, South East Nigeria. The Niger, J. Parasitol. 24:123-128.

Fleck, S.L. Moody A.M. (1992). Diagnostic techniques in Medical Parasitol. Helminths 4(8):1-75.

Florey, L.S. (2009). Epidemiology of Polyparasitism in Coastal Kenya: Determinants, Interactions and Health Effects of Plasmodium Species and Schitosoma haematobium infections. A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy (Epidemiological Science) in The University of Michigan.

Hotez, P.J., Kamath A. (2009). Neglected tropical diseases in Sub-Sarahan Africa: Review of their prevalence, distribution and disease burden. PloS. Negl. Trop. Dis.3 (8): e412. Doi: 101371/journal.pntd:0000412.

Ighoboja IS, Ikeh EL. (1997). Parasitic agents in childhood diarrhea and malnutrition. *West African J Med*; *16*(1):36–9.

Nock, I.H., Tanko, D. (2000). Prevalence and public health significance of parasites oocysts and ova on the sole of shoes. A case study in Zaria. Niger, J. Parasitol. 21:137-142.

Nwosu ABC. (1981). The community ecology of soil-transmitted nematode infections of humans in Nigeria. *Ann Trop Med Parasitol*; *75*(2): 197–203.

Ochei O.J. Kolhatkar, A. (2000). Laboratory techniques for intestinal parasites. Medical laboratory science theory and practical. Pp, 909-1044.

Odelowo OA. (1990). Intestinal helminthiasis in post-secondary institution in Kwara. *Nigerian J Parasitol*; *9*(11):91–3.

Omudu E.A, Emmanuel O, and Mathew E.B. (2012). Epidemiological studies of polyparasitism in two different communities in Benue State, Nigeria. JKAU: Med. Sci., Vol. 19 No. 1, Pp:21 – 34 (A.D/1433 A.H) Do1: 10, 4197/med. 19 – 1.2

Pullan R, Brokkers (2008). The health impact of polyparasitism in humans: are we underestimating the burden of parasitic? Parasitology; 135 (7): 83 – 94.

Shapiro A.E, Tukahebwa E.M, Kasten J, Clarks S.E, Magnussen P, Olsen A, Kabatereine N.BB, Ndyomugyenyi R, Brookers (2005). Epidemiology of helmurth infections and their relationship to clinical malaria in south west Uganda Trans R Soc Trop Med Hyg; 99(1): 18 – 24.

Smyth JD.(1976). *Introduction to animal parasitology,* II edn. New York: John Wiley and Sons; p. 466.

Stephenson L.S, Lathman MC, Ottenson E.A. (2000). Malnutrition and parasitic helminth infections parasitology; 121:23 – 38.

Uneke, C.J. Anachi, M.I. and Aiun, U. (2009). Parasite infections and urinary schistosomiasis among school children in semi-urban area of south eastern Nigeria. *Internet Journal of Health.* Vol. 9 No. 1 Pp24 – 28.

Uneke, C.J., Ugwuoru CDC, Ngwu BAF, Ogbu, O., and Agala CU, (2006). Public Health implication of bacteriuria and antibiotic susceptibility of bacteria isolates in Schistosoma haematobium infected school pupils in South-eastern Nigeria. World Health Pop. 2006; 1 – 11. (s).

WHO (1991). Basic laboratory methods in medical laboratory WHO Geneva Pp67 – 70.

WHO (World Health Organization). (2002). Prevention and Control of Schistosomiasis and Soil-Transmitted Helminthiasis, WHO Technical Series Report 912 Geneva: Geneva WHO.

Reference to this paper should be made as follows: Alaku I. A., Galadima A.A. and Sani Danladi (2018). Comparative Epidemiological Studies of Polyparasitism in Some Rural and Urban Settlements of Nasarawa State, Nigeria. *J. of Environmental Science and Resources Management* Vol. 10, No. 3, Pp. 38-60