Current Appraisal of Socio-Economic Factors Associated with Intestinal Helminth Infections in South-Eastern Nigeria.

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Abstract
A cross-sectional study was carried out to assess the current status of intestinal helminth infections and the associations between selected socio-economic variables and helminthosis among school children less than twenty years old in five rural communities in Southeastern, Nigeria. A total of 3000 school children randomly selected from the study communities were enrolled for the study. Data collection involved the use of Kato Katz for microscopic examination of stool samples, semi-structured questionnaires and focal group discussion (FGDs). T-test was used to to determine the association of socoi-economic variables and intestinal helminthosis.The overall prevalence of intestinal helminth infections was 60.4%. The intestinal helminthes isolated included hookworm (29.1%), *Ascaris lumbricoides* (22.1%), *Trichuris trichiura* (4.6%), *Strongyloides stercoralis* (2.4%), *Taenia spp* (1.1%) and *Diphyllobothrium latum* (1.1%). Hookworm (29.1%) was the most predominant helminth. Males were more infected (61.1%) than females (59.6%). Individuals aged 3-5 years old had the highest prevalence (75.4%) of intestinal helminth infections. Factors that were significantly associated with the risk of acquisition of the infections included age of the school children, type of toilet facility, source of water, level of education, occupation, housecrowding, hygiene habits. Conscientious personal cleanliness, proper sanitation and controlled good water supplies would be useful for effective control.

Keywords: intestinal, helminth, infections, socio-economic, factors, Nnewi South, Anambra, State, Nigeria.

INTRODUCTION
Helminthes are known to cause a lot of morbidity and socio-economic deprivation in population living in the tropics, where poor sanitary conditions provide optimal environmental conditions for their development and transmission (Akogun and Badaki, 1998; Pukuma and Sale, 2006). It is estimated that over one billion of the world population are chronically infected with the major soil transmitted helminthes. While the morbidity associated with these infections is estimated to affect 447 million people with annual mortality of 135,000 (Pukuma and Sale, 2006; WHO, 1998).

The different types of intestinal helminth parasites often encountered include *Ascaris lumbricoides* hookworm, *Trichuris trichiura*, *Strongyloides stercoralis*. Other helminthes such as the zoonotic (*Taenia solium*, *Cysticercus spp*, *Trichinella spp*, *Echinococcus spp*) are less prevalent but contribute significantly to morbidity (WHO, 1998).

Transmission of parasites is sometimes influenced by differences in environment, local population and socio-economic and socio-cultural habits such that parasite distributions in two adjacent communities sometimes differ among school age children. Different parasite species might have different effects on children (Olsen *et al.,* 2001). Heavy parasite burden may cause digestive and nutritional disturbances, blockages of the gut, abdominal pain, vomiting restlessness, disturbed sleep and the perforation of tissue (Mbanugo and Abazie, 2002; Obiukwu *et al*., 2009).

Although many studies regarding intestinal parasites focus on establishing the prevalence and intensity of these infections in different populations, fewer studies have examined the socio-economic and cultural factors that affect transmission of intestinal helminthes. Some studies have shown that lack of education, lack of adequate toilet facilities, lower socio-economic status, level of sanitation in households are related to parasitoses (Cooper and Bundy, 1988, Holland *et al*., 1988; Yusuf and Hussen, 1990; Rajeswani *et al*., 1994; Ighogboja *et al.,* 1997; Pegelow *et al.,* 1997; Gamboa *et al.,* 1998). These reports coupled with the fact that there have been few surveys designed to determine associations between socio-economic/ socio-cultural variables and intestinal helminth prevalence data prompted the initiation of this study in five communities in Nnewi South Local Government Area, Anambra State, Nigeria.

MATERIAL AND METHOD

Study area

This survey was conducted from July 2011 to August 2012 in Nnewi South Local Gonernment Area located in southern senatorial zone of Anambra State, south-eastern Nigeria. It lies approximately 6^0 to 12^o North latitudinally and $8^{\,0}$ to 15^0 East longitudinally. The population is about 39,000 people. The climate is tropical and vegetation characteristic is predominantly the rainforest with an average annual rainfall of about 2000mm and the average atmospheric temperature of about 30^0 C. There are two distinct seasons, the wet and dry seasons, the former takes place between April and October, while the latter occurs from November to March. The area is transverse by a number of streams which constitute the major source of water supply to all the communities in the area. Basic amenities are essentially lacking in these area and there no proper sewage disposal systems in most of the communities. Farming and trading are the major economic activities. Educational status of most of the inhabitants is generally very low and systematic de-worming exercise has never been conducted in the study area.

Study Population

Five communities out of ten community es were selected for the study through simple random sampling. The communities selected were as follows: Amichi, Ekwulumili, Ukpor, Osumenyi and Akwaihedi. Fifteen primary schools and five post-primary schools in the area were selected for the study. One hundred and fifty school children ere selected from each school through systematic sampling technique. A total of 3000 school children less than twenty years old were enrolled for the study.

Ethical Consideration

The protocol for this study was approved by the Infectious Disease Research Division (IDRD), Department of Medical Parasitology, Faculty of Biosciences Nnamdi Azikiwe

University Awka, Anambra State, Nigeria. The approval was based on the agreement that patient anonymity must be maintained, good laboratory practice/quality control ensured, and that every finding would be treated with utmost confidentiality and for the purpose of this only. All work was performed according to the international guidelines human experimentation in biomedical research (WHO, 1991). Approval for the study was obtained from the Chairman, and Secretary Local Government Education Authority (L.G.E.A.), Nnewi South LGA, Anambra State, Nigeria. Approval was also obtained from the Parents Teachers Association (P.T.A.) of each school studied and informed consent was obtained from each of the participating child. The participating school children were given biscuits, candies, pencils, pens, erasers, and pencil as incentives. Infected pupils were referred to the Primary Health Care Centre (PHCC) in the area for immediate treatment.

The children were educated on the causes of intestinal helminth infections among school aged children and they were convinced that every child ought to be free from such infections, thus the necessity of participating in the research work was appreciated by them.

Collection of Data

Data collection involved the use of questionnaires, focal group discussion (FGDs) and collection of stool samples. The questionnaire contained three sections:

1. Socio-demographic data: age, gender, residence, level education and occupation of the parents, number of children in the family.
2. Environmental factors: water supply, type of toilet facility commonly used.
3. Behavior habit: hand washing after defecation (never/sometimes/ always), footwear usage (never/sometimes / always), washing of fruits and vegetables before consumption (never/sometimes /always).

Parasitological Technique

The selected children were each given a clean, dry, well-labeled specimen bottle with which the feacal samples were collected. The collected feacal samples were transported to the laboratory for processing. They were examined for ova and or cyst of intestinal helminth parasites using the direct wet mount microscopic examination and the formol –ether concentration technique (WHO, 1998).

RESULTS

The results revealed that six different intestinal helminth parasites were identified among the communities studied. They include: hookworm, *Ascaris lumbricoides*, *Trichuris trichiura*, *Strongyloides stercoralis*, *Taenia* spp and *Diphyllobothrium latum*. Of these parasites, hookworm had the highest prevalence of 29.1%. This was followed by *A. lumbricoides* (22.0%). Where as the least prevalence of 1.1% was recorded in *Taenia* spp and *D. latum*. (Table 1)

The prevalence of intestinal helminth infections was high throughout the communities with a range of 53.2% -63.7%. All the intestinal helminth parasites were recorded in all the communities. The highest prevalence (63.7%) was recorded in Ukpor followed by Ekwulumili where a prevalence of 63.3% was obtained. The least prevalence (53.2%) was recorded in Akwaihedi (Table 2). Statistical analysis with t-test revealed a significant difference in the prevalence of intestinal helminth infections in respect to community (p <0.05; t-cal 9.875>t-cri 2.57).

Table 3 presents results on the prevalence of intestinal helminth infections by sex. More males (61.1%) were infected than females (59.6%). However, the difference was not statistically significant (p>0.05).

The prevalence of intestinal helminth infections were presented in table 4. The percentage of infections was high in all the age groups with a range of 46.9%- 75.4%. The highest prevalence of infection (75.4%) was recorded in age group 3-5 years old followed by age group 12-14 years old in which 72.2% were infected. The least prevalence (49.6%) was recorded in children less than two years old. T-test analysis showed a significant difference in age of children infected with intestinal helminth infections (p<0.05; t-cal.35.2>t-cri. 2.44)

Prevalence of intestinal helminth parasites in relation to type of toilet facility

As shown in table 5, 66.2% of people who practice open defecation (bush) were infected, 65.4% of those using pit latrines were infected while 28.9% of those using water closet were infected. *Taenia spp* (0.0%), and *D. latum* (0.0%) were found absent in individuals who use water closet. There was a significant difference between prevalence of intestinal helminth infections and water closet among community members ($p<0.05$ $\chi^2 = 42.64 > 26.30$). However, there was no significant difference between those using bush and those that use pit latrine. Some of the respondents from FGDs stated that defecating in the bush is the surest way to avoid infection. A female youth in affirmation to this stated thus “I feel comfortable defecating in the bush. Again it enables me to see my faeces and know whether there is any worm crawling in it” Those who use pit latrines are of the view that it is less laborious as one cannot start looking for water to flush the toilet as is the case with water closet. Another female youth stated that water closet is the safest system of disposing human waste but due to lack of water in rural areas people do not usually install it and where it is available they do not make use of it because of lack of water.

As shown in table 6, 72.1% of people who get water from local stream were infected, 38.4% who use shallow well were infected while 26.7% of those who use borehole as their source of water were infected. *Trchuris* was predominantly higher in those who use shallow well (5.1%) than those who use local stream (4.8%) and borehole (0.9%) while *D. latum* was completely absent from those who use borehole water 0(0.0%). There was a significant difference between prevalence of intestinal helminth infection and source of water ($p<0.05$; $\chi^2 = 74.6 > 26.30$).

A woman in one of the women FGDs noted that water from the local streams is the best because “it has a good natural clayey taste, besides, it is the original water handed to us by our ancestors that is why even if the government sink one hundred boreholes for us, we will still go to the stream” Some youths were of the view that they have their stream as the meeting point for friends where they meet, chart and wash our clothes especially during dry season. Those who use shallow well water stated that they make use of water conserved during rainy season when the paths to the stream must have been blocked.

Prevalence of intestinal helminth infections in relation to the level of education

As shown in table 7, the highest prevalence (68.0%) was observed among individuals who had no formal education. This was followed by those with First school Leaving Certificate (64.1%). The least prevalence was observed among those with degree (38.5%). The prevalence of hookworm was highest among those with First Leaving Certificate (33.3%) but least among those with degree (15.0%) Equal prevalence (4.0%) was found among those with degree and those with no formal education. There was a statistically significant difference between prevalence of intestinal helminth infection and level of education ($p<0.05$; $\chi^2 = 136.38 > 36.42$).

Among those with no formal education, the older folks in both male and female FGDs were of the view that worm infection is not a serious infection. Similarly, a female youth stated thus "worm infection is not as serious as malaria, I can spend only two hundred naira (#200.00) and buy any worm expeller from any chemist shop"

Prevalence of intestinal helminth infection in relation to occupation

As shown in table 8, the highest prevalence of intestinal helminth infections (65.1%) was observed among artisans, followed by farmers (63.7%). The least prevalence of intestinal helminth parasites (26.7%) was observed among the teachers. *S. stercoralis* (0.0%), *Taenia spp* (0.0%) and *D. latum* (0.0%) were found to be completely absent in health workers. and teachers. Artisans had the highest prevalence of *Ascaris* (40.8%) while the highest prevalence of hookworm was observed among the petty traders (37.3%). There was a significant difference between prevalence of intestinal helminth infection and occupation ($p<0.05$; $\chi^2 =292.6>46.18$)

A male artisan in one of the male FGDs stated thus "worm infection is a natural occurrence therefore we should allow our children to play in the soil and also eat it so that their teeth will be strenghthened" Some farmers in the FGDs maintained that worm is in every body's stomach and that it does not disturb. It is only when there is no food in the stomach that it disturbs, therefore one has to eat enough food that contains oil so that worm will have something to eat and not disturb. Two women (one a nurse and the other a teacher) maintained that they used to de-worm their children every three months.

Prevalence of intestinal helminth infections in relation to the number of individuals in a household

As shown in table 8, the highest prevalence (75.2%) was observed among individuals who have more than five members living in the same house. 36.4% of those with less than five household members were infected. There was a significant difference between prevalence of infection and house crowding ($p<0.05$ $\chi^2 = 49.7 > 15.51$). The prevalence of the individual parasite species were found to be higher among households with more than five members (hookworm (38.9%), *Ascaris* (25.7%), *Trichuris* (5.6%), *Strongyloides* (3.3%) and *Taenia spp* (1.1%) than households with less than five members (hookworm (313.2%), *Ascaris* (16.2%), *Trichuris* (3.0%), *Strongyloides* (1.3%) and *Taenia spp* (1.1%) except *D. latum* where the prevalence was higher in households with less than five members18(1.5%) than households with more than five members 16(0.8 %).

An elderly man in one of the male FGDs who has seven children stated that worm infection can only be contracted by eating over ripe number one mango and new season corn. Another woman, a mother of eight children, also stated that worm infection is not a serious health problem that everybody including the adults pass out worm every day. Another elderly woman (a mother of eight children) in agreement to what the man said stated that God while creating man created worm to be part of the body but kept it in a special bag where they stay and help in digestion of food.

Prevalence of intestinal helminth infection in relation to footwear usage

As shown in fig.1, the highest prevalence of intestinal helminth infection (46.4%) was observed among respondents who do not put on foot wears. This was followed by a prevalence of 33.2% participants who put on foot wears sometimes, and 20.5 % of respondents who wore footwears regularly. There was a significant difference on the prevalence of intestinal helminth infection in relation to footwear usage ($p<0.05$; $\chi^2 =221.35>5.991$). Those who do not wear footwears stated it was out of poverty that they do so. A woman in one of the FGDs stated thus “whenever I am working in my farmland I don’t put on my footwears because it slows my movement” Another also added that whenever she is in her compound she does not wear her footwears.

Prevalence of intestinal helminth infection in relation to washing of hands after defecation

As shown in fig. 2, 50.0% of respondents who never washed their hands after defecation were infected, while 37.3% of the respondents who occasionally (sometimes) washed their hands after defecation were infected and 12.7% of respondents who regularly wash their hands after defecation were infected. There was a significant difference on the prevalence of intestinal helminth infection in relation to washing of hands after defecating ($p<0.05$; $\chi^2 = 473.39>5.991$) A woman stated thus “I am always careful any time I am cleaning my anus and I make sure that no particle of faeces touches my hands. So why should I wash my hands since no particle of faeces touched my hands?” Another man from the group that wash their hands occasionally stated that he wash his hands after toilet only when there is enough water to do so and that is mostly during rainy season.

Prevalence of intestinal helminth in relation to washing of fruits and vegetables before consumption

As shown in fig. 3, 45.4 % of the respondents who never washed their fruits and vegetables before consumption were infected. While 31.9 % of those who occasionally (sometimes) washed their fruits and vegetables before consumption were infected, 22.7 % of those who regularly washed their fruit and vegetables before consumption were infected. There was a significant difference on the prevalence of intestinal helminth infection in relation to washing of fruits and vegetables before consumption ($p<0.05$; $\chi^2 =168.15>5.991$). Those who do not wash their fruits and vegetables stated thus “fruits and vegetables gotten from the farm contain some nutrients which when washed especially with salts clears the nutrients”.

Table 1: Prevalence of intestinal helminth parasites in Nnewi south Local Government Area

Parasite	Prevalence (%)

Hookworm	29.1
Ascaris lumbricoides	22.1
Trichuris trichiura	8.4
Strongyloides stercoralis	2.4
Taenia spp	1.1
Diphyllobothrium latum	1.1

Table 2: Prevalence of intestinal helminth infections in relation to community

Community	No. Examined	No. Infected (%)	Mean ± S.D	P-value
Ukpor	810	516 (63.7)	10.5 ±12.5	0.534
Osumenyi	676	405 (59.9)	9.8 ± 13.6	
Amichi	636	377 (59.3)	9.8 ± 11.4	
Ekwulumili	472	299 (63.3)	10.5 ± 12.9	
Akwaihedi	406	216 (53.2)	8.8 ± 11.0	

Table 3: Prevalence of intestinal helminth infections with respect to gender

Sex	No. Examined	No. Infected (%)	Mean ± S.D	P-value
Male	1510	926 (61.3)	154.3 ± 12.4	0.318
Female	1490	885 (59.4)	147.5 ± 12.1	

Table 4: Prevalence of instestinal helminth infections with respect to age

Age Group(years)	No. Examined	No. Infected	Mean ± S.D	P-value

		(%)		
<2	330	155 (46.9)	51.6 ± 7.2	0.087
3-5	548	414 (75.5)	69.0 ± 8.3	
6-8	493	275 (55.7)	45.8 ± 6.8	
9-11	424	243 (57.3)	40.5 ±6.4	
12-14	342	247 (72.2)	49.4± 7.0	
15-17	404	229 (56.6)	45.8 ± 6.7	
18-20	459	247 (53.8)	41.2 ± 6.4	

Table 5: Prevalence of intestinal helminth infection in relation to human waste disposal system

			Types of Parasites					
Types of toilet facility	**No Examined (%)**	**No infected (%)**	**Hookworm (%)**	***A. lum.* (%)**	***T. tri.* (%)**	***S. ster.* (%)**	***Taenia spp* (%)**	***D. latum* (%)**
Water closet	443(14.8)	128(28.9)	89(20.1)	30(6.8)	8(1.8)	1(0.2)	0(0.0)	0(0.0)
Pit latrine	1244(41.5)	814(65.4)	363(29.2)	332(26.7)	60(4.8)	30(2.4)	14(1.1)	15(1.2)
Bush	1313 (43.8)	869(66.2)	420 (31.9)	299(22.8)	70(5.3)	43(3.3)	18(1.4)	19(1.4)
Total	**3000**	**1811(60.4)**	**872(29.1)**	**661 (22.1)**	**138(4.6)**	**74(2.5)**	**32(1.1)**	**34(1.1)**

A. lum.* = *Ascaris lumbricoides

T. tri.* = *Trichuris trichiura

S. Ster.* = *Strongyloides stercoralis

D. latum.* = *Diphyllobothruim latum

Table 6: Prevalence of intestinal helminth infection in relation to source of water

			Types of Parasites					
Source of water	**No Examined (%)**	**No infected (%)**	**Hookworm (%)**	***A. lum.* (%)**	***T. tri.* (%)**	***S. ster.* (%)**	***Taenia spp* (%)**	***D. latum* (%)**

Borehole	210 (7.0)	56(26.7)	30(14.3)	22(0.7)	2(0.9)	1(0.5)	1(0.5)	0(0.0)
Shallow well	724(24.7)	278(38.4)	120(16.2)	69(9.3)	38(5.1)	22(2.9)	13(1.8)	16(2.2)
Local stream	2048(68.3)	1477(72.1)	722(35.4)	570(27.8)	98(4.8)	51(2.5)	18(0.9)	18(0.9)
Total	**3000**	**1811 (60.4)**	**872(29.1)**	**661 (22.1)**	**138(4.6)**	**74(2.5)**	**32(1.1)**	**34(1.1)**

Table 7: Prevalence of intestinal helminth infection in relation to the level of education

			Types of Parasites identified					
Level of Education	**No Examined (%)**	**No infected (%)**	**Hookworm (%)**	***A. lum.* (%)**	***T. tri.* (%)**	***S. ster.* (%)**	***Taenia spp* (%)**	***D. latum* (%)**
F.S.L.C.	150(5.0)	102(68.0)	46(30.7)	30(2.0)	14(9.3)	8(5.3)	6(4.0)	6(4.0)
O'Level	950(31.7)	535(56.3)	230(24.2)	221(23.2)	48(5.1)	21(2.2)	8(0.8)	7(0.7)
Degree	200 (5.0)	77 (38.5)	30(15.0)	28(14.0)	5(2.5)	5(2.5)	8(4.0)	1(0.5)
Total	**3000**	**1811 (60.4)**	**872(29.1)**	**661 (22.1)**	**138(4.6)**	**74(2.5)**	**32(1.1)**	**34(1.1)**

Table 8: Prevalence of intestinal helminth infection in relation to occupation

			Types of Parasites identified					
Occupation	**No Examined (%)**	**No infected (%)**	**Hookworm (%)**	***A. lum.* (%)**	***T. tri.* (%)**	***S. ster.* (%)**	***Taenia spp* (%)**	***D. latum* (%)**
Petty traders	700 (23.3)	409(58.4)	261(37.3)	90 (12.9)	38(5.4)	2(0.3)	8(1.1)	10(1.4)
Farmers	1610(53.7)	1026(63.7)	522(32.4)	350(21.7)	42(2.6)	68(4.2)	20(1.2)	24(1.5)
Health workers	20 (0.7)	9(45.0)	4(20.0)	3(15.0)	2(10.0)	0(0.0)	0(0.0)	0(0.0)
Artisans	490(16.3)	319(65.1)	61(12.4)	200 (40.8)	50(10.2)	4(0.8)	4(0.8)	0(0.0)
Teachers	180(6.0)	48(26.7)	24(13.3)	18(10.0)	6(3.3)	0(0.0)	0(0.0)	0(0.0)
Total	**3000**	**1811 (60.4)**	**872(29.1)**	**661 (22.1)**	**138(4.6)**	**74(2.5)**	**32(1.1)**	**34(1.1)**

Table 9: Prevalence of intestinal helminth infection in relation to house crowding

Types of Parasites identified

House crowding	No Examined (%)	No infected (%)	Hookworm (%)	*A. lum.* (%)	*T. tri.* (%)	*S. ster.* (%)	*Taenia spp* (%)	*D. latu* (%)
<5	1150 (38.3)	419 (36.4)	152(13.2)	186(16.2)	35(3.0)	15(1.3)	13(1.1)	18(1.5)
>5	1850(61.7)	1392(75.2)	720(38.9)	475(25.7)	103(5.6)	59(3.2)	19(1.0)	16(0.8)
Total	**3000**	**1811 (60.4)**	**872(29.1)**	**661 (22.1)**	**138(4.6)**	**74(2.5)**	**32(1.1)**	**34(1.1)**

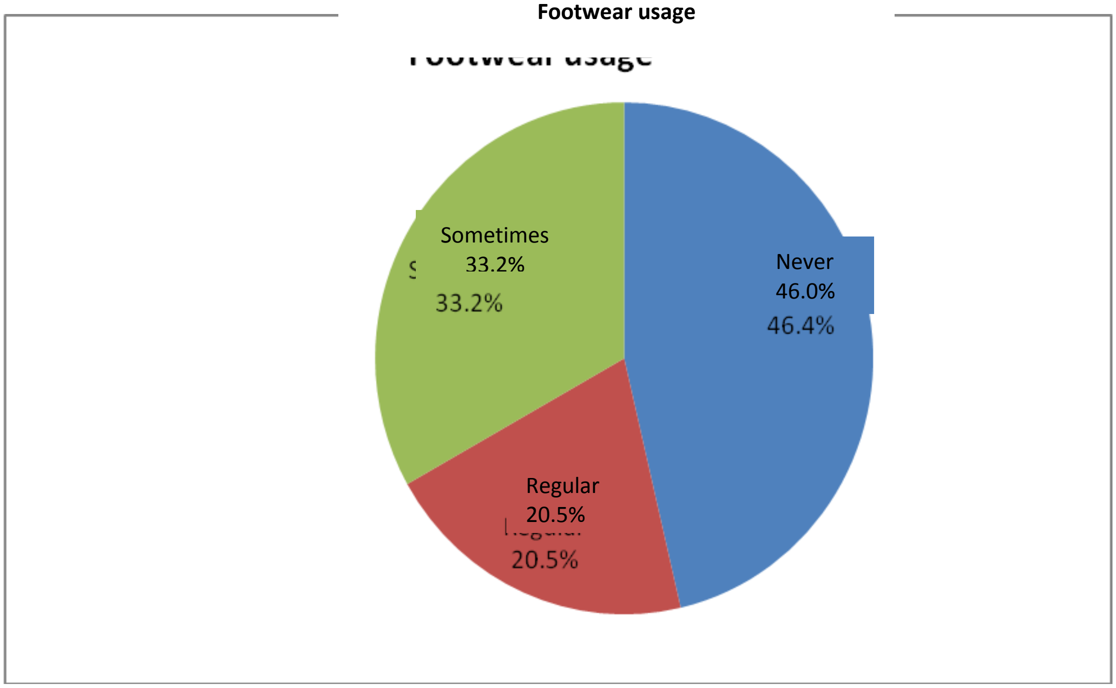

Fig. 1: Pie chart showing prevalence of intestinal helminth infection in relation to footwear usage.

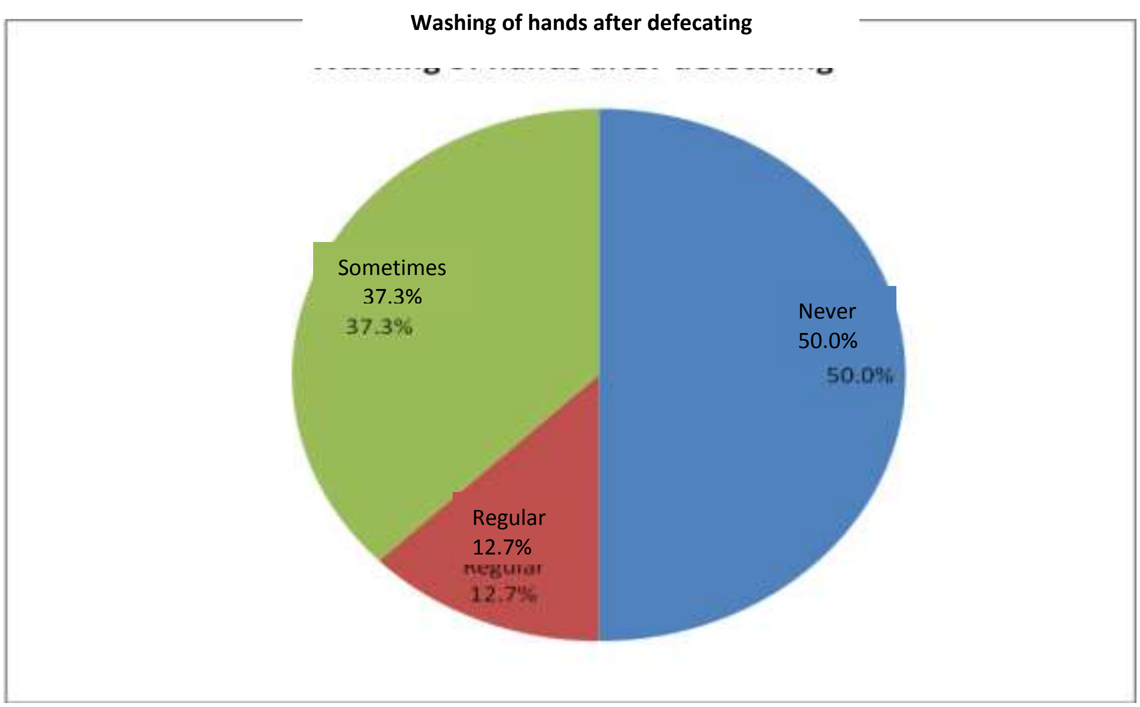

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Fig. 2: Pie chart showing prevalence of intestinal helminth in relation to washing of hands after defecation.

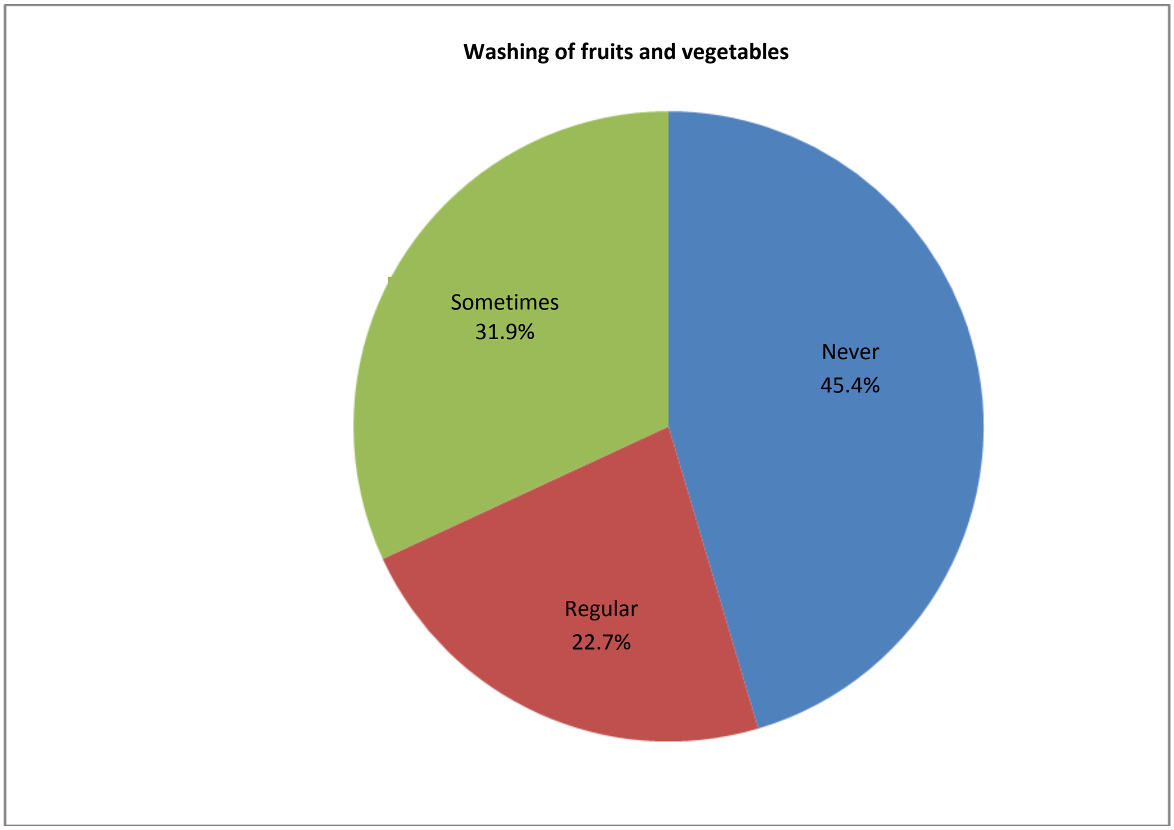

Fig. 3: Pie chart showing prevalence of intestinal helminth in relation to washing of fruits and vegetables before consumption.

DISCUSSION

The results of the present investigation showed a high prevalence (60.4%) of intestinal helminth parasites among children of Nnewi South Local Government Area. This is similar to the results presented by Ukpai and Ugwu (2003), Gundiri and Akogun (2003), Obiamiwe, (1997) in various studies in Nigeria. These results and those collated by Ogbe and Odudu (1990), Ndifon (1991), Kogi *et al* (1991) Gundiri and Akogun (2003) illustrated that helminth parasites particularly hookworm and *Trichuris trichiura* are common throughout much of Nigeria since the same environmental conditions abound.

The six intestinal helminth parasites identified in this study were detected in all the communities where screening took place. The universal and endemicity of these parasites have been attributed to previous studies to poor standard of public and personal hygiene, shortage of clean potable water and indiscriminate defecation (Atu *et al*., 2006)

The prevalence of intestinal helminth parasites by sex in this study showed that more males were infected than their female counterparts (Table 3). This agrees with the findings of Okon and Oku (2001); Luka *et al* (2000). The higher prevalence associated with males may be due to the fact that they more often engage in activities such as playing in the field thereby having contact with the soil. They also engage in rearing domestic animals which may predispose them to infections. Females on the other hand engage in domestic chores which expose them to intestinal helminth infections. However, the difference in the infection rate in respect to sex was not significant. This finding implies an equal exposure in sexes.

The study showed that the age groups 3-5, 12-14, 9-11 years recorded high prevalence rates of 75.4%, 72.2% and 57.3% respectively. This indicates a common pattern of behaviour and susceptibility for the age groups. The high prevalence of faeco-orally transmitted intestinal helminth (*Ascaris lumbricoides* and *Trichuris trichiura*) reported among age groups in this study are closely related to their habits. These are generally the school age subjects. Individuals in these age groups probably spend more time in water either washing or playing. They are also more often in contact with the soil and eat indiscriminately with unwashed hands. Lollies, food and snacks are freely purchased from hawkers and frequently shared among their friends. Cabrera *et al* (1994); Etim *et al*, (2002); Oslen (2003) and Ibidapo and Okwa (2008) in conformity to this, noted that unclean hands played a vital role in the transmission of ascariasis among children. Toddlers also recorded high positive rates for intestinal helminth infections because of the dirty environment in which they play and because contaminated hands were dipped into the mouth quite often. The prevalence of infection was observed to be on the decrease in individuals aged 18-20 years of age. This may be because children of this age are becoming more conscious of their personal hygiene and hence are able to avoid as much as possible what would lead them to one being infected. Luka *et al, (*2000); Ukpai and Ugwu (2003) observed a similar trend in Kaduna State and Abia State respectively.

The global public health importance of hookworm disease, ascariasis, trichuriasis and other intestinal helminth infection have been comprehensively reviewed (Ukpai and Ugwu, 2003; Sarraya *et al* 1971). Hookworms are directly responsible for blood loss leading to iron deficiency anaemia which may have profound effects on developmental increments in children via its influence on micronutrients status (Viteri, 1994). Also anorexia is known to accompany hookworm infection. Ascariasis is particularly common in children and is associated with malnutrition (Sam-Wobo *et al* 2004) affecting the health and growth of infected children.

In this study, the prevalence of intestinal helminth infections in relation to socio economic factors was also investigated. Improper disposal (bush) of human waste was positively associated with intestinal helminth infection. This has been previously reported in different parts of Nigeria (Adeyeba and Essiet, 2001, Ozumba and Ozumba 2002, Ukpai and Ugwu 2003). In this study, a comparison of the toilet systems used by the sample population showed that those who defecate in bush (66.2%) had the highest prevalence of the infection followed by those who defecate in pit latrine (65.4%), the least was observed among those who use water closet (28.9%). The low prevalence of infection among those who use water closet could be that some individuals who have water closet system sometimes prefer to defecate in bushes and farmland around their houses. This reaffirms the fact that parasitic disease transmission is promoted by poor environmental sanitation which includes indiscriminate defecating and poor personal hygiene.

With respect to water sources used for drinking and other needs, respondents make use of streams, borehole water and well water only. None of the communities studied had access to tap water. Infection rate was found to be highest among those who use local stream (72.1%) while the least was observed among those who use borehole (26.7%). The reason for this was not far-fetched these local streams in most cases are not protected and are subject to contamination by cysts and ova of parasite agents. The seeming high rate of infection observed among individuals who use borehole water is similar to the findings of Luka *et al.* (2000). It is possible that those who use borehole water also make use of local streams as children are fond of playing or swimming in it and possibly drink water from such streams. Other possible sources of contamination may be through unwashed contaminated hands of children after playing with soil. They in the process of fetching water contaminate the water containers, mouth or nozzle handle of borehole and the water itself.

The high infection rate observed among individuals whose parents are artisans (65.1%) and farmers (63.7% could also be attributed to poor personal hygiene and poverty. Inhabitants of the study communities were mainly farmers and many of them have their farms located 2-3 km away from their homes. Their children are usually left unattended after school to play around and eat whatever comes their way. Unlike the traders whose shops are located within local market square their children usually join them after school to assist in the shop, thereby restricting their movement. The low infection rate (26.7%) observed among teachers and health workers (45.0%) could be attributed to their high level of exposure and scholastic attainment their parents. This is similar to the findings of Ukpai and Ugwu (2003).

An individual's level of education has been recognized as one of the most important risk factor for intestinal parasitism (Toma *et al.,* 1999; Phiri *et al.,* 2000). In this study, the highest prevalence of intestinal helminth infections was observed among individual whose parents are without formal education (68.0%) followed by those with primary education (64.1%) while the least prevalence was observed among those with tertiary education (38.5%). This implies that as the level of education increases the likelihood of intestinal helminth infection declines significantly. This is because through health education in schools, individuals are taught risk factors.

The findings of this study confirm household crowding a significant determinant in intestinal helminth parasitism. In this study, households with more than five members harbor more infection rate (79.1%) than households with less than five members (37.9%). Previous studies (Atu *et al.*, 2006 Oyerinde *et al* 1980) on intestinal parasitism in institutionalized centers such as orphanages, crèches, Primary schools have similarly confirmed overcrowding an important factor in disease transmission.

In this study, association between walking barefooted while outdoors and a higher prevalence of helminth infection was observed. Individuals in the study communities who do not wear footwear had the highest prevalence (81.8%) of infection followed by those that sometimes wear footwear (72.2%). This could be attributed to the high level of poverty observed among the inhabitants as some could not afford to buy footwear. It could also be traced to the fact that the environment was seeded with many parasitic eggs and cysts. Nock *et al* (2003) made similar observations and conclusion in Ilorin, Kwara State of Nigeria. Furthermore the presence of eggs in soil could facilitate their dissemination both far and wide. It was also observed that children and young adults in these communities walk barefooted while shepherding their animals. They also with their animals co-mingle with people at water points and within the environment.

The study reports a significantly higher infection rate among those who never wash their hands after defecating (64.6%) than those who regularly do so (59.5%). The non-washing of hands was attributed to ignorance and lack of water. Hand washing as a good hygiene practice especially after toilet would eliminate any potential pathogen that would have been picked up and by so doing, would go a long in preventing further of transmission of intestinal parasitic infections (Nock *et al*., 2003).

The study revealed that those who never wash their fruits and vegetables were significantly highly infected (65.0%) than those who regularly (54.2%) do so before consumption ($p<0.05$). Unfortunately the hygienic nature of these fruits and vegetables is questionable both from their source of growth where human and animal excreta is largely employed as manure and to the point of consumption. In confirmation to this, several authors have reported passive transmission of enteric pathogens and parasite ova by fruits and vegetable (Umoh *et al.*, 2001; Eneanya and Njom, 2003).

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