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Prevalence of Human Intestinal Nematode Parasites in Three Rural Communities of the Niger Delta, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author APU designed the study, wrote the protocol and the first draft of the manuscript. Authors DAG and AG managed the literature searches and analyses of the study. Author JO performed the statistical analyses. All authors read and approved the final manuscript.

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ABSTRACT

Infection with intestinal nematode parasite is one of the most important neglected parasitic infection in our local area. The aim of this study was to determine the current status and prevalence of human intestinal nematode parasite in three rural communities of the Niger Delta in Nigeria namely Rumuewhor, Ubimini and Elibrada. The study design was school-based with another collection point at the Primary Healthcare centres of each community. Samples were collected monthly from children and adults from Rumuewhor, Ubimini and Elibrada: three rural communities of the Niger Delta from October 2016 to April 2017. One thousand bottles were issued to subjects of which four hundred (400) faecal samples were obtained. These were examined for nematode parasites using saline wet mount technique. Of the 400 samples examined 220 (55%) were positive for *Ascaris, Trichiuris* and Hookworm species. The age group 1-10 years old with 72.1% was the highest prevalence among the groups followed by age group 11-20 years (63.2%). The age 40^{+} years had zero prevalence. There

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was no gender and community difference ($p < 0.05$) in percentage infection. Poly-parasitism (co-infection) was recorded as *Ascaris* / Hookworm (AS/HK), *Ascaris / Trichiuris* (AS/TT) and *Hookworm / Trichiuris* (HK/TT) combinations in the study area. This was in decreasing order of AS/TT > HK / TT > AS / HK. This study has revealed that intestinal nematode parasites *Ascaris, Trichiuris* and hookworms were found with higher prevalence in the children of age 1 - 10. The nullity of polyparasitism in one of the communities (Ubimini) suggests unequal exposure to the infective stages which requires further investigation. The significantly higher prevalence of hookworm indicates environmental faecal contamination, coupled with the damp humid tropical soil that provides a good growth factor.

Keywords: Niger delta; prevalence; nematode; parasites; Nigeria.

1. INTRODUCTION

Intestinal nematode parasites are one of the most Neglected Parasitic Infections (NPIs) in our society. They thrive and persist in human population in which poverty, ignorance, inadequate sanitation is entrenched [1], or where people are not bothered by the parasite activities and burden. Nematodes are the most common infective agents of mankind that still result in morbidity in the developing world. As far as nematode infections are concerned, school-age children are often presented with much heavy worm infection because of their vulnerability to the infective phase of the parasites [2]. Intestinal nematode parasites do not self-replicate in their host, so the acquisition and intensity is as a result of host exposure to the bionomics of the parasite in its infective phase, which takes place in the soil environment [3]. Intestinal nematodes are transmitted by eggs or larvae present in human faeces which contaminate the soil in areas where sanitation is poor [4]. Contamination and transmission of these parasites arise from indiscriminate defecation most commonly seen in a rural setting, poor behavioural practices like open field defecation, the absence of regular hand-washing, and eating of fruits and vegetables from the farm without prior washing [5-9]. Uga et al., [4] stated that contaminations of soil by helminth parasite was prevalent in the tropical and subtropical region of the world where good sanitation and adequate disposal of human faeces were not assured. Additionally, walking bare feet on the soil also encouraged the dynamic process of transmission of helminthic infections [10].

Human intestinal nematode parasites are ubiquitous or global as it affects people from all over the world. The incidence and prevalence may be higher in some areas depending on prevailing conditions. Patel [11] recorded 65.21 % prevalence in South Gujarat, India and [12] recorded 30% in Hanoi Vietnam. Some other studies in Venezuella [13], Brazil [14], Nepal [15], India and Pakistan [16,17] also recorded helminth intestinal parasites in rural or squatter communities confirming their ubiquitous nature.

In Nigeria, different authors have recorded the prevalence of nematode parasites with different prevalence rates as parasitic infection is focal. Amadi et al., [7] observed high rate of helminth infections among people without good toilet facilities in Niger Delta and [18], recorded high prevalence of parasites in fruits and vegetables sold in the street of Obudu, Cross-River state. In South Eastern Nigeria, children who defecate in the bush were found to have a higher prevalence than those with water system facilities [19]. Onyido [20] recorded 10.18% prevalence among school children of Nnewi, while [21] recorded 77.8 % prevalence in a rural community in Ebonyi, East of Nigeria. School children were observed in Ibadan to have a higher prevalence of 50.4 % followed by food vendors - 34.5% [22]. These studies in Nigeria have therefore revealed a varying but significant prevalence of intestinal nematodes especially in rural areas making it a public health concern. Generally, nematode infections like hookworm, *A. lumbricoides, T. trichiura* and *Taenia spp* are associated with communities with poor sanitary conditions [23]. Therefore, this study is to determine the current status on the prevalence and pattern of nematode infection in different age groups and gender in three rural communities of Emohua Local Government Area of the Niger Delta.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in three communities-Rumuewhor, Ubimini, and Elibrada (Fig. 1) of

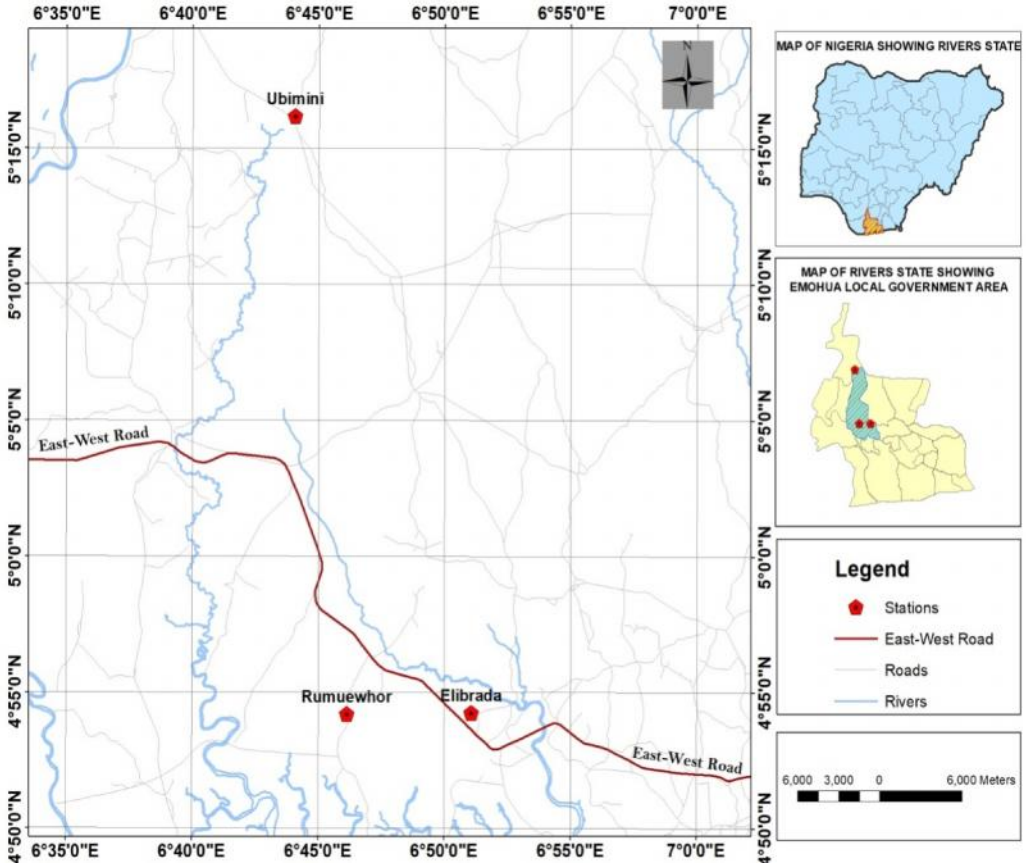

Fig. 1. Map showing study area

Emohua Local Government Area of Rivers State, Nigeria. The area is located between Latitude 5º 10 0 N and Longitude 6º 54 0 E. The area which lies within the tropical rainforest is characterised by eight months and four months of the wet and dry season respectively. The average temperature of the area is between 22ºC and 29ºC with high humidity and rainfall. The major occupation of the people is farming with a few other members of the communities engaging in trading and public service [24]. Sanitation facilities are grossly inadequate especially around the schools as we spotted defecations in and around classrooms and along the roads during this study. Most school children and some adults walk barefoot. Each community has a Primary Health care centre that was used during sampling as one of the collection points.

2.2 Ethical & Consent Clearance

Consent to carry out the sampling was obtained through the Headmasters, Principals and Matrons of various institutions after proper explanation of the basis for the research. Assent was obtained from the pupils and student of the various schools while at the Primary Health Centre, the laboratory technologist assisted to collect samples from volunteer parents and those who came for immunisation and antenatal. The relevance of the study especially the personal and public health significance was made known to them. It is regrettable that some pupils and student absconded from school, alleging that the stool samples were for rituals.

2.3 Sample Collection

Small clean screw-cap containers with a spatula, pre-labelled with subject age group and sex was issued to subjects at the Primary Health Care Centre, the Primary and the Secondary schools of the study areas. Subjects were instructed to provide fresh stool specimen passed in the morning hour using the sterilised spatula attached to the screw-cap container to avoid contamination of specimen. For providing the samples, subjects were appreciated with pencils,

erasers and sharpeners. One thousand bottles were given to the members of the communities (Rumuewhor, Ubimini and Elibrada) in the ratio of 350: 350: 300 respectively a day before sample collection and 400 (130: 140: 130 from the three communities) bottles were returned with stool samples. The provided stool samples were taken to the laboratory, to be examined for the presence of ova of helminths.

2.4 Laboratory Methods

Stool samples were examined using saline wet mount techniques [25]. Both formed and semi formed stool samples were examined. About 2 mg (match stick head amount) of stool specimen was mixed with 9% saline water on a microscopic slide to give a smooth thin preparation. The preparation was covered with a coverslip and examined under a compound microscope for helminth eggs using 10x objective and the condenser iris closed sufficiently to give a good contrast. Then a 40x objective was used to examine ova for identification. Identification of parasites was based on size, shell content, shape and colour based on [25,26].

Statistical analysis was done using SPSS 16. Tests for significance was by Chi-Square.

3. RESULTS

Fourty (40%) percent of the 1000 bottles given to subjects was returned with samples. The results of the survey revealed an overall helminth parasite prevalence of 55.0%. In Table 1, the people were divided into age groups. The age 1-10 years had the highest prevalence of 72.1% followed by age 11-20 years (63.2%) and the least was recorded in those 40^{+} years with no parasite observed. There was no difference in gender prevalence at P-value < 0.05.

The helminth parasite observed were *Ascaris lumbricoides* (26.8%), hookworm (45.62%) and *Trichiuris trichiura* (14.4%). *T trichiura* was found in stools of those < 20 years in the three communities (Table 2). Multiple infection with more than one parasite was more common in Rumuewhor, absent in Ubimini and only in age 11 – 20 at Elibrada. Hookworm infections were significantly higher in the three communities especially from age 11 up to 40. Age 1 - 10 had more of *Ascaris* infection. Age 40 and above had zero prevalence and *T. trichiura* was higher in subjects below 20 years.

Table 3 shows overall pattern of parasites co-infection in the study area. Poly-parasitism was observed in only two of the three communities and the combinations were *Ascaris* / *Trichiuris trichiura* (AS/TT), hookworm / *Trichiuris trichiura* (HK/TT) and *Ascaris* / Hookworm (AS/HK). AS/TT was more prevalent (5.7%) followed by HK/TT (4.37%) and AS/HK recorded the least (3.02%). Among the sex group with multi infections, females showed higher prevalence of AS/TT while males had more of HK/TT which was not different at P-value of 0.96 > 0.005. Single hookworm infections were significantly higher for both males and females followed by *A. lumbricoides*.

Table 4 shows the overall sex prevalence of the infection from the study area. Females had the highest prevalence of 57.2% than males (52.4%) which was not different at the P-value of 0.605. Rumuewhor had the highest prevalence of 59.3 %, and the least prevalence was recorded in Elibrada 46.9%. These differences were not different at P < 0.05.

There were variations in the pattern of the prevalence of intestinal nematodes in males and females from the three communities (Table 5) but the differences were not significant at p < 0.05.

Table 1. Prevalence of human intestinal nematode parasite from stool samples among age groups in the study area

Age group	Number Examined		Total	% Number infected		% Total
	Male	female		Male	female	Prevalence
1-10	36	50	86	77.8	69.0	72.10
11-20	97	107	204	59.8	66.4	63.2
21-30	22	33	55	31.8	39.4	36.4
31-40	24	18	42	16.17	27.8	21.4
40+	6	7	13	0	0	0
Total	185	215	400	52.4	57.2	55.0

Table 2. Pattern of prevalence human intestinal nematode parasite among age groups in the different communities studied

Age	Rumuewhor prevalence (%)				Elibrada prevalence (%)				Ubimini prevalence (%)			
group(yrs)	*Ascaris*	Hookworm	*T.trichiura*	Multi	*Ascaris*	Hookworm	*T.trichiura*	Multi	*Ascaris*	Hookworm	*T.trichiura*	Multi
1-10	27.5	28.8	21.2	22.5	33.3	66.7	0	0	60	26.7	13.3	0
11-20	21.3	36.2	23.4	19.1	29	44.9	11.6	14.5	25.5	66.7	7.8	0
21-30	12.5	0.75	0	12.5	14.3	85.7	0	0	0	100	0	0
31-40	16.6	66.6	0	16.6	0	50	50	0	66.7	33.3	0	0
41 +	0	0	0	0	0	0	0	0	0	0	0	0
Total	24.1	35.5	19.9	20.6	27.2	49.4	11.1	12.3	31.16	60.5	7.9	0

Table 3. Pattern of intestinal nematode Parasite Prevalence as single and multi infection among gender in the study area

Gender	Pattern of Parasites Combination %					
	AS	HK	T.T	AS/HK	AS/T.T	HK/T.T
Male	26.7	45	15.3	3.05	4.58	5.34
Female	26.9	46.1	13.8	3.0	6.0	4.2
Total	26.8	45.6	14.4	3.02	5.7	4.37

Keys: AS = Ascaris lumbricoides T.T = Trichuris trichiura HK = Hookworm complex

Table 4. Overall gender prevalence of human intestinal nematode parasite in the study area

Gender	Rumuewhor		Elibradia		Ubimini	
	No. examined	% infected	No. examined	% infected	No.examined	% infected
Male	60	58.3	63	41.3	62	58.1
Female	80	60.0	67	52.2	68	58.8
Total	140	59.2	130	46.9	130	58.5

4. DISCUSSION

Prevalence of infections with intestinal helminths is a typical marker of poverty, lack of good sanitary measures and presence of ecological factors that influence parasite development, survival and transmission [8]. The overall prevalence of 55.0% classifies the study communities as a “high risk area” for helminth parasite infection by WHO [1] standard. Onyido [18] observed a lower prevalence (10.18%) while [27] recorded a prevalence of 50.6% in Anambra State. Intestinal helminths parasites are disseminated by contaminated soil environment with infected faecal matter. Infection results from poor behavioural risk factors or poor personal hygiene [7], so that each community's prevalence of intestinal nematodes is a reflection of their behaviour and personal hygiene. This is a major factor in the transmission process of the infective parasites. According to [9], intestinal helminth parasites affect almost a quarter of the world’s poorest and most marginalised people that live in rural areas. These people lack good toilet system and lack positive behaviour in handling food items as transmission results from ingesting the ova of parasites into the mouth.

The age groups of 1 - 10 years recorded higher prevalence rate of 72.1%. This age group has great impact on the epidemiology of local helminthiasis as they are most exposed and have greater chances of acquiring the infections either at school or home as toddlers with their behavioural disposition. It is the age of playing around the house, in backyards or along the streets. Usually, children are barefoot, playing on the soil and eating with unwashed hands fruits picked directly from the soil. They may not be cautious of their personal hygiene, or old enough to understand the need for cleanliness as they play on ’contaminated’ soil. This is consistent with [28] who noted that activities of individuals may strongly contribute to infection with intestinal helminths parasites. Age 11-20 years is the domestic activity age where children fetch woods and crops from the farm, play in the fields and may not be properly schooled in personal hygiene. Age groups 40^{+} recorded zero prevalence indicating that prevalence of infection decreased with increasing age. This may be attributed to immunity interference by the older individual or it could be due to psychosocial development of the individual, as they are more self-conscious of their personal hygiene and appearance. The significantly higher hookworm infections could suggest a contaminated environment. Environmental contamination is non-selective as the only determining factor is walking barefoot or sitting naked on the ground which may be common in rural areas. Faecal - oral infection is selective as it depends on eating or drinking infective stages. Cooking, washing of hands and some form of water treatment may eliminate some people from infection with these parasites. Not wearing shoes and slippers in a contaminated environment that is probably damp, humid with a lot of humus will be an advantage for hookworm infection.

The variations in prevalence among the gender was not significant which is in agreement with [29], who stated that infection with intestinal parasites was not sex dependent but rather depended on level of exposure to predisposing factors as intestinal helminths parasites are prevalent in many tropical countries due to the climatic conditions that influence the survival of

Table 5. Gender based pattern of human intestinal nematode parasites in the three communities studied

Gender	Rumuewhor Prevalence (%)				Elibradia Prevalence (%)				Ubimini Prevalence (%)			
	Ascaris	**Hookworm**	***T.trichiura***	**Multi**	***Ascaris***	**Hookworm**	***T.trichiura***	**Multi**	***Ascaris***	**Hookworm**	***T.trichiura***	**Multi**
Male	21.3	37.7	19.7	21.3	29.4	47.1	11.8	11.8	33.3	55.6	11.1	0
Female	26.2	33.8	20	20	25.5	51.1	10.6	12.8	30	65	5	0
Total	24.1	35.5	19.9	20.6	27.2	49.4	11.1	12.3	31.6	60.5	7.9	0

the parasites. This could also be as a result of individual behavioural factors and activities as well as the number of parasites available at the time of sampling [10,30]. The variations in percentage prevalence among communities was not significant probably due to the fact that the three communities were rural with similar predisposing factors. The absence of multi infection in Ubimini requires further investigation into the lifestyle of this community. The parasites- *A. lumbricoides, T. trichiura* and hookworm co-infected the same host as observed in this study. This could be attributed to their means of transmission [7] which is feaco – oral from food and water or hands that have become contaminated with infective eggs. This could also explain the absence of *T. trichiura* in age groups above 20 years. The HK/AS or HK/TT combinations were found only in Rumuewhor and Elibradia indicating multiple exposure to infective forms of the parasites. Polyparasitism comes as a result of equal exposure of individuals to available infective stages which could be because of indiscriminate disposal of excrement washed off and spread by rain into the soil, with direct contamination of food and water. The outcome of which will be multiple infections with different intestinal helminth parasites. It is possible that in Ubimini, the people were not equally predisposed to the different parasites resulting in single infections. A further study (with increased sample size for these communities) correlated with clinical examinations, interviews and socio-cultural questionnaires including questions about work habits and self-care is needed to give informed decisions on control measures.

5. CONCLUSION

Intestinal helminths parasites are prevalent in the three study areas of Emohua, and the high prevalence indicates these communities as a high risk area for infection with helminth parasites. There is, therefore, need for health talks and sensitisation on personal hygiene in pre and school-age children. The higher prevalence of hookworm indicates a contaminated environment and a lifestyle that predisposes the people to hookworm infection. Polyparasitism in two communities could be as a result of equal exposure of individuals to available infective stages.

COMPETING INTERESTS

Authors declare that no competing interest exist.

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