GEOPHAGY AS A RISK FACTOR FOR GEOHELMINTH INFECTIONS AMONG WOMEN IN ENUGWU-AGIDI COMMUNITY, ANAMBRA STATE, NIGERIA

ABSTRACT

Aim: The aim of this study was to determine the prevalence of soil- transmitted helminthes and geophagy as a behavioural risk factor among women in Enugwu-Agidi, Njikoka Local Government Area, Anambra State, Nigeria.

Study design:A community based cross sectional study, discriptive study.

Place and Duration of Study: Women in Enugwu-agidi community, Anambra state, between May to December, 2023.

Methodology: A total of 264 women aged below 20 and above 51 years old were enrolled for the study and a total of 264 faecal samples collected and analyzed using direct faecal smear and formol-ether sedimentation techniques for estimation of prevalence. Both quantitative and qualitative surveys involving in-depth interviews and pretested questionnaires were used in determining the predisposing risk factors, the level of knowledge and impact of geophagy among both pregnant and non-pregnant women. The relationship between each variable and geohelminths prevalence was analyzed using Chi square. Test of statistical significance was set at P-value of 0.05 (95%) confidence interval.

Results: Of the 264 faecal samples examined, 108 (40.9%) were positive with one or two STHs parasites. The parasites recovered were *Ascaris lumbricoides* 58(53.7%), Hookworm 26(24.1%) and *Trichuris trichiura*24(22.2%). The study showed that 61.3% of women interviewed practiced geophagy at the time of the study. Prevalence of STHs parasites was higher (61.3%) among those who practiced geophagy than those who do not (17.2%). Similarly, pregnant women who practiced geophagy were more infected with STHs parasites (63.8%) than those who were not pregnant (56.3%). Age –specific prevalence was highest among those who were less than twenty years old (both for those who practice geophagy (70.0%) and those who do not (100.0%). The highest prevalence of STHs infections (72.3%) was observed among those in their first trimester trimester. In the same vein, primigravids who practice geophagy were more infected (81.0%) than those who do not (50.0%). Traders among women who practice geophagy were more infected (71.4%) than those who donot practice geophagy (27.8%).The preference for the soil type was ranked as clay (75.4%), termite mounds from tree trunk (38.7%) and hut bricks (36.6%). Perceived reasons for geophagy included dimished cravings when they eat clay (%), prevention of vomiting and nausea 56(39.4%) and others ingested soil for taste 62(43.7%). Possible health risks involved in geophagy

such as abdominal discomfort 158(59.8%), heartburn 88(33.3%).

Conclusion: Consumption of geophagic clay has significant association with contraction of STHs infections.Sensitization and mass education of women on the dangers of geophagy is needed. Guidelines should be developed for implementation of routine faecal examination screening procedure for all women especially pregnant women attending antenatal clinics so that mass management can be offered to all pregnant women.

Keywords*:* Geophagy, soil-types, Geohelminth infections, *A. lumbricoides*, *T. trichiura*, Hookworm, Women ,Enugwuagidi

1. INTRODUCTION

Soil-transmitted helminthes (STHs) infections are among the most common infections worldwide and affect the poorest and most deprived communities. They are a group of nematodes that infect more than a billion people worldwide [1] particularly in marginalized, low-income and resource-constrained regions of the world [2,3]. Approximately 1.5 billion people or 24% of the world's population are infected with STHs globally [4]. Infections are widely distributed in tropical and subtropical areas, with the greatest numbers occurring in sub-Saharan Africa, the Americas, China and East Asia. Infections in countries in these widely distributed areas account for over 56% of the infection globally [5].

Nigeria has the highest total number of people infected with STHs in sub-Saharan Africa (Federal Ministry of Health [6] report as cited by [7] with school-age children having the highest intensity of infection [8].The disease is most prevalent in warm and moist climates where sanitation and hygiene are poor and waters are unsafe, including the temperate zones during warmer months. Thousands of rural and impoverished villagers throughout the tropics and sub-tropics are often chronically infected with several different species of parasitic worms.The prevalence of STHs infections is especially high among populations with poor environmental sanitation [9]. Other practices such as hand washing, disposal of refuse, personal hygiene and wearing of shoes when not done properly, may contribute to the infection or picking of infective forms of the worm from the environment [10].

The risks of the individuals suffering from soil-transmitted helminths (STHs) infections- related morbidity appear to be a joint function of the number of species harboured and/or the infection intensity of any species[11]. This is even more among the vulnerable populations such as pregnant women with suppressed immunity due to their pregnancy status. In many agricultural communities, women often acquire helminthes infections in the process of growing family's food because of the constant contact with soil [12]. Hookworm infection is an important etiological agent of anaemia in women of reproductive age [12]. Given that the geographical distribution of STHs infections widely overlaps in sub-Saharan Africa, the occurrence of hookworm infection during pregnancy may

contribute significantly to the degree of anaemia in mothers and the new born[13]. The high prevalence of STHs in sub-Saharan Africa alone has been documented, mainly in countries such as Nigeria [14,5] Ethiopia [15,16], Democratic Republic of the Congo, Tanzania, Sudan, Angola, Ghana, South Africa, Côte d'Ivoire, Mozambique and Kenya [17,9]. However, analysis has focused primarily on the general population and school children.

Geophagy, the deliberate consumption of soil or earth materials, has been observed in various cultures and regions worldwide. Despite being considered a peculiar behaviour by some, geophagy has deep cultural and historical roots and is practiced for a variety of reasons. The prevalence and significance of geophagy vary across different populations and contexts, including Enugwu-agidi, where it has been found to be prevalent among women in the community[18].One potential explanation for geophagy is the nutritional hypothesis, which suggests that individuals engage in the practice to obtain essential minerals and nutrients that may be lacking in their diets. Soil can contain trace elements such as iron, calcium, zinc, and other micronutrients, which are crucial for human health [19].

.1 STATEMENT OF THE PROBLEM

The high rates of STHs infections among women are mostly indicative of soil and domestic water supply around homes due to poor sanitation and improper sewage disposal. Pregnant women are also at high risk of infection because of their close relationship with children. Pregnancy has been associated with an increase in prevalence of *A. lumbricoides* and *T. trichiura* infections compared to non-pregnant women.

Geophagia is commonly practiced by women in developing countries. Self reported reasons for geophagia include enjoyment of soil taste, texture and smell, and also a kind of culture to show pregnancy in some African countries. However, soil may harbor toxic materials and infectious organisms. Consumption of soil during geophagia practice may therefore expose people to to toxic minerals, pathogenic microbes and helminthic infections.

1.2 JUSTIFICATION FOR THE STUDY

Geophagy behavior has long been a suspected sources of soil-transmitted helminth infections. The effect of geophagy on women especially pregnant women as a consequence of of intestinal helminthes infections has not been extensively studied although available information suggests that it is especially common among women. A pilot syudy conducted had shown that geophagy was widely practiced in Enugwu-Agidi and that it is being mined there. Given the role that soil-transmitted

helminthes play in excarbating malnutrition, and the importance of maternal nutrition during pregnancy (especially among pregnant women in rural areas), this research assessed the relationship between deophagy as a risk factor for the transmission of the orally ingested nematode parasites among women in Enugwu-Agidi, Njikoka Local Government Area, Anambra State.

The specific objectives of the study were to determine:

1. The prevalence of soil-transmitted helminthes infections among pregnant and non-pregnant women in Enugwu-Agidi.
2. The prevalence of STHs infections among women practicing geophagy in Enugwu-Agidi.

2. MATERIAL AND METHODS

2.1 Study Area

Enugwu-Agidi is located in Njikoka Local Government Area of Anambra state. Its geographical coordinates are 6^0, 13'0" North, 7^0 1^0 0" East. It is situated close to the localities Abagana and Umuokpo. Enugwu-Agidi is also situated nearby villages of Ukwulu 8 km northwest, Nawfia 4 km south, Enugu-ukwu 5 km south, Norgu 5 km northwest, Amawbia 6 km southeast, Ukpo-Akpu 5km southwest and Ifite-Ukpo 6km west. The seven children of Omenakanu developed the lineages that constituted the original seven Villages of Enugwu-agidi namely: Normu, Umu-agidi, Achalla, Ifite, Igbollo, Ogwugwu and Egbedeana. These villages were formerly divided into two maximal lineages; Ezi and Ifite (EzinaIfite). The population of people in the community is6,731, Male population is 3,439 while Female population is 3, 292 [20].The town is populated with people of various socio-economic classes, including farmers, teachers, civil servant traders and so on. Due to the fertile land, almost everybody in the community practice one form of farming or the other, either as occupation or as a supplementary occupation, some have vegetable garden. The people are also known for timber trading because of the think rain forest that surrounds them. Clay is mined, process and sold for consumption in Enugu-agidi. They have few boreholes and rivers such as Offiah River.

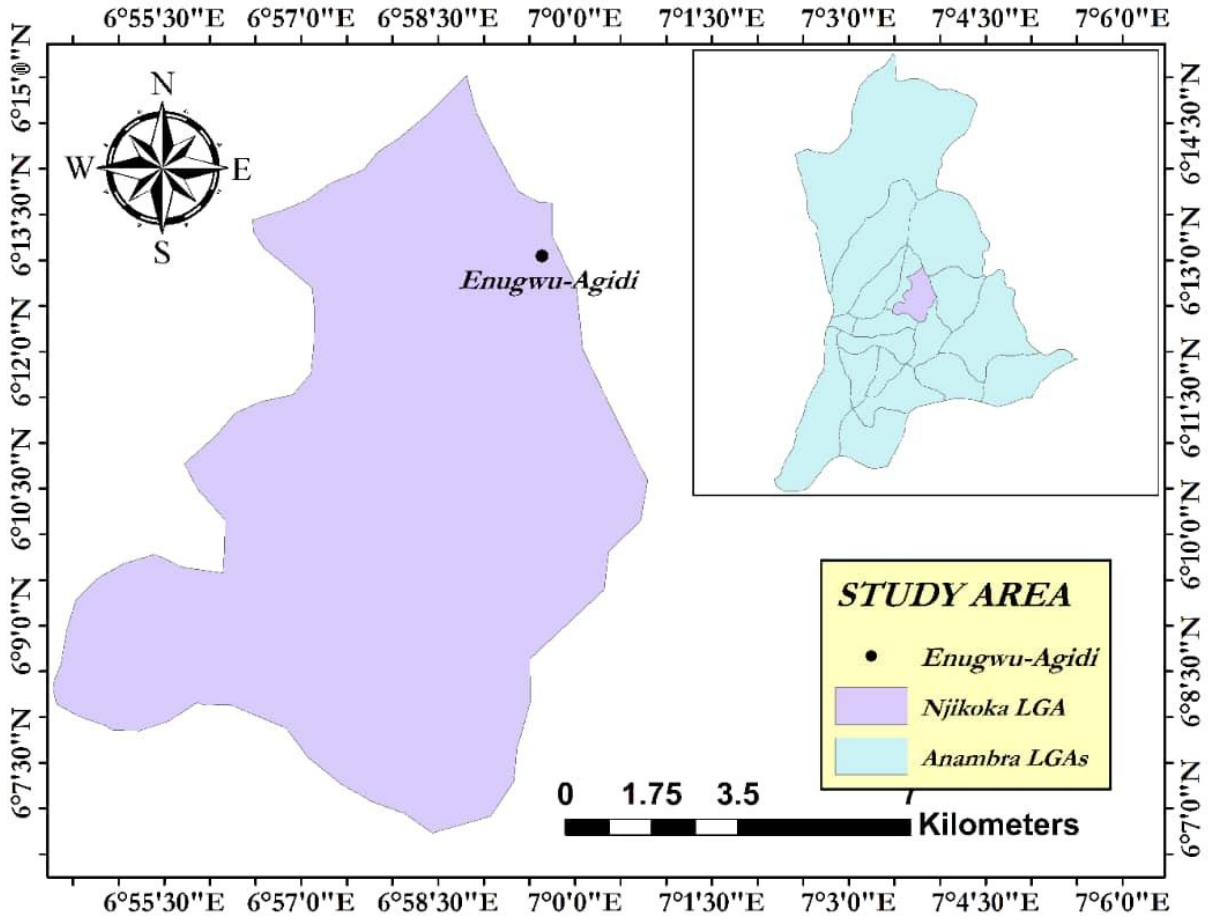

Figure 1: Map of Anambra showing EnugwuAgidi in Njikoka Local Government Area

Source: Department of Geography and Meteorological Nnamdi Azikiwe University,Awka

2.2 Study Design

A community base cross sectional study among women in Enugwu-agidi, Anambra state was carried out for the period of six months. A verbal consent was made stating the aim and method of study before the investigation began.

2.3 Ethical Consideration

A letter of introduction was obtained from the Head Department of Parasitology and Entomology, Nnamdi Azikiwe University Awka. Ethical approval was obtained from Ethical committee of COOUTH, Awka, Anambra state (REF: COOUTH/CMA/ETH.C/VOL.1/FN:04/243), seeking permission to carry out research in Enugwu-Agidi.

2.4 Advocacy and Informed consent

Prior to the commencement of the study, Advocacy visits was made to the Igwe and Heads of the villages to explain the objectives, expected benefit and potential risk, to solicit for co-operation of the populace. A verbal consent was also made to the people in the community through the community announcer, also through written letter to all the churches in the community informing the people aim of the study, duration of the research study, days collection of sample will done at the community hall.

2.5 Exclusion Criteria

The subjects who admitted to have received antihelmintics in three months prior to the study were excluded from the study.

2.6 Inclusion Criteria

All women both pregnant and non-pregnant who have not taken antihelmintics within the past three months and also those who gave their consent were enrolled for the study. The objectives of the research and its implications were explained to the women with the consent form. Participation was after signing the consent form and a participant could withdraw from the study at any time without consequences for her antenatal services.

2.7 Ethical Approval

The approval for the study was obtained from the Ethics and Research Committee, Chukwuemeka Odimegwu Ojukwu University Teaching Hospital, Awka.

2.8 Sample Size Determination

A formular for sample size determination as described by Yamane (1964) was used, thus

$n=N/1+N(e^2)$ where n=sample size

N=population size

E=error limit

1=constant

The expected sample size was 250 but was made up to 264.

2.9 Collection of stool samples

Prior to the stool sample collection, the women were guided on how to bring their stool samples not to mix with soil and urine. The women were provided with a dry, clean and leak- proof stool cup, labeled with the identification number of each woman and application stick. Samples after collection were preserved in 8ml of 10% formalin solution, and transported to the Department of Parasitology and Entomology Laboratory, Nnamdi Azikiwe University Awka, for processing.

2.10 Examination of Sample Specimens

2.10.1 Macroscopic Examination of Stool Samples

The stool samples collected were physically examined for colour, consistency, presence of mucus or blood, adult parasites.

2.10.2 Microscopic examination of stool samples

The following techniques were adopted for examining the stool samples

2.10.2.1 Direct Smear/ wet Preparation

Five grammes of each stool sample were weighed out on a microscopic slide. This was emulsified with a drop of saline and spread with the aid of a wooden applicator until translucent. Prepared slide was then covered with a cover slip and examined under a microscope using x40 and x100 objectives. STHs eggs were identified using [21], [22] guide and illustration.

2.10.2.2 Formol-ether Concentration technique

An applicator stick was used to collect 1g of faeces and emulsified in 4 ml of 10% formalin ether contained in a tube until a slightly cloudy suspension was formed. A guaze filter was fitted into a funnel and the funnel was placed on top the centrifuge tube. The faecal suspension was passed through the filter into the centrifuge until 7 ml mark was reached. The filter was removed and discarded with the lumpy residue. Four ml of ether was added and mixed well for a minute. The suspension was transferred back to the centrifuge tube and centrifuged at 1000 rpm for a minute. The feacal debris was loosened with an applicator stick and the supernatant was poured away quickly by inverting the tube. The tube was replaced in its rack and the fluid on the sides of the tube was allowed to drain down to the sediment. It was mixed well and a drop was placed on a slide and then covered with coverslip for examination under a microscope. X10 and x40 objective lenses were used to examine the whole area under the cover slip for eggs and larvae of soil-transmitted helminthes [23]. The eggs and larvae were identified with reference to Atlas of Parasitology [22].

2.11 To determine the behavioural risk factors, level of knowledge and management factors of women to STHs infections.

Indepth interviews were used to determine the behavioural risk factors, level of knowledge about geophagic practices.

2.11.1 Indepth Interviews: Indepth interviews were held with both pregnant and non-pregnant women in Enugwu-Agidi. This was employed to elicit information on the practice of geophagy in relation to STHs infections.

2.11.2 Structured Questionnaire: A total of four hundred and twenty pre-tested questionnaires were administered among the women studied. The questionnaire consisted of open–ended questions of discriminatory statements ondemographic, socio-economic, educational status, behavior, level of

knowledge on causes, signs and symptoms, preventive measures and geophagy practices of women in relation to STHs infections in Enugu-Agidi. The structured questionnaires were given to the women to fill and administered in the mother tongue (Igbo Language) for women who do not understand some of the questions in English language. Finally accuracy and completeness of all the questionnaires were checked at the end of each data collection day. Four hundred and twenty questionnaires were given out and all (100.0%) were retrieved from the participants.

2.12 Examination of soil types

To determine the role of different soil types ingested by pregnant women in the transmission of geohelminth, the concentration of the eggs/larvae in each soil type provided was evaluated using the method of [19]. About 20 g of each soil type was preserved in 10% formalin within 24 h of collection. The samples were transported to the Parasitology Laboratory, Department of Parasitology and Emtology, Nnamdi Azukiwe University, Awka, where sample examination was conducted. Entire sample of each soil type was passed through a double layer of 1 mm steel mesh into a petri dish. Water was then added to the dish and examined using an inverted microscope with a mechanical stage and a 10 x objective. Detected eggs/larvae were confirmed and speciated with a 40 x objective. This technique which has proven to have greater/equal sensitivity to the floatation technique usually employed to examine parasites in soil, is based on the protocol for identifying nematodes in stool samples.

2.13 Data analysis

The data collected were fed into Microsoft Excel 2010 software and then copied into Statistical Programme for Social Sciences (SPSS) software version 22.0 for analysis. Chi-square test was performed to access the presence of any significant differences in the variables. Questionnaire results were also coded into SPSS and variables created.

3. RESULTS

3.1 Prevalence of soil- transmitted helminthes

Of the 264 stools examined microscopically, 108 samples were positive for STHs infection giving a total prevalence of 40.9%. Three STHs parasites were identified. These were *A. lumbricoides* (53.7%), *T. trichiura* (24.1%) and Hookworm (22.2%). Only two cases of mixed infections of *A. lumbricoides* and *T. trichiura* with a prevalence of 0.8% was obtained.

Of the 114 pregnant women examined, a total of 75 were positive for STHs infections giving a prevalence of 65.8%. However, of the 150 non-pregnant women examined, 33(22.0%) were infected with STHs parasites. Statistical analysis showed that there was a significant difference (Chi-square=51.185, df=1, P-value=0.000).

The prevalence of the individual *A. lumbricoides* among both pregnant and non-pregnant women studied was almost equal (Table 1): *A. lumbricoides* (53.3% and 54.5% for pregnant and non-pregnant women respectively); *T. trichiura* (24.0% and 24.2% for pregnant and non-pregnant women respectively); Hookworm (22.7% and 21.2% for pregnant and non-pregnant women respectively).

Table 1:Prevalence of STH parasites among women in Enugwu-Agidi in relation to status.

Status	**No. Ex.**	**No. Inf. (%)**	***A.lum*. (%)**	***T. tri* (%)**	**Hookworm (%)**
Pregnant	114	75(65.8)	40(53.3)	18(24.0)	17(22.7)
Non-pregnant	150	33(22.0)	18(54.5)	8(24.2)	7(21.2)
Total	**264**	**108(40.9)**	**58(53.7)**	**26(24.1)**	**24(22.2)**

X^2=51.185, df=1, P-value=0.000

3.2: Prevalence of STHs parasites among women in relation to practice of geophagy.

The result on the prevalence of STHs parasites in relation to practice of geophagy was as presented in Table 2. Of the 142 women that practice geophagy, 87(61.3%) were infected with STHs parasites. Among those infected with STHs, 51(58.6%) were infected with *A. lumbricoides*, 24(27.6%) were infected with *T. trichiura*, while 12(13.8%) were infected with Hookworm. Statistical analysis showed that there was a significant difference in the prevalence of STHs infections in relation to practice of geophagy ($p<0.05$) (Chi-square=36.128, df=1, P-value=0.000)

However, among 122 women who do not practice geophagy, only 21(17.2%) were infected with STHs parasites. Twelve had Hookworm infections giving a prevalence of 57.1%, 7(33.3%) had *A. lumbricoides* while only 2(9.5%) had *T. trchiura* infections.

Table 2: **Prevalence of STH parasites among women in relation to practice of geophagy.**

Geophagy practice	**No. Ex.**	**No. Inf. (%)**	***A.lum.* (%)**	***T. tri* (%)**	**Hookworm (%)**
Yes	142	87(61.3)	51(58.6)	24(27.6)	12(13.8)
No	122	21(17.2)	7(33.3)	2(9.5)	12(57.1)
Total	**264**	**108(40.9)**	**58(53.7)**	**26(24.1)**	**24(22.2)**

X^2=36.128, df=1, P-value=0.000

Table 3: Geohelminth parasites recovered from soil samples examined in the study area

Geohelminth parasite stages were encountered in 85.7% of the soil samples, and species identified from them were Ascaris lumbricoides, hookworm and Trichuris trichiura. The overall prevalence of the parasite eggs were A. lumbricoides (52.3%), hookworm species (18%) and T. trichiura (33.3%).

Soil samples examined.	**Soil samples contaminated with geohelminth parasite species**			
Total	**Positive for geohelminths**	***Trichuris***	***Hookworm***	***Ascaris***
21	18	7	4	11
	85.7%	33.3%	19%	52.3%

4. DISCUSSION

The prevalence of STHs parasites (40.9%) recorded in this study highlights the increased susceptibility of women especially pregnant women to STHs infections which has been attributed to pregnancy–inducedreduction in cellular and humoral immunity [24,25] which is essentially physiological. The adverse effects of increased prevalence of STHs constitutes a major public health problem which makes the realization of the millennium development goals in the state a herculean task if adequate measures are not taken to control the scourge. The high occurrence of STHs detected in this study could be indicative of feacal pollution of soil and domestic water supply around homes due to poor sanitation and improper sewage disposal. The prevalence of STHs parasites in this study was comparable to 43.4% recorded by [26] in Ibadan. However, it was higher than the prevalence of 11.8% reported in Enugu by[27], 17.9% reported among pregnant women in Thailand by [28]. However, the prevalence was lower than that reported by [29] in Abakaliki, Ebonyi State who reported a prevalence of 73.9%.

The study showed that the practice of geophagy was observed both among those who were pregnant (65.8%) and those who were not pregnant (22.0%). Of those who ingested soil, more than half of them (53.0%) started eating soil long before they became pregnant indicating that geophagy is practiced even among people who are not pregnant. The STHs parasites encountered in this study were *Ascaria lumbricoides,Trichuris trichiura* and hookworm. Geophagy is common in sub-Saharan Africa in pregnant women and children who deliberately consume soil [19]. The prevalence of geophagy varies between and within countries, but is estimated between 10-75% [30,31]. It is likely that under-reporting of geophagy occurs, for a variety of reasons, including embarrassment regarding

the behaviour, lack of knowledge and sensitive questioning on the part of investigator inquiring about geophagy and differing perceptions, beliefs, and cultural norms [32]. [19] reported that geophagy is practiced by both men and women of different age groups in different parts of the world. The prevalence and significance of geophagy vary across different populations and contexts, including Enugwu-agidi, where it has been found to be prevalent among women in the community [33]. One potential explanation for geophagy is the nutritional hypothesis, which suggests that individuals engage in the practice to obtain essential minerals and nutrients that may be lacking in their diets. Soil can contain trace elements such as iron, calcium, zinc, and other micronutrients, which are crucial for human health [19]. Another proposed explanation for geophagy is the detoxification hypothesis. According to this hypothesis, individuals' practice geophagy as a means of detoxifying their bodies and alleviating gastrointestinal distress caused by ingesting harmful substances such as toxins or pathogens [19].

The prevalence of 61.3% as found in this study is in contrast to the findings of [34], who recorded 30.05% and did not associate the risk of parasitic infections with geophagy. The difference between the findings might have risen from the difference in the soil samples consumed by the subjects in both studies. Unlike in Nigeria, where the soils ingested are not sterilized after excavation, the soils consumed in their study were sterilized by heat.The high prevalence of STHs among pregnant women who practice geophagy could be attributed to unhygienic handling of the clay being eaten by majority of the women.Geohelminth parasites encountered was 85.7% from the soil samples, and species identified were *Ascaris lumbricoides*, hookworm and *Trichuris trichiura*. The overall prevalence of the parasite eggs were *A. lumbricoides* (52.3%), hookworm species (18%) and T. trichiura (33.3%). Studies in many parts of Nigeria [5,10,35] have highlighted the hyperendemicity of STHs among children and women of reproductive age.The timing of soil ingestion and amounts consumed vary with tribes and individual persons but soil comes consistently from certain sites. In some cultures, well-established trade routes and clay traders make rural clays available for geophagy in urban settings. However, parasitological findings of this study proved thatgeophagy put women at risk forgeohelminthic infections because both pregnant and non-pregnant women who practice geophagy were infected, and as suchgeophageal soils were likely to be source of infection and storage.

Additionally, geophagy could pose the risk of some othermedical conditions such constipation or could containtoxic substances like mercury, or arsenic. Otherexplanations for the high helminthes infection ratesamong pregnant women recorded in the literature, suchas pica, poor hygiene, and unsanitary environment mustbe sought. It is more common in females than males, among children, during pregnancy and in the elderly [36,37]. Anaemia increases costs of medical care and lowers a

person's productivity through a decreased ability to work (Smith, 2010)[38].The prevention of high worm infectionsreported in pregnant women, must be accompanied bythe promotion of good and healthy eating habits.

5. CONCLUSION

The prevalence of soil-transmitted helminths infections in pregnant women is still high in Enugu-Agidi. This study supports the fact that geophagy practice among women is a possible vehicle for transmission of STHs parasites as also found by studies of [39] and [40]. This may necessitate initiation of preventive treatment of helminths infections during pregnancy, so, focus should be on this group of adults during antenatal periods with regards to giving proper education on the need to observe good personal hygiene and environmental sanitation. In addition, routine examination and treatment of these gastro-intestinal infections in pregnant women is recommended. Ante-natal clinics should also incorporate safe water, sanitation and hygiene practices in their health education to the pregnant women.

Consent and Ethical approval

A verbal consent was made to the community stating the aim and method of study before the investigation began. They were equally informed that data generated will be kept confidential and only be used for academic purpose. The ethical approval was obtained from Chukwuemeka Odumegwu Ojukwu university Teaching Hospital Amaku, Awka(REF: COOUTH/CMA/ETH.C/VOL.1/FN:04/243).

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