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GEOPHAGY AND PARASITIC INFECTIONS IN PREGNANT WOMEN ATTENDING AN ANTE-NATAL CARE CLINIC IN THIKA HOSPITAL, KIAMBU COUNTY, KENYA

A. W. MUTURA, J. O. WESONGAH and G. M. MKOJI

ABSTRACT

***Background*: Geophagy, a regular and deliberate habit of eating non-food substances is practiced worldwide and in sub-Saharan Africa. Pregnant women and children commonly eat soil. Soil consumption exposes one to the risk of consuming eggs of soil-transmitted intestinal parasites, which may cause severe health consequences for pregnant women and children.**

***Objective*: Determine the association between geophagy and parasitic infections in pregnant women attending Thika Level 5 Hospital.**

***Design*: Cross sectional hospital based study.**

***Setting*: Ante-natal care clinic at Thika Level-5 Hospital.**

***Subjects*: Four hundred and ten pregnant women.**

***Results*: Twenty six point one percent of the studied women practiced geophagy, majority of whom did it occasionally. Ninety two point five percent preferred soil purchased from market places. Eleven percent of the study women examined were infected with *Entamoeba histolytica* (8.8%), *Trichuris trichiura* (1%), *Ascaris lumbricoides* (1%), *Schistosoma mansoni* (0.7%), and *Strongyloides stercoralis* (0.2%). None of the five intestinal parasites detected were however, associated with geophagy, P>0.05. Nevertheless, only the *E. histolytica* infection (8.4%) was found in women who practised geophagy. Gestation period was associated with *E. histolytica* infection, p=0.049. Those who ate soil from the garden were more likely to have *E. histolytica* infection, p=0.026.Closely associated to geophagy were education at p=0.009, feeding problems at p=0.000 and history of practising geophagyat p=0.000.**

***Conclusion*: While geophagy was not associated with parasitic infections in pregnant women, geophagy was found to have a significant association with education, history of geophagy and the feeding problems. Besides, pregnancy trimester and the source of soil were found to beassociated with *E. histolytica* infection.**

INTRODUCTION

Geophagy is a type of pica, in which non-food substances are regularly and deliberately eaten, it is a habit practiced worldwide (1). In sub-Saharan Africa, it is especially common among pregnant women and children who often consume soil (2). The prevalence of geophagy varies between and within countries, but it is estimated at 10-75% (3-6).While geophagy is most often seen in tribal and rural societies among children and pregnant women, it is practised by members of all races, social classes, ages and sexes (1).

In parts of Africa, prevalence of geophagy during pregnancy of up to 84% has been reported (3,6-9). Among pregnant women in a coastal district of Kenya, 73% of the women eat clay regularly, the habit is culturally acceptable during pregnancy and it is practised for its symbolic ties to fertility,

reproduction, and ancestral blessing (6).

The timing of soil ingestion and amounts consumed vary with individuals and ethnic groups but soil comes consistently from specific sites (10). Women engage in geophagy during the first, second and third trimesters of pregnancy (10). It is postulated that geophagy in pregnancy is due to micronutrient deficiencies, cultural influences and gastrointestinal upsets (1). Despite their potential to supply micronutrients, soils interfere with bio-availability of micronutrients leading to micronutrient deficiency and can also act as a pathway for ingestion of soil transmitted helminths and heavy metals, putting the women and foetuses at risk (1).

Obviously, there is health risks associated with consumption of soil, including the risk of infection with soil-transmitted parasites. The predilection of children and pregnant women to engage in geophagy makes them most vulnerable to parasitic infestations (1,11). Parasitic infections affect tens of millions of pregnant women worldwide and directly or indirectly lead to a spectrum of adverse maternal and foetal effects especially in relation to iron deficiency and anaemia (12). Geophagy is believed to be a risk factor in particular for the transmission of soil-transmitted helminths (STH) namely, *Ascaris lumbricoides*, *Trichuris trichiura* which are acquired through ingestion of parasite eggs with contaminated soils. Other STH that might infect pregnant women and children are hookworm and *Strongyloides stercoralis*. Although, these may not necessarily be transmitted through geophagy, they nevertheless cause severe morbidity in pregnant women (13).

Additionally, geophagy is a common route of infection with amoebiasis in certain cultures; Amoebiasis is caused by the protozoan *Entamoeba histolytica* (14).It is globally considered as a leading parasitic cause of human mortality besides malaria and schistosomiasis, and is known to be more severe in pregnant women (15).

The present study was a cross-sectional hospital-based study that was undertaken between the periods of April to June 2014, to investigate geophagy and its role in acquisition of parasitic helminthes and other parasites in pregnant women attending antenatal care clinic at Thika Hospital, in Kiambu County, Kenya. In particular, the study examined geophagy and its association with parasitic infections.

MATERIALS AND METHODS

Study Site: The study was carried out at the antenatal clinic of Thika Level 5 Hospital. The hospital is one of Kiambu county`s teaching and referral hospital and is located 40 Km North East of Nairobi.

Study Population: The study population were pregnant women attending antenatal care clinic at Thika Level 5 Hospital who are estimated to be 9,600 per year. The study participants were those who met the selection criteria.

Inclusion and Exclusion Criteria: Participants were pregnant women who were at any gestation period, attending antenatal care clinic at Thika Level 5 Hospital and those who consented to participate in the study and were either eating or not eating soil, aged 18 years and above. The study excluded pregnant women who did not consent to participate in the study and those who had a history of anti-helminthic drug hypersensitivity.

Study Design: This was a cross sectional hospital based study

Study Procedures

a) Questionnaire Survey: A questionnaire having the patient and laboratory numbers (for confidentiality) was administered to each enrolled participant by the principal investigator (PI). The questionnaire aimed to obtain personal and behavioural information.

b) Faecal Sample Collection: The subjects were given a sterilised dry stool container and instructed on how to provide a faecal sample for diagnosis of parasitic infections. Upon submission of the stool specimen by the subject, the stool samples were labelled with patient number and transferred into a bio safety bag and transported back to the Thika hospital laboratory in a cool box for processing.

The faecal samples were processed for diagnosis of parasitic infections as soon as they arrived in the laboratory. The direct faecal smear and Kato Katz technique (16,17) were used to prepare the sample for examination under a microscope at x400. Faecal matter was pressed through a sieve with 200 micrometres mesh size. An amount of sieved stool (41.7 mg measured by a template of 6 mm diameter hole and 1.5 mm depth) was transferred to a slide and covered with Malachite green pre-soaked cellophane strip to help clear the faecal debris. The microscope slide was then inverted and firmly pressed against the cellophane strip. Double microscope slides were made per specimen for examination. The material was then spread evenly and followed by careful removal of the slide by gently sliding it sideways to avoid separation of the cellophane strip. The slide with the cellophane was then placed facing upwards. The faecal smear on the microscope slide was examined for parasite ova as soon as it was prepared. Advantages of this method are its simplicity, low cost, small amount of faeces used and it's quantitative while the limitation is that the method is messy and the faecal sample must be tested within 20-40 minutes to avoid over clearance of hookworm eggs due to the glycerol soaked cellophane strip.

Quality control reading of 80 slides that represents 10% of the total slides were picked at random and re-examined by an independent microbiologist who was unaware of the findings to verify the results.

Data Collection and Analysis: Privacy and strict confidentiality of the patient's data were ensured. Patient data were recorded in special designed data sheets and stored under lock and key, it was entered into computer using Ms-Excel software. Data were also recorded in the laboratory work book and later transferred into a password protected computer at KEMRI.

Data were analysed using statistical tools available in SPSS version 20 (SPSS Inc. Chicago, IL, USA), the hypothesis was tested using Chi square ($\chi 2$). Significant associations were identified based on a P-value of <0.05 and 95% confidence interval.

Study Approvals: The proposal was submitted for review and approval to KEMRI, JKUAT and Thika Level 5 Hospital. Both scientific and ethical approvals were sought from these institutions.

Ethical Considerations: Consent to participate in the study was sought from each subject that met the selection criteria. The study procedures were explained to each consenting participant in a language they spoke fluently and understood, they were given an opportunity to ask questions and seek clarifications on issues not well understood. Each participant was requested to give a faecal sample for diagnosis of parasitic infections. In addition, each participant was requested to respond to a simple questionnaire to obtain personal and behavioural information.

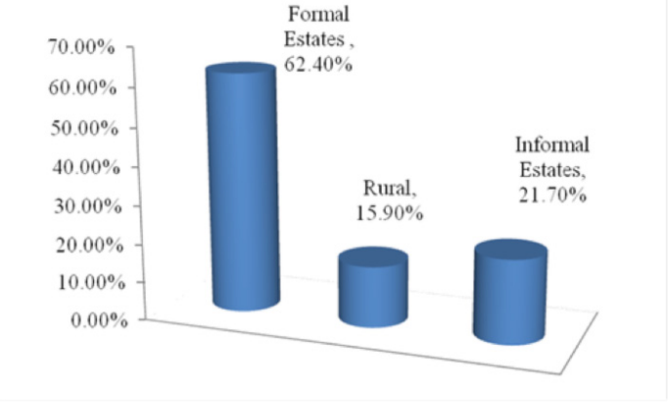
The benefits that each of the consenting woman got by participating in the study were free investigation, further free medical treatment and management.

RESULTS

Of the 410 pregnant women investigated, 84.1% were from Thika urban area, of which 62.4% lived in formal housing estates while 21.7% came from informal settlements and 15.9% of the women lived in rural areas. Figure 1 provides a graphic representation of the population distribution of the study participants.

Figure 1

Residence of Participants



Majority of the women (84.4%) were between 21-35 years old and 12.4% were below 20 years old. Apparently, most of the women 85.4% said they were married. Majority of the women (91.7%) were either in their 2nd or 3rd trimester of their pregnancy, while 71% of the study women had attained secondary school education.

Geophagy: From the study, it was determined that 107 (26.1%) of the respondents practiced geophagy, 47.7% of them did it occasionally, 27.1% rarely and 25.2% did it on regular basis. One hundred (92.45%) of the respondents preferred soil obtained from the market places, while less than 8% preferred soil from dry termite mound, quarry and shamba (garden) as indicated in Table 1. 72% of the respondents who practised geophagy had secondary education. 91% of those who practised geophagy were in their 2nd and 3rd pregnancy trimester. Apparently, 86% were in the formal employment, 13.1% were in informal employment and1% were students as indicated in Table 1.

Among the pregnant women who practiced geophagy, only 11% were infected with one or more of the parasitic infections detected, in general parasitic infections were rare among women who did not practice geophagy.

Analysis of the association between geophagy and parasitic infections using SPSS, showed that there was no significant association between geophagy and parasitic infections ($p>0.05$). However, there was a significant association between geophagy

and the education levels, ϱ= 0.009, geophagy and women with feeding problems at ϱ= 0.000 and geophagy with women with previous history of practisinggeophagy at ϱ=0.000. Interestingly, 72% of the women who practiced geophagy had secondary education as compared to 28% who only had the primary education. Whereas, a significant number of women (70%) claimed they didn't have any feeding problem despite the fact that they practised geophagy. Apparently, the analysis also showed that most (78%) of the women had no history of been geophagic before the pregnancy period but only 22% of them did and who proceeded with the practice even after pregnancy.

Table 1
Associationof factors with Geophagy

Factors	Number within Geophagy	% within Geophagy	ϱ-Value
Occupation			
Formal Employment	14	13.1%	0.084
Farmer	1	0.9%	
Business Woman	31	29%	
House Wife	60	56.1%	
Student	1	0.9%	
Education Levels			
Primary	30	28%	0.009
Secondary	65	60.7%	
Tertiary	12	11.2%	
Residence			
Formal Estates	63	58.9%	0.661
Informal Estates	26	24.3%	
Rural Areas	18	16.8%	
Marital Status			
Single	15	14%	0.870
Married	92	86%	
Divorced	0	0%	
Widowed	0	0%	
Age			
20 And Below	13	12.1%	0.867
21-25	44	41.1%	
26-30	35	32.7%	
31-35	12	11.2%	
36 And Above	3	2.8%	
Pregnancy Trimester			
1st Trimester	10	9.3%	0.474
2nd Trimester	61	57%	
3rd Trimester	36	33.6%	
Feeding Problems			
Had Problems	37	34.6%	0.000
Had None	70	65.4%	

History of Geophagy before Pregnancy			
Practised	24	22.4%	0.000
Didn't Practise	83	77.6%	
Parasites			
Entamoeba histolytica			
Positive	9	8.4%	0.875
Negative	98	91.6%	
Strongyloides stercoralis			
Positive	0	0%	0.552
Negative	107	100%	
Trichuris trichiura			
Positive	0	0%	0.232
Negative	107	100%	
Ascaris lumbricoides			
Positive	0	0%	0.232
Negative	107	100%	
Schistosoma mansoni			
Positive	0	0%	0.302
Negative	107	100%	

Parasitic Infections: Of the 5 different parasitic infections detected among the study women, *E. histolytica* was the most common and infected both those who practiced geophagy and those who did not. Apparently, *E. histolytica* was the only parasite detected among the women who practiced geophagy (see Table 1).

When source of soil consumed by the women was analysed for its association with *E. histolytica* infections, those who ate soil from the shamba had the highest prevalence (100%) of *E. histolytica* infection (at p-value 0.026), than those who ate soil purchased from a market place or the quarry pits(see Table 2).

When association between occupation and the parasitic infections was analysed, no significant associations were observed. However, prevalence of *E. histolytica* infection was highest (12.1%) among those who engaged in business as an occupation, followed by those employed with 8.6%, and housewives at 7.4%. No parasitic infections were detected in college students or the farmers.

While there was no significant association between geophagy and parasitic infections, a significant association was observed between gestation period and infection with *E. histolytica*. Women in their second trimester of pregnancy had the highest risk of infection with *E. histolytica* (p value 0.049) compared with the other trimesters as indicated in Table 2.

Table 2
Association of factors with parasites

Factors	*E. histolytica*		*Strongyloides stercoralis*		*Trichuris trichiura*		*Ascaris lumbricoides*		*Schistosoma mansoni*	
	Positive	P-value	Positive	P-value	Positive	P-value	Positive	P-value	Positive	P-value
Occupation										
House wife	14	0.45	1	0.883	1	0.653	1	0.653	0	0.299
Employed	7		0		2		2		2	
Farmer	0		0		0		0		0	
Business woman	15		0		1		1		1	
College Students	0		0		0		0		0	
Education level										
Primary	8	0.409	0	0.612	3	0.079	3	0.079	2	0.195
Secondary	2		1		0		0		0	
Tertiary	6		0		1		1		1	
Pregnancy trimester										
1st Trimester	1	0.049	0	0.643	0	0.641	0	0.641	0	0.829
2nd Trimester	26		1		3		3		2	
3rd Trimester	9		0		1		1		1	
Source of Soil										
Non geophagic	27	0.026	1	0.986	4	0.843	4	0.843	3	0.902
Market	8		0		0		0		0	
Anthills Soil	0		0		0		0		0	
Quarry	0		0		0		0		0	
Shamba	1		0		0		0		0	
Water Source										
Tap	31	0.752	1	0.98	4	0.865	4	0.865	3	0.908
River	3		0		0		0		0	
Well/Borehole	1		0		0		0		0	
Tanks	1		0		0		0		0	
Type of Toilet										
Pit Latrine	21	0.88	1	0.409	2	0.697	2	0.697	2	0.8
Water Closet	15		0		2		2		1	
Walking Barefooted										
Never	27	0.684	1	0.861	3	0.13	3	0.13	2	0.061
Rarely	8		0		0		0		0	
Occasionally	1		0		1		1		1	

DISCUSSION

In the present study 26.1% of the pregnant women investigated practised geophagy. The prevalence of geophagy varies between and within countries, but according to global estimates, it is generally in the range of 10-75% (3-6). This prevalence is much lower than observed among pregnant women in other parts of Kenya such as Kilifi in coastal Kenya, Bondo in western Kenya and Nairobi, with geophagy prevalence in the range 45-74%(5,6,9). Although, prevalence of geophagy observed in the present

study is considered low, it is within the ranges in the region as shown by a study carried out on HIV-pregnant women in Dar es Salaam, Tanzania (18). It is likely that underreporting of geophagy occurs, for a variety of reasons, including embarrassment regarding the behaviour, lack of knowledge and insensitive questioning on the part of investigators inquiring about geophagy and differing perceptions, beliefs, and cultural norms (4,19).

In the present study, majority of the women (92.45%) preferred to consume soil purchased from the market. These findings are similar to those from another study conducted on pregnant women in Dares Salaam, Tanzania who commonly ate hardened clay soil sold in the local market(18).Majority of the women in the present study said they preferred this soil as it is easily accessible, affordable and they believe it is free from contamination as it is dried in the sun heat.

The overall prevalence of soil-transmitted parasites in the study women was 11%. Although five intestinal parasites were detected among the study women, none was associated with geophagy, P>0.05. Interestingly, a significant association was observed between source of soil and *E. histolytica*, P = 0.026. *E. histolytica* is closely associated with poor sanitation and water supplies (20), the fact that the infection was most common among women who consumed soil from the gardens in this study, suggest that poor environmental conditions may have been the source of infection.

Amoebiasis, an infection by the protozoan parasite *E. histolytica* is globally considered as a leading parasitic cause of human mortality besides malaria and schistosomiasis and is known to be more severe in pregnant women (15). Nevertheless, infection with *Entamoeba histolytica* is a cause for concern from the public health view point and therefore, requires intervention.

Pregnant women engage in geophagy during the first, second and third trimesters of pregnancy, and often, throughout the day and 30-50 mg of soil may be consumed a day (10). A significant association was observed between gestation period and infection with *E. histolytica* (ϱ=0.049). Those in their second trimester had the highest risk of *E. histolytica* infection, compared with those in the first trimester or third trimester. Similarly, prevalence of other parasitic infections tended to be most common among women in their second trimester, even though, this was not statistically significant.

This study also noted that the epidemiological variables (walking barefoot, site of defecation, source of drinking water and appetite disorders) had no significant association at P>0.05 in the transmission of the parasitic infections.

Education was closely associated with geophagy in the present study (p= 0.009), with majority of the women practicing geophagy (72%) reported to have attained secondary school education. Despite, the high level of education they still practised geophagy, this could possibly be as a result of the schools and colleges primarily concentrating on the school curriculum, thus there is need for public health education campaigns to enlighten pregnant women, soil traders and the community at large on the risks of geophagy and poor sanitation, this would have the potential to lower parasitic infections.

There is also a need to provide for a mineral supplementation program for the pregnant women especially during the first trimester when the morning sickness symptoms like vomiting, low appetite and dislike of certain foods due to smells and tastes sets in, hence they are deprived of the essential minerals from most of these foods and this may be the main reason for the cravings of non –food substances like soil that increase their chances of infection with parasitic infections. Hence mothers should be encouraged to visit the antenatal clinic from the first month of pregnancy so that their health can be monitored.

There is a need for the formulation of a policy on the routinely deworming of pregnant women in their second trimester to offer significant and relatively inexpensive long term health benefits for both the mother and her unborn child as it is done in Madagascar, Nepal and Sri Lanka.

There is also a need to have a routine testing of amoebiasis in pregnant women and treatment of the infected especially in the second trimester as amoebiasis, is globally considered as a leading parasitic cause of human mortality besides malaria and schistosomiasis.

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