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Soil transmitted helminthes infection among pregnant women in peri-urban areas of Ibadan, Nigeria: A cross-sectional study

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Abstract
Background: Soil Transmitted Helminthes (STH) infection is an important public health problem in developing countries which adversely affects pregnant women and their newborn infants. The epidemiology of STH among pregnant women has not been fully explored in Nigeria. We examined the prevalence, intensity and risk factors of STH among antenatal care attendees in Ibadan.
Methods: A cross sectional facility-based study was conducted among the 326 pregnant women attending antenatal care clinics in six selected Primary Health Care centers, in the peri-urban areas of Ibadan Oyo State. An interviewer administered questionnaire was used to obtain information on the socio-demographic, maternal, environmental characteristics and hygiene practices. Kato-Katz method was used to identify the presence of STH from stool samples. Data were analysed using chi-square and bivariate logistic analysis.
*Results***:** The overall prevalence of STH was 13.8%, 95% CI (10.0 -17.7). *Ascaris lumbricoides* 12.8%, 95% CI (9.5 -16.9) was the most prevalent followed by hookworm infection 0.6%, 95% CI (-0.2 – 0.15) and *Trichuris trichuria* 0.3%, 95% CI (- 0.2 – 0.9). Majority of the infection were of light intensity (44 out of 45). Walking bare footed in the home environment increased the likelihood of being infected with STH [OR 1.93 95% CI (1.01 -3.72) p=0.048] compared with women who wore shoes.
Conclusion: STH infection is prevalent among pregnant women in the peri-urban region of Ibadan. Therefore public health interventions like active surveillance of STH and the prescription of deworming drugs will be beneficial tofor pregnant women.

Keywords: *Soil transmitted helminthes, pregnancy, prevalence, intensity.*

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Résumé
Contexte: L'infection par les helminthes transmissibles par le sol (HTS) est un problème de santé publique important dans les pays en voie de développement, qui affecte négativement les femmes enceintes et leurs nouveau-nés. L'épidémiologie des HTS chez les femmes enceintes n'a pas été complètement explorée au Nigéria. Nous avons examiné la prévalence, l'intensité et les facteurs de risque des HTS chez des patientes en soins prénatals à Ibadan.
Méthodes: Une étude transversale a été réalisée parmi les 326 femmes enceintes fréquentant les cliniques de soins prénatals dans six centres de soins de santé primaires sélectionnés, dans les zones périurbaines d'Ibadan, l'État Oyo. Un questionnaire administré par l'intervieweur a été utilisé pour obtenir des informations sur les caractéristiques sociodémographiques, maternelles, environnementales et les pratiques d'hygiène. La méthode de Kato-Katz a été utilisée pour identifier la présence d'HTS à partir d'échantillons de selles. Les données ont été analysées en utilisant l'analyse chi-carré et la logistique bi-variée.
Résultats: La prévalence globale d'HTS était de 13,8%, IC 95% (10,0 - 17,7). Ascaris lombricoïdes 12,8%, 95% CI (9,5 -16,9) était la plus fréquente suivie par Ankylostomiase 0,6%, IC 95% (-0,2 - 0,15) et Trichuris-trichuria 0,3%, IC 95% (- 0,2 - 0,9). La majorité des infections était d'intensité faible (44 sur 45). Marcher pieds nus dans l'environnement du ménage a augmenté la probabilité d'être infecté par HTS [OR 1,93 95% CI (1,01 - 3,72) p = 0,048] par rapport aux femmes qui portaient des chaussures.
Conclusion: L'infection par l'HTS est prévalent chez les femmes enceintes dans la région périurbaine d'Ibadan. Par conséquent, les interventions de santé publique comme la surveillance active des HTS et la prescription de médicaments antihelminthiques pour les femmes enceintes.

Mots-clés: *Helminthes transmissibles par le sol, grossesse, prévalence, intensité, facteurs*

Introduction

Soil Transmitted Helminthes (STH) are the most prevalent Neglected Tropical Disease (NTD)

affecting more than 1.5 billion people worldwide, largely in sub-Saharan Africa, Latin America, China and East Asia [1,2]. The STH is reported to be responsible for about 40% of the health burden of neglected tropical diseases [3]. The STH of public health importance include *Ascaris lumbricoides, Trichuris trichiura* and hookworm (*Necator americanus* or *Ancylostoma duodenale*). Global estimates indicate that there are about 807-1227 million cases of *Ascaris lumbricoides*, 540-700 million cases of *Necator americanus* and *Ancylostoma duodenale* and 604 – 795 million cases of *Trichuris trichiura* [4]. Helminthes infection are majorly attributed to poverty, inadequate water supply, improper sanitation [3, 5]. Children, women of reproductive age, particularly pregnant women, and adults with high risk jobs such as miners [2] are most at risk of the infection. However, children especially school-age children have received more research focus and public interventions because of the associated malnutrition, impairment of growth and cognitive development in the age group [6].

In sub-Saharan Africa, approximately 24 million women become pregnant annually [7]. Pregnancy is associated with hormonal and immune changes that increase their susceptibility to infections including parasitic infections like STH [8, 9]. The prevalence of STH among pregnant women in Africa varies widely, with a prevalence of 76.2% in rural Kenya [10], 54% in Ethiopia [3] and 47.1 % in Cameroun [11] and 70.0% in Thai-Burmese border [12]. Although, the epidemiology of these parasites among pregnant women have not been fully documented in Nigeria, the few available studies have reported a prevalence that ranges from 13.8% - 23.74% [13- 15]. The STH in pregnancy is associated with increased risk of maternal and perinatal morbidity resulting from iron deficiency anaemia, impaired nutrition status, intrauterine growth restriction and low birth weight [7, 8, 11, 15]. Hookworm is a major cause of anaemia in pregnancy by ingesting blood and damaging the intestinal mucosa. Approximately one-third of all pregnant women in low and middle income countries (LMICs) have been estimated to be infected with hookworm infection (44 million out of 124 million pregnancies and 7.5 million pregnant women in sub-Saharan Africa [16]. *Trichuris tricuria* to a lesser degree also contributes to maternal anaemia through blood loss and reduced appetite [17]. *Ascaris lumbricoides* is usually asymptomatic but with heavy infestation, it can cause abdominal distension and pain, lactose intolerance and malabsorption [18].

Intensity of STH infection, measured by the number of eggs per gram of faeces, is the main epidemiological index used to describe STH infection [4]. The risk factors for infestation by STH include demographic, socioeconomic, environmental and behavioral factors but the distribution of these risk factors may differ from one region to another and sometimes within the population or the country itself [3, 7, 10]. Hence the need to understand the epidemiology of these infections in different locations in order to implement targeted and population specific interventions. Furthermore, WHO recommends periodic anti-helminthic medical therapy (deworming) without previous individual diagnosis, to all persons at-risk in endemic areas including pregnant women. Treatment should be given once a year when the prevalence of STH infections in the community is over 20% [19, 20]. Therefore, the aim of this study was to determine the prevalence, intensity and risk factors of STH so as to provide the needed evidence for the control of STH and the effect in pregnancy.

Materials and methods

Study setting

This study was conducted among pregnant women attending selected Primary Health Care Centers in two peri-urban local Government areas (LGAs) - Ido and Akinyele (LGAs) of Oyo state. Oyo state is one out of the 36 states in Nigeria, and it is located in the south western part of the country. Typically, Ibadan experiences dual seasons like most tropical areas - dry season between November to February and wet season between March and October each year. Ido and Akinyele Local Government areas have extensive fertile soil and large hectares of grassland, which are suitable for agriculture hence the predominant occupations of the people are farming and animal rearing.

Study design and data collection

A cross sectional facility-based study was conducted among 326 pregnant women attending antenatal care clinics in six most functional Primary Health Care centers (PHCs) were purposively selected. In each of the PHCs, study participants were serially recruited into the study until the sample size was reached. Although women who had taken anthelminthic drugs within a month prior to study and those who were severely sick were excluded from the study. Pre-tested, semi-structured, interviewer administered questionnaires were used to obtain information on the socio-demographic, maternal, medical and environmental characteristics

as well as hygiene practices of participants. The sample size estimation for single proportion was used based on a 95% confidence interval (1.96), precision level of 5%; α = 0.05; and a prevalence rate of 23.74% of helminthes infection among pregnant women by Omorodion *et al* [13].

Specimen collection and processing

Fresh stool samples were obtained from the study participants using in screw capped labeled leak proof stool containers (universal bottles) and applicator sticks. The stool samples were transported in ice packs in order to maintain the viability of the helminthes ova to the laboratory. The stool samples were collected in the morning between 9am and 11am and were transported immediately to the Department of Medical Microbiology and Parasitology laboratory for examination. These stool samples were examined microscopically using the direct wet preparation method and Kato-Katz technique of quantification of ova according to the WHO 2002 guidelines [22]. Egg counts (in eggs per gram of stool, epg) was used to classify infection intensities into light, moderate, or heavy infections respectively as follows: *Ascaris lumbricoides*: 1 – 4,999 epg, 5,000 – 49,999 epg and > 50,000 epg; *Trichuris trichiura*: 1 – 999 epg, 1,000 – 9,999 epg and > 10,000 epg; Hookworms (*Ancylostoma duodenale/Necator americanus*): 1 – 1,999 epg, 2,000 – 3,999 epg and > 4,000 epg [23].

Data analysis

The data was analysed using Stata version 12, quantitative variables were analyzed using mean and standard deviation, while categorical variables were presented with frequencies and proportions. The

Table 1: Socio-demographic and maternal characteristics of the pregnant women by soil transmitted helminthes

Characteristics	Total (N=326)	Soil-transmitted helminthiasis Yes (n=45)	No (281)	p-value
Age group				
<20	11 (3.4)	1 (9.1)	10 (90.1)	
20 -35	266 (81.8)	36 (13.5)	230 (86.5)	0.759
>35	48 (14.8)	8(13.9)	40 (86.1)	
Marital Status				
Married	290 (89.0)	42 (14.5)	248 (85.5)	0.313
Not married	36(11.0)	3 (8.3)	42 (91.7)	
Education				
Primary or less	61(18.7)	6 (9.8)	55 (90.2)	
Secondary	176 (54.0)	24 (13.6)	152 (86.4)	0.471
Tertiary	89 (27.3)	15 (16.8)	74 (86.1)	
Occupation				
Unemployed	109 (33.4)	15 (13.8)	94 (86.2)	
Self employed	118 (36.2)	16 (13.6)	102 (84.4)	0.992
Employed	99 (30.4	14 (14.1)	85 (85.9)	
Ethnicity				
Yoruba	254 (77.9)	33 (13.0)	221 (87.0)	
Non Yorubas	72 (22.1)	6 (16.7)	30 (83.3)	0.425
Religion				
Christianity	154 (47.2)	19 (12.3)	134 (87.7)	
Islam	168 (51.5)	25 (14.9)	143 (85.1)	0.789
Others	4 (1.2)	1 (25.0)	3 (75.0)	
Monthly income				
<10,000	218 (66.9)	6 (9.8)	55 (90.2)	
10000 – 20000	61 (18.7)	24 (13.6)	152 (86.4)	0.952
>20000	47 (14.4)	15 (16.8)	74 (86.1)	
Gravidity				
Primigravida	88 (27.0)	12 (13.6)	76 (86.4)	
Multigravida	238 (73.0)	33 (13.9)	205 (86.1)	0.958
Gestational age				
1st trimester	42 (12.9)	4 (9.5)	38 (90.1)	
2nd trimester	110 (33.7)	16 (14.6)	94 (85.4)	0.689
3rd trimester	174 (53.4)	25 (14.4)	149 (85.6)	

overall prevalence of STH as well as age and gravidity specific prevalences and the 95% confidence intervals were determined. The associations between various risk factors (socio-demographic, maternal, environmental and hygiene practices) and STH were examined using chi-square statistic. Bivariate logistic regression was used to compute unadjusted odds ratio and also to identify independent determinants of STH in pregnancy. The level of significance for this study was set at $p<0.05$.

Ethical standard: Ethical approval to conduct the study was obtained from the Oyo State Ministry of Health Ethical Review Board and permission to carry out the study was obtained from the Medical Officers of Health in charge of the LGAs. Informed consent was obtained from each respondent in this study, after the procedure of the study had been explained.

Results

The socio-demographic and maternal characteristics of the respondents by their STH status are shown in Table 1. The mean age of the respondents was 28.4 ± 5.6 years. Majority of these women were within the 20 – 35 age bracket (81.8%), married (89.0%), belonged to Yoruba ethnic group (77.9%) while about two-thirds (66.9%) earned less than 10,000 naira per month. Primigravida made up about a quarter (27.0%) of the population.

However, there was no statistical difference in the distribution of socio-demographic and maternal characteristics by their STH status (p > 0.05). Prevalence (95% confidence interval) and Intensity of Soil transmitted Infections are shown in Tables 2 and 3. The overall prevalence of STH was 13.8%, 95% CI (10.0 -17.7). *Ascaris lumbricoides* 13.2%, 95%CI (9.5 -16.9) was the most prevalent

Table 2: Prevalence and 95% confidence intervals of soil transmitted helminthes among pregnant women by age and gravidity

	STH	Ascaris lumbridcoides	Hookworm	Trichuris trichura
Overall	13.8(10.0 -17.7)	12.8 (9.5 -16.9)	0.6 (-0.2 -0.15)	0.3 (-0.2 – 0.9)
Age				
<20	9.1 (-8.8 – 27.0)	9.1 (-8.8 – 27.0)	-	-
20 -35	13.5 (9.4 – 17.7)	13.5 (9.4 – 17.7)	3.7 (-3.7 – 1.1)	0.4 (-0.3 -1.1)
35	16.7 (6.0 – 27.3)	14.5 (4.4 – 24.7)	2.0 (-2.0 – 6.2)	-
Gravidity				
Primigravida	13.6 (6.4 – 20.8)	13.6 (6.4 – 20.9)	-	-
Multigravida	13.9 (9.4 – 18.3)	13.0 (8.7 – 17.3)	0.8 (-0.3 – 2.0)	0.4 (-0.4 – 1.2)

Table 3: Intensity of soil-transmitted helminthiasis among the pregnant women

Type of STH	Intensity classification	Intensity	Number	Frequency (%)
Ascaris lumbricoides				
	< 5000	Light	41	
	5000 – 49,999	Moderate	1	
	≥50,000	Severe	0	
			42	**93.4%**
Trichuris trichiura				
	<1,000	Light	1	
	1,000 – 9,999	Moderate	0	
	≥10,000	Severe	0	
			1	**2.2%**
Hookwarm				
	<1,000	Light	2	
	1,000 – 9,999	Moderate	0	
	≥10,000	Severe	0	
			2	**4.4%**

Table 4: Environmental characteristics and hygiene practices of the pregnant women by the status of soil transmitted helminthiasis

Characteristics	Soil-transmitted helminthiasis		p-value
	Yes (n=45)	No (281)	
Washing hands with soap			
Yes	35 (14.5)	205 (85.4)	
No	10 (11.6)	76(88.4)	0.495
Type of toilet facility			
Pit latrine	5 (9.4)	48 (90.8)	
Water closet	38 (15.3)	211 (84.7)	
Open defaecation	2 (8.3)	22 (91.7)	0.387
Wearing of shoes at home			
Yes	6 (9.9)	145 (90.1)	
No	129 (17.6)	136 (82.4)	0.046
Roofing types			
Thatched roof	6 (15.8)	32 (84.2)	
Corrugated iron	39 (13.5)	24 (96.5)	0.706
Rearing animals at home			
Yes	18 (15.4)		
No	27 (13.0)	182 (87.1)	0.769
Pets			
Yes	8 (15.1)	45 (84.9)	
No	37 (13.6)	182 (87.1)	0.536
Use of human feces as fertilizers			
Yes	6 (15.4)	33 (84.6)	
No	39 (13.6)	248 (86.4)	0.76
Geophagy			
Yes	0 (0.0)	16 (100.0)	
No	44 (14.1)	267 (85.5)	0.101

followed by hookworm infection 0.6%, 95% CI (-0.2 – 0.15) then *Trichuris trichuria* 0.3%, 95% CI (-0.2 – 0.9). The prevalence of STH increased with age. However, the prevalence was similar between primigravidae [13.6%, 95% CI (6.4 -20.8)] and multigravidae [13.9%, 95%CI (9.4 -18.3)]. Majority of the infection were of light intensity (44 out of 45): 41 (12.6%) *Ascaris lumbricoides*, one (0.3%) *Trichuris trichiura* and two (0.6%) of hookworm infections.

Environmental characteristics and hygiene practices of the pregnant women by STH status are shown in Table 4. Wearing of shoes in the home environment was the only variable significantly associated with STH with the women who walked bear footed having higher proportions of STH compared with those who wore shoes (17.6% versus 9.9%, p=0.046). Although, use of thatched roofing sheets (15.8% versus 13.5%), rearing animals at home (15.4% versus 13.0%) and use of human faeces as fertilizers (15.4% versus 13.6%) were higher among women with STH, these associations were not statistically significant (p> 0.05). Factors associated with soil transmitted infections are presented in Table 5 along with the odds ratio and 95% confidence interval. Walking bare footed in the

Table 5: Odds ratio and 95% confidence Interval of factors associated with soil transmitted helminthiasis among pregnant women

Factor	Odds Ratio	95% Confidence Interval	p-value
Shoes at home			
Yes	1.00	-	
No	1.93	1.01 – 3.72	0.048

home environment was only variable tested in the bivariate logistic model. These women were found to be almost twice at risk [OR = 1.93; 95% CI (1.01 – 3.72) p=0.048] of being infected by STH compared with women who wore shoes.

Discussion

Soil transmitted helminthes is the most prevalent Neglected Tropical Disease (NTD) to which pregnant women are vulnerable. In this study, we investigated the prevalence, pattern, intensity and risk factors of STH among 326 pregnant women attending selected antenatal clinics in the peri-urban areas in Ibadan. The overall prevalence of STH was 13.8% which increased with age as adolescent women recorded the lowest prevalence of 9.1% and women 35 years and older had highest prevalence of 16.7%. However, primigravida and multigravida had similar vulnerabilities towards the infections. Our findings are similar to those of some other investigators such as Shrinivas *et al* (2014) who reported a prevalence of 12.4% among pregnant attending antenatal clinic in a tertiary facility in India [19] and Wekesa *et al* (2014) who similarly reported a prevalence rate of 13.8% among the pregnant women attending antenatal clinic at Kitale district hospital, Kenya [20]. Conversely, other studies that have examined STH in pregnancy have reported much higher prevalences: 32.4% in Nigeria [14], 41% in Southwest Ethiopia [3] and 76% in rural Kenya [10]. Remarkably, most of the studies reporting higher prevalence rates were conducted in the rural areas [10, 14, 17] which are likely to have higher level of poverty coupled with poor sanitary facilities and hygiene practices. Laroque and co-workers in Peru [19] noted women living in rural areas had significantly higher prevalence of hookworm infestation compared with those living in the peri-urban areas. Our study was conducted in the peri-urban areas of Ibadan where sanitary facilities are likely to be better compared with those found in the rural areas. For example, while only 7 percent of our study participants practiced open defaecation, 76 percent reported using water closet. Furthermore, the application of different methods for the detection of helminthes infection could also partly contribute to the variations in the prevalence rates. While some authors had used fecal concentration, others used the Kato-Katz method [3, 10, 14, 15], even though the sensitivity of these methods for detecting STH have been noted to vary widely [18, 26]. The other plausible explanation might be the difference in the geographical location of the studies as soil types and climatic conditions have been attributed to STH endemicity [3].

Specifically *A. Iumbricoides* had the highest prevalence (12.8%), followed by hookworms (0.6%) and *Trichuris trichiura* (0.3%) as reported by studies from Venezuela and Kenya [20, 27]. In Nigeria, Egwunyenga *et al in 2001* [15] reported the prevalence of 19.1%, 14.2% and 7% for *A. Iumbricoides*, hookworm and *T. trichiura* respectively. In addition, single specie infection (monoparasitism) was the predominant pattern in our study population. This is unlike other studies that have reported multiple parasite infection (polyparasitism) [3, 11, 15, 18].

Furthermore, the Peruvian study highlighted the importance of measuring the STH intensity since higher intensity of infection was associated with higher proportion of anaemia among 1,042 second trimester pregnant women while there was no association found with the mere presence of infection [17]. This implies that adverse effects of STH infections are related to the intensity of infection. Intensity of infection, a measure of burden of worms harboured in the host, is the main epidemiological index used to describe soil-transmitted helminthic infection and is measured by the number of eggs per gram of faeces [4]. Most of the respondents in this study had light intensity infection for STH, and one person with moderate intensity infection. The intensity of *Ascaris lumbricoides* and *T. trichura* infection tends to decrease with age, such that heavy intensity infections are commonly found in children aged 5-15 years [17].

Generally, several determinants influence the occurrence of STH, but from our study the environmental characteristics and hygiene practices seem to be most significant. Particularly, women who walked bare footed were twice at risk (OR = 1.93) of having STH compared with those who wore shoes, and this is similar to previous reports [11, 17, 25]. Faecal pollution of soil has been implicated in the transmission of STH as walking bare-footed can facilitate the spread of infection by increasing the exposure to helminthic eggs and larvae in the soil. Nevertheless, Ascaris lumbricoides, the most predominant STH in our study, is transmitted primarily by faeco-oral route in which eggs are ingested through contaminated food or water. Therefore hygiene practices like hand washing before eating and after defecation has been found to lower the odds of STH infection (3, 28) although the association was not statistically significant in our study. Moreover, walking bare footed may also be a marker for other environmental and hygiene practices

related to STH. In this study, it was noted that rearing of animals at home and the use of human faeces for fertilizers were higher among women with STH compared with those without STH. Humphries *et al* (1997) had equally shown that the use of human faeces for fertilizers was associated with intensity of hookworm infection among Vietnamese women [29].

The main limitation of this study is the low prevalence of soil transmitted helminthes among the study population which perhaps is due to the low endemicity of STH in the study area. However, a larger sized, community-based study that will give a higher yield of the study outcome, will more precisely investigate the relationship between the risk factors of STH among pregnant women. On the other hand, since that data was collected over a period of 4 months particularly during the dry season when transmission was lower, the prevalence might be been underestimated as the effect on the seasonal variation could not be ascertained while the use of a cross section study design precluded the examination of causal relationships. In addition, Kato-Katz method of quantification was used which has been reported to be unsuitable for hookworm egg identification [26]. These limitations notwithstanding, our study has provided information on the local epidemiology of STH among pregnant women in attending antenatal clinic in the PHCs in the peri-urban region in Ibadan Nigeria. Future studies exploring STH among pregnant women need to be conducted in areas of higher endemicity like the rural areas as comparative studies involving the urban, semi-urban and the rural settings would offer better information.

In conclusion, the prevalence of STH infection among pregnant women resident in Ido/Akinyele LGAs of Ibadan was 13.8%. This was below the cutoff point of 20% recommended for implementing antihelminthic therapy. Light intensities were reported for the three major STH (*A. lumbricoides*, hookworms and *T. trichiura*) in this study. The factors that were associated with STH in this study were majorly environmental and hygiene practices particularly walking bare footed around the home environment.

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