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Prevalence of and knowledge about intestinal helminths among pregnant women in a rural and a semi-rural community in the Volta Region, Ghana

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Abstract
Background: Soil Transmitted helminths and Schistosomiasis may have implications for pregnancy outcomes especially, in rural communities. In Adidome (A rural community) and Battor (A semi-rural community), soil and water contact activities expose inhabitants to helminth infections. There is, however, limited information on the prevalence and determinants of these infections among pregnant women in these areas. The present study was conducted to access the prevalence, knowledge and perceptions about helminthiasis among pregnant women accessing obstetric care at Adidome Government Hospital and Battor Catholic Hospital in the Volta region of Ghana.
Methodology/Principal Findings: A cross-sectional survey during which 1,295 pregnant women reporting for their first antenatal visit were interviewed for data on sociodemographic characteristics and knowledge about helminth infection transmission, symptoms and prevention. Out of this figure, 616 pregnant women, representing 47.5% willingly provided stool samples for analysis. Questionnaire data were analyzed using STATA and stool specimen were processed by Kato Katz for helminth eggs. Also, gDNA was extracted from aliquots and tested for *S. mansoni* and *N. americanus.* Helminth infections and participant knowledge were expressed in proportions. Chi-square and Fisher's exact tests were used to show association at $p< 0.05$ significant level. Intestinal helminth infections found among ANC participants were *T. trichiura* (0.4%), *N. americanus* (0.4%) and *S. mansoni* (0.4%). At delivery, a PCR prevalence of 5% was observed for *S. mansoni*. A high proportion of study participants, 82.5% in Adidome and 87.1% in Battor do not take dewormers on regular basis. Also, a high proportion of participants did not receive any dewormer prior to sample collection. Although knowledge on helminth transmission, risks and prevention were low, prevalence of helminth infections were also low.
Conclusion/Significance: Intensifying health education as community-based interventions is necessary for the total and effective control and elimination of schistosomiasis and STH in the study area.

Keywords: Prevalence, helminths, knowledge, prevention

Introduction
Schistosomiasis and Soil Transmitted Helminthiasis (STH) are parasitic diseases of medical and public health importance in many parts of the world. Classified among the neglected tropical diseases, they are prevalent in populations characterized by poverty and poor sanitation. STHs infect more than 1.5 billion people worldwide [1] accounting for nearly 3.3 million disability-adjusted life years [DALYs]. Despite the goals set at the 54th World Health Assembly resolution [2], the number of people affected by these neglected diseases remains very high [3, 4].
In Ghana, the predominant STHs are *Necator americanus*, *Ancylostoma duodenale*, *Ascaris lumbricoides* and *Trichuris trichiura* [5]. Transmission is either oral or by direct skin contact with the infective stages. Significant morbidities have been attributed to STH infections, including anemia, malnutrition, growth retardation and low intellectual ability [6]. For pregnant women, these complications might have implications for pregnancy outcomes and neonatal health [3].
Intestinal schistosomiasis is caused by *Schistosoma mansoni.* Transmission is by contact with contaminated freshwater body which harbours the specific snail intermediate hosts. People become infected during routine activities which bring them into contact with infected water

bodies [7]. Symptoms include fever, joint and abdominal pains, bloody diarrhea and hematuria and the infections are also known to contribute to the burden of anemia in pregnancy [8].

Generally, higher prevalence of helminth infections are observed in younger people living in communities with inadequate sanitation, overcrowding, and low socioeconomic status [4, 5] than in their older counterparts. Chronic STH infections tend to be asymptomatic [5] especially in low intensities and can prolong for a lifetime into adulthood.

In recent years, there has been a growing interest in the effect of helminth infections on pregnancy and pregnancy outcomes. Chronic helminth infection is reported to significantly increase maternal risks for future parasitic infections and adverse pregnancy outcomes. Infants born to malnourished mothers are often delivered prematurely, with low birth weight, and may have poor growth and development throughout childhood [9-10].

Even though there is global commitment to implementing helminth control programs, the primary target population is usually school children. Older age groups including pregnant women are often left out despite the risk of serving as reservoirs for reinfection within the communities [11]. Deworming with single dose 400mg albendazole or 500 mg mebendazole has been used as public health intervention for pregnant women after the first trimester especially in communities where baseline prevalences of ≤20% have been observed for Hookworm and *T. trichiura* [12].

Battor-Dugame and Mafi-Adidome are two district capitals of the North Tongu and Central Tongu districts, respectively, which share a common boundary, thereby encouraging trade among the people. The two communities are situated close to the Volta Lake which was created after the damming of the Volta River in 1965 for the generation of hydroelectric power and consequently, has become infested with the snail intermediate hosts for schistosomiasis. The lake serves as a source of potable water for many households. Farming activities in the Volta basin along the Lake expose the people to STHs while water contact activities also expose them to schistosomiasis. Information on helminth infections among pregnant women in the study area is limited, following the continued focus on school children for helminth control [13-14].

Adidome Government Hospital (AGH) and Battor Catholic Hospital (BCH) are the main referral centers in Mafi-Adidome and Battor-Dugame, respectively. Stool examinations in these hospitals are performed only upon the request of the medical officer in charge and not on routine basis. Consequently, the needed treatment for asymptomatic pregnant patients may be overlooked. The WHO target for the elimination of schistosomiasis and soil-transmitted helminths by 2030 warrants a clear understanding of community knowledge about these infections.

Research question

What is the influence of community knowledge about helminthiasis to the fight against STHs and schistosomiasis?

The aim of this study, therefore, was to determine prevalence of STH and *S. mansoni* in relation to local knowledge on symptoms and prevention amongst pregnant women reporting at Adidome Government Hospital and Battor Catholic Hospital for obstetric care.

The specific objectives were to:

1. Estimate local knowledge on causes, symptoms and prevention of helminth infections.
2. Determine prevalence of STHs and *S. mansoni.*
3. Evaluate the deworming history among study participants.

Methods

Study area and study site

Battor-Dugame (North Tongu District capital) and Mafi-Adidome (Central Tongu District capital) have tropical climates, which is favorable for farming, a major occupation for 73.5% of households in North Tongu and 78.4% in Central Tongu. There are two rainy seasons: a major season from mid-April to early July and a minor season from September to November. Average annual rainfall varies between 900 mm and 1100 mm with 50% occurring in the major season. Daily minimum and maximum temperatures range between 22 °C and 33 °C with average humidity around 80% [15-16]. The natural vegetation is savannah grassland. Aside crop farming, some households also engage in fish farming, livestock rearing and petty trading. Transportation in the north and central Tongu districts is by motorcycles, taxies, small buses and private cars. People living on the banks of the lake also use small canoes for navigation. Accommodation in Battor-Dugame and in Mafi-Adidome ranges from large extended family settlements to smaller nuclear family houses. Toilet facilities range from privately owned to public pit latrines, KVIPs and water closets. Some residents however, resort to open defecation in the surrounding bushes due to the absence of these facilities within their households.

Battor-Dugame has a semi-urban structure with a literacy rate of 74% (ie 51.7% male and 48.4% female) [15] while Mafi-Adidome has sparse or scattered settlements with small clusters of households near the central market. The literacy rate is 72% ie 52% male and 48% female [16]. The catchment area for AGH includes neighboring towns and small communities such as Mepe, Volo, Mafi-Kumase, Bakpa, Battor etc, while BCH also receives patients from adjoining towns and communities such as Mepe, Osudoku, Ada East and West, Volo, Abutia, Mafi-Adidome etc.

Study design and participant recruitment

This is a cross-sectional survey targeting pregnant women reporting at two health facilities for their first ANC visit and for delivery. Stool samples were collected from consenting pregnant women during the first ANC attendance and as they report for delivery, between November 2016 and March 2019. Participants who could not provide samples the same day were asked to bring their samples the following day. Information about sociodemographic characteristics and knowledge (Or myths) on helminth infection transmission, symptoms and prevention were collected by questionnaire interviews. Aliquots of the stool samples were analyzed for Kato-Katz detection and preserved at -20 ºC for PCR.

Sample size calculation

This study was part of a large study on malaria and helminth coinfections. Sample size was calculated using a confidence interval of 95% and an estimated prevalence of 17% [17] cited for malaria-helminth coinfections. The minimum sample size 'n' was calculated using the equation:

$$n = \frac{Z^2 P(1-P)}{D^2} \quad (18)$$

where 'D' is the margin of error (5%), 'n' is the minimum sample size, 'P' is the estimated prevalence (17%) and 'Z' is the standard normal deviate that corresponds to the 95% confidence interval [16]. Therefore, the minimum sample size required was 216 per study area.

Ethical considerations

Ethical and scientific approvals for the study were obtained from the Ghana Health Service Ethical Review Committee (GHS_ERC06/06/16) and the Institutional Review Board of the Noguchi Memorial Institute for Medical Research (NMIMR-IRB CPN 071/15-16 amend. 2017). Before commencement of the study, there were meetings with hospital staff with training sections on study participant recruitment protocols, sample collection and preservation. The objectives of the study, risk and benefits were explained to participants by a midwife/nurse on duty in the participants' local language**.** Participants who agreed to be part of the study and signed the consent form were assigned unique IDs. Parental consent was obtained on behalf of participating minors (<18 years) who also gave their assent.

Socio-demographic and parasitological questionnaire

Questionnaires were administered via the face-to-face interview method and separate questionnaires, structured into different sections were designed for ANC and delivery participants. Section A (ANC and delivery) dealt with information on socio-demographics including marital status, employment and occupation. Section B (ANC and Delivery) was about the pregnancy i.e., primigravidae or multigravidae, including number of pregnancies and number of children. At the ANC, study participant's knowledge on whether or not the participant had helminth infection and if a test was carried out for confirmation as well as the treatment received were obtained. Sections C and D (ANC and delivery) dealt with knowledge about helminths, symptoms and prevention of infection. Sections E, F and G (ANC and delivery) dealt with access to health facility, knowledge about risks and prevention during pregnancy and section H (ANC) was used to collect some clinical information such as temperature, blood pressure, Hb level, gestation, etc about the study participants.

Stool analysis

Two Kato-Katz smears were prepared from each stool sample and observed microscopically for helminth ova. For hookworm detection, each smear was observed fifteen minutes after preparation. For the detection of other helminths such as *Ascaris*, *Trichuris* and *S. mansoni*, the stool samples were examined again after thirty minutes. Genomic DNA was extracted from each stool aliquots using the Qiagen stool DNA kit according to the manufacturer's protocol and species-specific primers were used to detect *Necator americanus* and *S. mansoni* by PCR. *N. americanus* PCR was particularly necessary due to the low sensitivity of Kato-Katz technique to hookworm infection. Optimization of PCR for *Ascaris* and *Trichuris* was not performed because of limited resources.

Limitation

The study had some limitations. First is the failure of most pregnant women to provide stool samples for analysis. Also is the failure of some participants who provided stool samples to provide background information. Correlation or association between knowledge of helminth infection among the study population and prevalences observed could not be performed due to the very low prevalences observed. There were only 10 PCR schistosomiasis positive cases, nine from Battor with only two having background information, and one *N. americanus* positive case, therefore, this low number could not be used for comparative analysis with knowledge. The Kato-Katz data also showed three schistosomiasis positive cases and one positive *Trichuris*. Thus, comparative analysis could not be performed as well.

Data capture and analysis.

Knowledge on helminth infection acquisition, symptoms, prevention and associated risks for the mother and for the baby were obtained by questionnaire, analyzed and expressed in proportions. Chi-square test and Fisher's exact test were used to show association between categorical variables and choice of health facility at $p<0.05$ significance level.

Results

Sociodemographic characteristics

A total of 1,295 pregnant women were interviewed. However, only 616 pregnant women provided stool samples for analysis, comprising 249 participants from AGH and 367 participants from BCH**.** Mean ages of participants were 25.9 ($\pm$6.5) years at AGH and 27.4($\pm$6.0) years at BCH (t = -3.46, $p<0.001$). Most of the participants were basic school (primary and junior high school) leavers. The proportion of primary school leavers were 24.6% at AGH and 20.5% at BCH. While Junior High School (JHS) and Senior High School (SHS) leavers were 53.0% and 10.6% respectively at AGH and 43.4% and 14.0% respectively at BCH. Only a small proportion had completed tertiary level education. These were 1.6% at AGH and 10.8% at BCH ($X^2(4) = 37.96$, $p<0.001$).

Prevalence of helminth infections

Species of helminths observed are *Schistosoma mansoni*, *Trichuris trichiura* and *Necator americanus*. A general, low prevalence of helminths infection was observed during the study.

Table 1: Prevalence of STH and *S. mansoni*

Study site	Dept/unit	Microscopy (n, %)			
		S. mansoni	***N. americanus***	***T. trichiura***	***A. lumbricoides***
AGH	ANC	1, 0.4%	0%	1, 0.4%	0%
	Delivery	0%	0%	0%	0%
BCH	ANC	2, 0.6%	0%	0%	0%
	Delivery	0%	0%	0%	0%
		PCR (n, %)			
AGH	ANC	1, 0.4%	0%	-	-
	Delivery	0%	0%	-	-
BCH	ANC	4, 1.4%	1, 0.4%	-	-
	Delivery	5, 5.0%	0%	-	-

AGH=Adidome Government Hospital, BCH= Battor Catholic Hospital, STH= Soil Transmitted Helminth

At AGH, a prevalence of 0.4% by microscopy was recorded among ANC study participants for *S. mansoni* and also for *T. trichiura*. No helminth infection was recorded among the participants at delivery (Table 1). At BCH, a prevalence of

0.6% was recorded for *S. mansoni* by microscopy among ANC participants.

A PCR analysis show prevalences of 0.4% and 1.4%, for *S. mansoni* among ANC participants at AGH and BCH respectively. STH infection was only observed among ANC participants at BCH for a PCR prevalence of 0.4% for *N. americanus*. Among participants at delivery, a PCR prevalence of 5.0% was recorded for *S. mansoni* at BCH (Table 1).

Deworming history, worm infection and knowledge about dewormers: Table 2 is the summary of the responses to questions on the deworming habits among ANC participants. Majority of them, comprising 82% in Adidome and 87% in Battor, do not regularly take dewormers. A Chi-square test however, showed a statistically significant difference ($p<0.001$) in regular deworming across the two health facilities. For those who regularly take dewormers, a proportion of 13.1% was observed in Adidome and 12.6% in Battor. Nearly all the participants (100% in Adidome and 99% in Battor) did not receive dewormers prior to stool sample collection. Also, whereas 29% of participants in Battor did not take dewormers because in their opinion, it was too early in the pregnancy, 89% in Adidome did not take dewormers because the medicines were not available in the health facility ($X^2(4) = 634.48$, $p<0.001$).

Table 2: Deworming habits and worm infection at ANC

	ANC Health facility, N (%)			
	Adidome	**Battor**	**Test statistic**	**P-value**
Carry out regular deworming				
No	372 (82.5)	331 (87.1)	$X^2(2) = 14.75$	$p<0.001$
Yes	59 (13.1)	48 (12.6)		
Don't know	20 (4.4)	1 (0.3)		
Had worms during current pregnancy				
No	435 (96.5)	320 (84.2)	$X^2(2) = 37.89$	$p<0.001$
Yes	1 (0.2)	1 (0.3)		
Don't know	15 (3.3)	59 (15.5)		
Received dewormer today				
No	451 (100.0)	376 (99.0)	$X^2(1) = 4.77$	p=0.043[f]
Yes	0 (0.0)	4 (1.0)		
Reason for no dewormer today				
Too early in pregnancy	22 (4.9)	109 (29.0)	$X^2(4) = 634.4$	$p<0.001$
Not available in facility	402 (89.1)	6 (1.6)		
Not offered	19 (4.2)	162 (43.1)		
Not tested for worms	6 (1.3)	19 (5.1)		
Other reasons	2 (0.4)	80 (21.3)		
Total	451 (100.0)	380 (100.0)		

X^2(df) = Chi-square (degrees of freedom), f = Fisher's exact p-value.

Deworming habits and knowledge of dewormers among participants at delivery is presented in Table 3. Here too, a high percentage of participants reportedly did not take any dewormers during the pregnancy and they were 71.4% in Adidome and 87.1% in Battor. For those who took dewormers, 55.8% in Adidome and 61.9% in Battor took Albendazole, whiles 14% in Adidome and 19.1% in Battor took Mebendazole. Few participants, however, could not tell whether they had taken dewormers or not. Only a small proportion of participants (3% in Adidome and 1.2% in Battor) showed knowledge of herbal preparations against intestinal worm infections (p=0.343).

Table 3: Deworming history and knowledge about dewormers at delivery

	Delivery Health facility, N (%)			
	Adidome	Battor	Test statistic	P-value
Taken dewormer during current pregnancy:				
No	215 (71.4)	142 (87.1)	$X^2(1) = 14.67$	$p<0.001$
Yes	86 (28.6)	21 (12.9)		
Type of dewormer taken:				
Albendazole	48 (55.8)	13 (61.9)	$X^2(3) = 1.40$	p=0.706
Mebendazole	12 (14.0)	4 (19.1)		
Don't know	24 (27.9)	4 (19.1)		
Other	2 (2.3)	0 (0.0)		
Know herbal preparation used to treat worms				
No	292 (97.0)	161 (98.8)	$X^2(1) = 1.42$	p=0.343[f]
Yes	9 (3.0)	2 (1.2)		
Can 0-6 month old babies get worm infestations?				
No	46 (15.3)	30 (18.4)	$X^2(2) = 4.90$	p=0.086
Yes	85 (28.2)	31 (19.0)		
Don't know	170 (56.5)	102 (62.6)		
Total	301 (100.0)	163 (100.0)		

X^2(df) = Chi-square (degrees of freedom), f = Fisher's exact p-value.

Knowledge on helminthiasis

The level of participants' knowledge about helminth infection estimated as the number of correct answers to questions and expressed as a percentage of the highest possible score is presented in Table 4. Knowledge levels were categorised into 'Low' (0-33.33%), 'Medium' (33.34-66.66%) and 'High' (66.67-100%). Very high percentages of participants (both at ANC and delivery) showed 'Low knowledge'. Average score among ANC participants were 17.7% (±10.8) in Adidome and 26.0% (±15.8) in Battor ($X^2(2) = 76.54$, $p<0.001$). At delivery, average scores were 19.4% (±13.3) and 22.2% (±16.1) in Adidome and Battor, respectively ($X^2(1) = 1.19$, p=0.276). At ANC, differences in average score were significant but not at delivery, comparing the two health facilities.

Table 4: Level of knowledge of helminthiasis

	ANC Health facility, N (%)		Test statistic	Delivery Health facility, N (%)		Test statistic
	Adidome	Battor	P-value	Adidome	Battor	P-value
Knowledge level						
Low	430 (95.3)	281 (74.0)	$X^2(2) = 76.54$	242 (80.4)	124 (76.1)	$X^2(1) = 1.19$ p=0.276
Medium	21 (4.7)	98 (25.8)	$p<0.001^f$	59 (19.6)	39 (23.9)	
High	0 (0.0)	1 (0.3)		0 (0.0)	0 (0.0)	
Total	451(100.0)	380(100.0)		301(100.0)	163(100.0)	
Mean (SD)	17.7 (10.8)	26.0 (15.8)		19.4 (13.3)	22.2 (16.1)	

Knowledge level: Low = 0-33.33%, Medium = 33.34-66.66%, High = 66.67-100%
X^2(df) = Chi-square (degrees of freedom), f = Fisher's exact p-value.

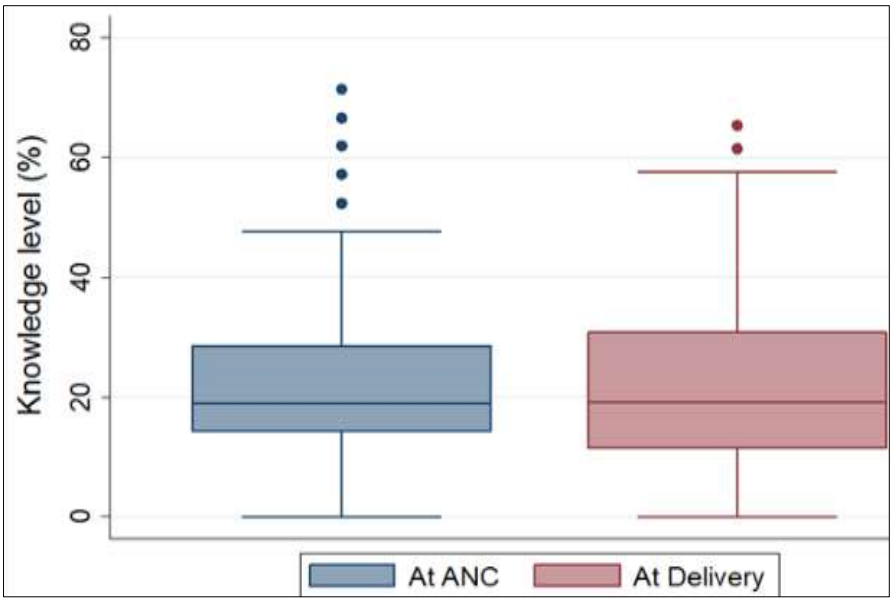

Fig 1: Comparison of general knowledge (% scale) at ANC and Delivery.

Table 5: Knowledge about the risk and prevention of helminths during pregnancy

	ANC Health facility, N (%)			
	Adidome	Battor	Test statistic	P-value
Knowledge about risks during pregnancy**				
Anaemia	123 (27.3)	263 (69.2)	$X^2(16)=229.48$	$p<0.001$
Complications of the pregnancy	95 (21.1)	86 (22.6)		
Low birth weight	59 (13.1)	43 (11.3)		
Preterm birth	39 (8.7)	20 (5.3)		
No knowledge	174 (38.6)	86 (22.6)		
Knowledge about prevention during pregnancy**				
No knowledge	341 (75.6)	308 (81.1)	$X^2(3)=4.34$	p=0.227
Taking Dewormer	100 (22.2)	68 (17.9)		
Traditional/herbal prevention	2 (0.4)	1 (0.3)		
Total	451 (100.0)	380 (100.0)		

**Multiple responses allowed and so totals for variable may exceed totals below. X^2(df) = Chi-square (degrees of freedom).

A comparison of the range of scores between ANC and delivery participants on knowledge about helminthiasis is presented in Figure 1. Though the median scores (<20%) at the two units (ANC–Delivery) appear similar and positively skewed, a bigger box, indicating a wider interquartile range was obtained at delivery. The range of values however were more varied at ANC than at delivery as more ANC participants had extremely high scores than those at delivery.

In Table 5 is the detailed summary of responses to questions on risks and prevention of helminth infections during pregnancy. The highest proportions of 69.2% in Battor and 27.3% in Adidome ticked anaemia as the risk of helminth infection during pregnancy. A much lower proportion (11.3% in Battor and 13.1% in Adidome) ticked 'low birth weight' ($X^2(16) = 229.48$, $p<0.001$). Participants who indicated 'no knowledge' were 38.6% in Adidome and 22.6% in Battor.

On the issue of knowledge about the prevention of helminth infections during pregnancy, a high proportion of participants (75.6% in Adidome and 81.1% in Battor) also indicated 'no knowledge'. A small proportion of participants (0.4% in Adidome and 0.3% in Battor) however specified knowledge of 'herbal preparations' while (22.2% in Adidome and 17.9% in Battor) specified taking 'dewormers' as the prevention methods during pregnancy ($X^2(3) = 4.34$, p = 0.227).

The questions on prevention of helminths in newborn babies got responses such as 'Boiling/filtering drinking water', 'Exclusive breast feeding', 'Good personal hygiene' and 'Deworming every three months' as presented in Table 6. In Adidome, only 5.3% and 3.0% stated 'boiling/filtering drinking water' and 'Deworming every three months', respectively, as preventive measures for babies. Similarly, in Battor, a proportion of 12.9% and 3.1% participants, respectively, held the same view. Participants who stated, 'Exclusive breast feeding' were 14.6% in Adidome and 14.7% in Battor. 'Good personal hygiene' was chosen by 14.3% of participants in Adidome as against 9.2% participants in Battor ($X^2(31) = 50.94$, p = 0.013).

Table 6: Knowledge about prevention of helminths in newborn babies

	Delivery Health facility, N (%)		Test statistic P-value
	Adidome	**Battor**	
Knowledge about prevention of worms in babies**			$X^2(31) = 50.94$ p=0.013
Boiling/filtering drinking water	16 (5.3)	21 (12.9)	
Exclusive breast feeding	44 (14.6)	24 (14.7)	
Clean environment	27 (9.0)	9 (5.5)	
Good personal hygiene	43 (14.3)	15 (9.2)	
Eating properly cooked meals	14 (4.7)	2 (1.2)	
Deworming every 3 months	9 (3.0)	5 (3.1)	
Total	301(100.0)	163(100.0)	

**Multiple responses allowed and so totals for variable may exceed totals below.
X^2(df) = Chi-square (degrees of freedom).

Details of responses on general knowledge about the causes, symptoms and prevention of helminth infections are presented in Table 7. A general observation shows the highest proportion of participants both at ANC and delivery selected 'vomiting' as a symptom of helminth infection. Among ANC participants, the proportions were 33.9% in Adidome and 45.3% in Battor and among delivery participants, the proportions were 45.2% in Adidome and 45.4% in Battor. 'Stomach ache' and 'diarrhoea' were other common responses observed among participants as symptoms of helminth infections. Among ANC participants in Adidome, the proportions observed were 22.2% and 22.6% respectively. In Battor too, the proportions were 13,7% and 32.1% respectively. Among delivery participants in Adidome, the proportions observed for 'Stomach-ache' and 'diarrhoea' were 38.5% and 22.3%, respectively, and in Battor 53.4% and 23.3%, respectively, were observed.

General knowledge about the cause of helminth infections showed majority of Adidome participants at ANC (26.2%) and delivery (39.2%) ticked 'eating improperly cooked food'. The highest proportion of participants who ticked 'playing in the sand' was observed among delivery participants in Adidome (39.5%) and the highest proportion who ticked 'poor sanitation' was observed among ANC participants in Battor.

Table 7: General knowledge on causes, symptoms and prevention of helminthiasis

	ANC Health facility, N (%)		Test statistic	Delivery Health facility, N (%)		Test statistic
	Adidome	**Battor**	**P-value**	**Adidome**	**Battor**	**P-value**
Knowledge on symptoms of worm infections**						$X^2(47) = 107.49$ $p<0.001$
Diarrhoea	102 (22.6)	122 (32.1)	=111. $X^2(37)$ 57 $p<0.001$	67 (22.3)	38 (23.3)	
Headache	70 (15.5)	42 (11.1)		14 (4.7)	38 (23.3)	
Vomiting	153 (33.9)	172 (45.3)		136 (45.2)	74 (45.4)	
Stomach ache	100 (22.2)	52 (13.7)		116 (38.5)	87 (53.4)	
Weakness	38 (8.4)	32 (8.4)		11 (3.7)	31 (19.0)	
Loss of appetite	67 (14.9)	33 (8.7)		82 (27.2)	66 (40.5)	
Knowledge on causes of worm infections**						$X^2(28) = 79.21$ $p<0.001$
Eating improperly cooked food	118 (26.2)	229 (60.3)	$X^2(20) = 196.51$ $p<0.001$	118 (39.2)	80 (49.1)	
Playing in the sand	80 (17.7)	146 (38.4)		119 (39.5)	48 (29.6)	
Poor sanitation	86 (19.1)	171 (45.0)		104 (34.6)	73 (44.8)	
Exposure to human excreta	67 (14.9)	79 (20.8)		103 (34.2)	52 (31.9)	
Malnutrition	5 (1.1)	3 (0.8)		9 (3.0)	26 (16.0)	
Knowledge on prevention of worm infections**						$X^2(26) = 45.09$ p=0.011
Clean environment	142 (31.5)	218 (57.4)	$X^2(23) = 223.01$ $p<0.001$	127 (42.2)	80 (49.1)	
Good personal hygiene	213 (47.2)	150 (39.5)		144 (47.8)	69 (42.3)	
Sleeping under a bed net	8 (1.8)	11 (2.9)		10 (3.3)	7 (4.3)	

Can't be prevented	4 (0.9)	3 (0.8)		0 (0.0)	0 (0.0)	
Deworming every 3 months	11 (2.4)	36 (9.5)		115 (38.2)	59 (36.2)	
Eating properly cooked meals	13 (2.9)	110 (29.0)		91 (30.2)	66 (40.5)	
Total	451(100.0)	380(100.0)		301(100.0)	163 (100.0)	

**Multiple responses allowed and so totals for variable may exceed totals below. X^2(df) = Chi-square (degrees of freedom).

General knowledge on prevention of helminth infections saw majority of the participants across both facilities and units ticking 'clean environment' and 'good personal hygiene'. A smaller proportion of ANC participants (2.4% in Adidome and 9.5% in Battor) however chose "deworming every three months". The corresponding proportion of delivery participants were 38.2% in Adidome and 36.2% in Battor.

Information in Table 8 are the mean scores on knowledge about helminthiasis across sociodemographic characteristics estimated as percentages of correct answers from the series of questions to determine participant knowledge. Across age categories, participants in Battor received higher scores than their counterparts in Adidome with the 40+ age category showing the highest mean score of 31.9 $\pm$ 11.5.

Table 8: Knowledge on helminths by sociodemographic characteristics

	Knowledge level, Mean (SD)	
	Adidome	**Battor**
Age (Years)		
<20	16.1 (11.3)	19.9 (14.3)
20 – 29	17.6 (10.5)	24.9 (15.5)
30 – 39	19.1 (10.7)	29.1 (16.4)
40+	16.7 (12.7)	31.9 (11.5)
Residence		
Adidome	17.0 (10.8)	20.2 (18.0)
Battor	25.2 (8.4)	27.3 (15.9)
Other	17.4 (10.6)	24.6 (15.5)
Marital status		
Married	18.1 (11.1)	27.9 (15.4)
Single	16.9 (10.3)	19.2 (14.2)
Cohabiting	19.0 (0.0)	10.8 (12.2)
Formal education		
None	15.4 (10.1)	21.8 (15.0)
Primary	15.7 (10.4)	21.0 (14.6)
Junior High School	17.9 (10.6)	24.3 (14.4)
Senior High School	22.5 (10.6)	29.0 (14.9)
Tertiary	25.9 (16.0)	42.9 (14.0)
Gravida		
Primigravidae	16.8 (10.6)	24.6 (15.0)
Multigravidae	18.1 (10.9)	26.5 (16.0)

Overall knowledge level scale: 0 (Lowest) to 100 (Highest).

Considering marital status and all other sociodemographic characteristics participants in Battor recorded higher mean scores than those in Addome.

Discussion

The study set out to determine prevalence of intestinal helminth infections among pregnant women and to compare local knowledge about helminthiasis in two rural communities where school children had been targets for helminth control to the total exclusion of the elderly and pregnant women.

Prevalence of STH and *S. mansoni*

The low prevalences observed among study participants are similar to prevalences observed among school children in a previous study [13] in some three districts in the Volta region. Even though known risk factors for helminth infections such as exposure to contaminated fresh-water bodies, soil contact activities through farming and other agricultural practices were present in the study areas, prevalence of helminth infections were very low. The very low prevalence observed may be due to preventive measures such as public education on 'clean environment' and 'personal hygiene' to which a considerable proportion of the participants attested (Table 7).

Deworming history and knowledge about dewormers

Although a high percentage of study participants reportedly do not regularly take dewormers (Table 2), that did not reflect in the prevalence of helminthic infection observed. Other factors not identified by the study might account for the low prevalence. Since deworming helps to reduce morbidity in infected individuals, there is the need for public education on the importance of periodic deworming most especially for the asymptomatic carriers.

Local knowledge about causes, symptoms and prevention of helminth infections

The overall low level of knowledge observed (Table 4 and Figure 1) coupled with other existing predisposing factors indicated that the study populations were at risk of helminth infections. This observation was confirmed by the observation where a high percentage of participants indicated no knowledge of preventive measures during pregnancy (Table 5). This observation compared to those who indicated low birth weight and preterm is a serious handicap in the community. The low-level knowledge could also account for the study populations' dislike for deworming as a preventive measure evidenced by the high percentage of participant showing no knowledge about prevention compared to the percentage taking dewormers and herbal preparations. Battor as a community has more schools than Adidome. Consequently, it was expected of participants from Battor to show better knowledge about helminthiasis as has been observed in Table 4.

Common perception of risk of helminth infection among study participants were anemia, pregnancy complications and low birth weight.

Conclusion

In spite of the low prevalence observed, the study revealed low knowledge about helminthiasis among the study population. The cause for the low prevalence of helminth infection among the study participants could not be identified. It is not clear whether or not malaria infection identified among study participants in a parallel study has an impact on helminth prevalence or intensity in the study areas. A further study is necessary to unravel such hypothesis. Despite the low prevalence observed, intensifying health education as community-based interventions is still necessary for the effective control and elimination of schistosomiasis and soil transmitted helminths in the study area. There is also the need to include pregnant women in future control programs to achieve

complete elimination of intestinal helminths in the study communities.

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