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Prevalence and risk factors of intestinal parasitic infections in pregnancy: a cross-sectional study in a rural district in Ghana

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Abstract

Background Intestinal parasitic infection is a common public health problem in developing countries. The disease caused by these infections affects millions of pregnant women worldwide, and may lead to adverse maternal and foetal outcomes. This study aimed to determine the burden of intestinal parasitic infections and the associated risk factors among pregnant women attending Pentecost Hospital in the Upper Denkyira West District of Ghana.

Methods A hospital-based cross-sectional study was conducted at Pentecost Hospital in the Upper Denkyira West district in the Central region of Ghana. Pregnant women were recruited from June to October 2021. Questionnaires were administered to the participants to obtain socio-demographic, behavioural, and obstetrics characteristics. Non-repetitive fresh stool samples were produced by the participants and processed for parasite detection by direct wet mount, formol-ether concentration, and Ziehl-Neelsen staining technique.

Results Two hundred and seven pregnant women were enrolled. Most (61.8%) of them were between 20 and 29 years. The overall prevalence of intestinal parasitosis was 19.3% (95% CI: 14.2–25.3). Eight different parasitic species were identified, among which hookworm (4.8%) was the majority, and identified by both direct wet mount (4.8%) and formol-ether concentration (3.4%) methods. Pregnant women who have experienced a pregnancy loss had 2.912 times increased odds of parasitic infection compared to those with no record of pregnancy loss [aOR = 2.912, 95% CI: 1.210–7.011; p-value = 0.017].

Conclusion Intestinal parasitic infection was prevalent among pregnant women, with hookworm being the most common parasite. Risk factors included a history of pregnancy loss and handwashing practices. Unexpectedly, women who washed their hands with soap and water had higher infection rates. Public health interventions are essential to mitigate the impact of these infections on maternal and foetal health.

Keywords Intestinal parasites, Risk factors, Pregnant women

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Background

Parasitic infections are of serious public health concern globally, particularly in developing countries [1, 2], with geo-helminths being the most widespread intestinal infections affecting humans [3]. The infection is transmitted faeco-orally by ingestion of contaminated food and water, and by direct skin penetration. Parasitic infections affecting the gastrointestinal tract may present with skin itching, abdominal cramps, vomiting, excessive bowel sound, nausea, diarrhoea, loss of appetite, and malabsorption [4].

In developing countries, research from São Tomé and Príncipe found a 58.2% prevalence of Intestinal Parasitic Infections (IPIs) in pregnant women, with helminth infections being the most common [5]. Similarly, a study in Ecuador by Calvopina, Contreras [6] reported an overall IPI infection rate of 69%. The most prevalent helminths were *Ascaris lumbricoides* (27%) and *Trichuris trichiura* (13%), while protozoan infections, such as *Entamoeba histolytica* (23%), were also widespread [6]. In Ghana, Atakorah, Afranie [7] reported a 36.7% prevalence of IPIs in pregnant women, with protozoan infections, including *Giardia lamblia* and *Entamoeba histolytica*, contributing to gastrointestinal distress, anaemia, and low birth weight.

IPIs in developing countries have been associated with poverty, low literacy rate, lack of safe drinking water, poor sanitation and hygiene, habit of walking barefoot, malnutrition, and changes in climatic conditions [8]. In pregnant women, severe complications like intrauterine foetal growth restriction [9], stillbirth, preterm birth, low birth weight, poor foetal growth, maternal anaemia, death, and cognitive abnormalities in newborns have been associated with IPIs [8, 10].

During pregnancy, immune responses are altered, making women more susceptible to parasitic infections, which can contribute to increased blood loss and a higher prevalence of anaemia [11, 12]. Current statistics indicate that 41.8% of pregnant women globally present with anaemia; the highest being in Africa [13]. In Ethiopia, the prevalence of intestinal parasitic infection was 70.6%, with 60.8% having high-intensity of infection, 18.3% of moderate intensity, and 21% of low intensity [8]. A study conducted in Ghana reported an overall prevalence of IPIs of 14.3%, with associated factors including age, gravidity, and parity [14].

While the potential adverse health consequences of intestinal IPIs in pregnancy is uncontested [15], studying the prevalence of infections in pregnant women is crucial for minimizing the burden of infection during pregnancy. Moreover, the prevalence of IPIs in pregnancy is likely to change over time due to targeted interventions addressing identified risk factors [16, 17]. While there is a paucity of data on intestinal parasitic infections among pregnant women in this region, the varying prevalence across different settings highlights the influence of context-specific behaviours, environmental factors, and healthcare access. This study, therefore, aimed to determine the burden of intestinal parasitic infections and the associated risk factors among pregnant women attending Pentecost Hospital in the Upper Denkyira West District of Ghana.

Methods

Study design

A hospital-based cross-sectional study was conducted at Pentecost Hospital, Ayanfuri from June 2021- October 2021. A hospital-based study was chosen due to the accessibility of participants who sought medical care, ensuring a more reliable sample of individuals potentially at risk for the condition under investigation. Conducting the study in a healthcare setting allowed for controlled data collection, laboratory-confirmed diagnoses, and reduced recall bias compared to self-reported infections in a community setting. Additionally, resource constraints and logistical challenges made a full-scale community-based study less feasible within the given timeframe. Questionnaires were administered to participants to obtain socio-demographic, behavioural, and obstetric characteristics.

Study site

The study was carried out in Pentecost Hospital, Ayanfuri, in the Upper Denkyira West District. The Pentecost Hospital Ayanfuri was established in 1983 as a mobile clinic until 2001 when it became a static clinic. The facility was recently upgraded from a Clinic to a Primary Hospital by the Health Facility Regulatory Agency (HeFRA) in October 2019. Currently, the Hospital has a bed capacity of 20 for admitting patients whose conditions might require short-term hospitalisation and a total staff strength of 84. The following are the services currently available: Pharmaceutical Services, Laboratory Services, maternal and child welfare services, the outpatient department, and theatre. The antenatal clinic of the hospital records about 80 pregnant women in a month. The Pentecost Hospital at Ayanfuri has set up an ultramodern surgical theatre to provide quality healthcare services for people of Ayanfuri and other surrounding communities. It serves as the largest healthcare facility and the primary referral centre for the community and its environs.

The Upper Denkyira West District is one of the 22 administrative districts in the Central region carved out of the Upper Denkyira District. It lies within latitudes 5° 30’ N and 6° 02’ N of the equator and longitudes 1° W and 2° W of the Greenwich Meridian. It shares common boundaries with the following districts: Babiani Ahwiaso-Bekwai District (Western North Region which was carved out of the Western Region) to the north, Amansie West and Amansie Central Districts (Ashanti Region) to the east, Wassa Amenfi East and Wassa Amenfi West districts (Western Region) to the west, and Upper Denkyira East Municipality to the south (Fig. 1). The district has a total land area of 579.21km^2 which represents 3% of the total land area of the Central region. The total population in the district stood at 60,054. The entire population of the district resides in rural areas, making it one of the two districts in the Central region with no urban population. The General Fertility Rate is 105.5 births per 1000 women aged 15–49 years which is the second highest for the region. Females are more likely than males to be engaged as skilled agricultural, forestry and fishery workers, service and sales work [18].

Study population
Pregnant women attending the antenatal clinic at Pentecost Hospital, Ayanfuri, during the study period were recruited. Women in all stages of pregnancy who sought antenatal care were enrolled in the study.

Inclusion criteria
All pregnant women attending the antenatal clinic in the Pentecost Hospital, Ayanfuri, and consented to participate were enrolled in the study.

Exclusion criteria
Pregnant women who had received antiparasitic medication within four weeks prior to recruitment were excluded from the study. Additionally, women who declined participation or were unable to provide a stool sample for laboratory analysis were excluded.

Sample size determination and sampling technique
Using the Raosoft sample size calculator [19], with 5% margin of error, 95% confidence interval, 400 population size, and 50% response distribution, a sample size of 197 was calculated. A convenience sampling technique was employed, where all eligible pregnant women who attended the clinic during the recruitment period were consecutively enrolled in the study without random selection. We employed a convenience sampling approach due to accessibility of participants, time constraints, feasibility, and the nature of the population. This method was chosen to ensure adequate participant recruitment within the scope of the study, considering logistical and time constraints.

Data collection
Before data collection, the questionnaire was pretested in the Ho Metropolis to ensure clarity, reliability, and validity before administration. Informed consent was also obtained from all participants after explaining the study's purpose, procedures, potential risks, and benefits. Study participants were then given structured, closed-ended questionnaires to obtain data on sociodemographic characteristics, socio-behavioural factors, obstetric characteristics, and knowledge of parasitic infections. English language was the main language used to administer the questionnaire. English was used as the primary language for the questionnaire because it is the official language of

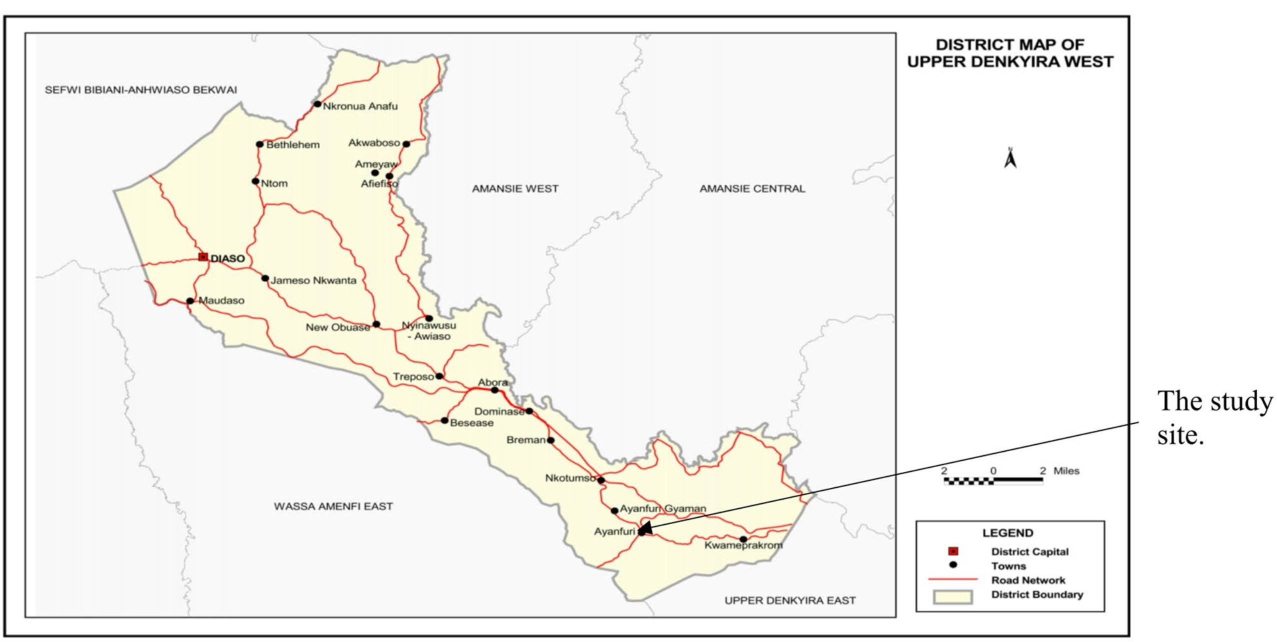

Fig. 1 District map of Upper Denkyira West showing the study site [18]

instruction and communication in Ghana, and a majority of the study population had basic proficiency in it. For participants who could not speak or understand the language, assistance was provided by an interpreter. Questions were translated to Twi for pregnant women who could not read and understand English.

Sample collection

Clean, screw-capped plastic stool containers with wide necks were given to the study participants, each labelled with a unique identification number. Before sample collection, participants were provided with standardized instructions on the proper method for stool collection to ensure sample quality and prevent contamination.

Laboratory analysis

Participants were requested to provide stool samples, which were then examined for intestinal parasites, eggs, cysts, and oocysts using the direct wet mount method, formol-ether concentration technique, and Ziehl-Neelsen staining technique.

Direct wet mount method

Less than 1 g of the collected stool sample was emulsified in a drop of normal saline on a clean grease-free glass slide. A cover slip was then gently placed on it to avoid air bubbles, and the preparation was examined under the microscope [20]. The microscopic examination was done under 10x objective lens to scan the preparation entirely and then 40x objective for identification of parasites under low light intensity. This method was used to detect motile trophozoites of protozoan parasites and helminth eggs or larvae *(Entamoeba histolytica*, *Giardia lamblia*, *Ascaris lumbricoides*, *Hookworm*, *Strongyloides stercoralis*, *Trichomonas hominis*, *Trichuris trichiura* and *Schistosoma spp*).

Formol-Ether concentration technique

One gram (1 g) of each stool sample was emulsified with 4 ml of 10% formol saline completely. An additional 4 ml of the 10% formol saline was added and the suspension was mixed thoroughly by shaking. The suspension was further processed according to the method employed by Kpene, Lokpo [21] and Deku, Botchway [22]. This concentration technique was used to enhance the detection of protozoan cysts (Hookworm, *Entamoeba histolytica*, *Giardia lamblia*), helminth eggs (*Ascaris lumbricoides*, *Trichuris trichiura*, *Schistosoma spp.*), and larvae of certain parasites.

Modified Ziehl Neelsen staining technique

A smear was prepared from the sediment obtained by the formol-ether concentration technique, air-dried, and fixed in methanol for 3 min. The smear was primarily stained with carbol fuchsin for 15 min and 0.5% methylene blue was used to stain for 30 seconds as a counter stain, following 10 seconds of decolorization with 1% acid alcohol [20]. This technique was specifically used for detecting oocysts of *Cryptosporidium spp.* and *Isospora belli.*

Quality control

Quality control of the test procedure was done according to the method employed by Abaka-Yawson [14], except that a licensed Senior Medical Laboratory Scientist was consulted for a second opinion in case of doubtful results.

Data analysis

Statistical analysis was done with STATA version 16.1. Both descriptive and inferential statistics were done. The age of participants was non-parametric and thus described with median (Interquartile range). Intestinal parasitic infection status was the main categorical outcome variable classified as “yes” or “no” for presence (identification of parasite by any or all of the methods) or absence of infection respectively. A univariate logistic regression analysis was conducted to evaluate the relationship between each independent variable and intestinal parasitic infection. Variables (knowledge of IPI, employment status, age of pregnancy, type of toilet facility, “before eating, I wash hands with”, main source of drinking water, and walk barefoot) with a p-value less than 0.25 in the univariate analysis were then incorporated into the multivariate logistic regression model to identify predictors of intestinal parasitic infection. Data is presented as figures and percentages. A p-value threshold of less than 0.05 was used to determine statistical significance.

Results

A total of 207 respondents took part in the study with zero non-response. The median age of the study respondents was 26 (8) years. Most of the women were 20–29 years (61.8%), Christian (79.7%), married (71.5%), informally employed (60.9%), and having a secondary level of education (74.9%). Most of the pregnant women were in their third trimester (64.7%) and were experiencing their first pregnancies (33.3%). About three-quarters of the respondents (71.0%) had ever lost a pregnancy. Twenty, representing 9.7% have previous stillbirth and only 1.9% have ever had a preterm baby [Table 1].

Apart from one woman who engages in open defaecation, most had water closets at home (46.4%) and shared toilet facilities with others (87.4%). More than three-quarters (95.2%) wash their hands after defaecation and with soap and water 205 (99.0%). The main source of feeding of the pregnant women was homemade foods (99.0%). They also mostly wash their hands before eating

Table 1 Demographic characteristics of study participants

Variables	Frequency	Percentage
Age (years)*	26 (8)	
Age category (years)		
< 20	25	12.1
20–29	128	61.8
30–39	52	25.1
40–49	2	1.0
Religion		
Christian	165	79.7
Islam	42	20.3
Educational Level		
None	21	10.1
Primary	24	11.6
Secondary	155	74.9
Tertiary	7	3.4
Marital Status		
Single	59	28.5
Married	148	71.5
Employment Status		
Unemployed	71	34.3
Informal	126	60.9
Formal	10	4.8
Age of present pregnancy		
1st Trimester	17	8.2
2nd Trimester	56	27.1
3rd Trimester	134	64.7
Number of pregnancies		
One	69	33.3
Two	38	18.4
Three	46	22.2
Four	35	16.9
Five	8	3.9
More than 5	11	5.3
Ever lost a pregnancy		
No	147	71.0
Yes	60	29.0
Number of pregnancies lost (*n* = 60)		
1	42	70.0
2	12	20.0
3	4	6.7
4	2	3.3
Previous stillbirth		
No	187	90.3
Yes	20	9.7
Number of dead babies (*n* = 20)		
1	15	75.0
2	5	25.0
Ever had a preterm baby		
No	203	98.1
Yes	4	1.9

*is presented as median (Interquartile range)

(99.0%) and with soap and water (81.2%). Further, the main source of drinking water was pipe borne (71.5%), followed by sachet water (21.7%) with the least drinking from both pipe and sachet water (2.9%). Most (41.5%) of the participants had dewormed for more than a year. Only two women do not wash their vegetables before use, while the majority do (99.0%) and with salt water (37.7%), warm water (1.9%) or water only (60.4%). A great number of the respondents do not practice geophagy (83.6%) but walk barefoot (55.1%). To dispose their refuse, most prefer the refuse dump (96.1%) [Table 2].

Less than a quarter of the pregnant women alluded to knowing intestinal parasites (22.2%). However, when asked about the mode of transmission, most had no idea (52.2%), 21.7% said via unclean environment and faecal-oral route, 21.7% through eating and drinking contaminated food and 4.4% said drinking contaminated water. The majority (93.5%) of those who responded in the affirmative to knowing about intestinal parasites said that it can affect everybody. Regarding complications associated with intestinal parasitic infection, most had no idea, while anaemia/stomach pain (13.0%), stillbirth/miscarriage (13.0%), gastrointestinal bleeding (4.4%), and deformities in the foetus (8.7%) were some identified complications [Figure 2].

Table 3 shows the prevalence of the different intestinal parasites among pregnant women using the various laboratory techniques. Overall, a prevalence rate of 19.3% was recorded. Specifically, the saline, formol-ether concentration technique, and the modified Ziehl Neelsen technique yielded a prevalence of 16.9%, 3.9%, and 3.4% respectively.

Macroscopically, most (40.1%) of the stool samples were formed, 37.7% were semi-formed, 21.3% were loose and 1.0% were watery (Fig. 3A). The prevalence of the identified parasites: hookworm, *Giardia lamblia*, *Tinea* spp ova, *Ascaris lumbricoides* ova, *Trichomonas hominis*, *Strongyloides stercoralis*, *Schistosoma mansoni* and *Trichuris trichiura* were 4.8%, 4.3%, 2.4%, 1.9%, 1.4%, 1.0%, 0.5% and 0.5%, respectively with the saline wet preparation technique (Fig. 3B). Hookworm (3.4%) and *Ascaris* ova (0.5%) were identified using the formol-ether concentration technique (Fig. 3C) while *Giardia lamblia* (2.4%) and *Trichomonas hominis* (1.0%) were identified using the modified Ziehl Neelsen staining technique (Fig. 3D).

Ever losing a pregnancy and the number of pregnancies lost were the only individual-level factors associated with intestinal parasitic infection. Women who had ever lost a pregnancy had 2.131 increased odds of IPI compared to those who had not experienced pregnancy loss [OR:2.131; 95% CI: 1.041–4.363; p-value = 0.038]. Also, women who had experienced a single pregnancy loss had 2.995-fold increased odds of infection compared

Table 2 Socioeconomic characteristics and lifestyle of study participants

Variable	Frequency	Percentage
Type of toilet facility		
Open defecation	2	1.0
Pit latrine	59	28.5
Public toilet	50	24.2
WC	96	46.3
Share toilet facility with others		
No	26	12.6
Yes	181	87.4
Wash hand after defecation		
No	4	1.9
Sometimes	6	2.9
Yes	197	95.2
Wash hand after defecation with		
Soap & water	205	99.0
Water only	2	1.0
Main source of feeding		
Homemade food	205	99.0
Buy outside	2	1.0
Wash hands after eating		
Sometimes	2	1.0
Yes	205	99.0
Wash hands with		
Soap & water	168	81.2
Water only	39	18.8
Main source of drinking water		
Well/Borehole	8	3.9
Pipe borne water	148	71.5
Sachet water	45	21.7
Pipe and sachet water	6	2.9
When last you dewormed		
Never	4	1.9
< 3 months	54	26.1
3–6 months	21	10.1
7–12 months	42	20.3
> 12 months	86	41.6
Wash vegetables		
No	2	1.0
Yes	205	99.0
How do you wash it		
Salt water	77	37.6
Warm water	4	2.0
Water only	124	60.4
Practice Geophagy		
No	173	83.6
Yes	34	16.4
Walk barefoot		
No	93	44.9
Yes	114	55.1
How to dispose of household waste		
Burning	6	2.9
Open Disposal	2	1
Refuse dump	199	96.1

WC: water closet

to those with no loss [OR:2.995; 95% CI: 1.384–6.483; p-value = 0.005] (Table 4).

Knowledge on intestinal parasitic infection complications, hand washing before eating, having a toilet facility, source of drinking water and walking barefoot were likely factors associated with IPI among the pregnant women in this present study, however, none was statistically significant. [Table 5 and 6].

After adjusting for all other associated factor, it was found that those who have experienced a pregnancy loss had 2.912 times increased odds of parasitic infection compared to those with no record of pregnancy loss [aOR = 2.912, 95%CI: 1.210–7.011; p-value = 0.017]. Pregnant women who wash their hands with soap and water had 5.976 times increased odds of intestinal parasitic infection compared to those who wash their hands with only water [aOR = 5.976, 95%CI: 1.172–30.467; p-value = 0.031], as shown in Table 7.

Discussion

Intestinal parasitic infection is a public health problem in sub-Saharan countries. Pregnant women are one of the most vulnerable groups to this infection due to their immune suppression during pregnancy [15]. The ultimate goal of preventing intestinal parasites among pregnant women is to reduce maternal and newborn morbidity and mortality [23]. Therefore, effective preventive measures can be implemented if the burden and determining factors are well identified. The current study recorded a 19.3% prevalence of intestinal parasitic infection among pregnant women. This is higher than other studies carried out in Ghana by Abaka-Yawson [14], which recorded a 14.3% prevalence, and 13.46% by Kengne, Taheu [24] in Cameroon. Though the current prevalence of 19.3% was high, it was lower than that reported from other studies in other parts of Africa such as 36.7% in Northwestern Ethiopia [25], 52.8% in Sao Tome and Principe [26], and 39.02% in Owerri, Nigeria [27]. The differences in the prevalence might be due to the differences in the sociodemographic factors, lack of awareness on the prevention of parasitic infections, eating uncooked food, not trimming fingernails, poor waste disposal, bare footedness [28], sanitation and hygiene practices [29], differences in geographical location, and climatic conditions [30]. Additionally, differences in prevalence could be due to difference in study design, study period and study population [31–34]. However, most IPI prevalence studies among pregnant women utilized a hospital-based design [35–37]. The most predominant parasite in the study area was hookworm, and this is in agreement with reports from other studies conducted in other jurisdictions [15, 29, 38, 39]. Findings from our current study were inconsistent with the studies that reported *Giardia lamblia* [28, 40], *A. lumbricoides* [26], *Entamoeba histolytica/*

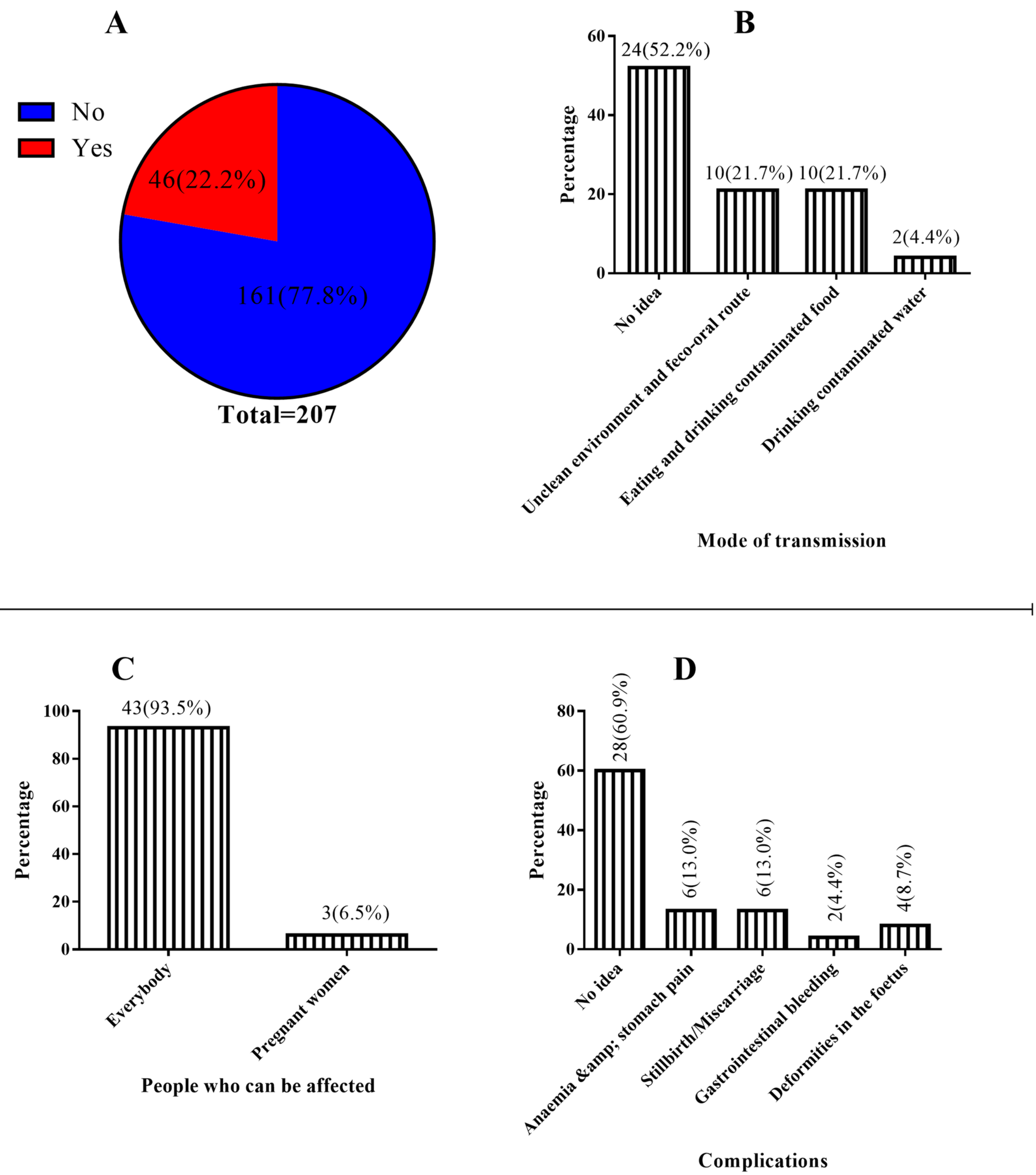

Fig. 2 Knowledge on intestinal parasites **(A)**, mode of transmission **(B)**, people who are likely to be affected **(C)** and the complications associated with it **(D)**

Table 3 Prevalence of parasites using the various laboratory techniques

Prevalence	Frequency	Percentage (%) [95% CI]
Overall	40	19.3 [14.2–25.3]
Saline	35	16.9 [12.1–22.7]
Formol ether	8	3.9 [1.7–7.5]
Modified Ziehl Neelsen (ZN)	7	3.4 [1.4–6.9]

dispar [25, 41] as the most predominant parasites. This disparity might be due to the differences in geographical location and level of income as lower income often correlates with inadequate sanitation and increased risk of parasitic infections. It could also be due to differences in shoe-wearing habits and the level of exposure to contaminated soil with hookworm larvae that penetrate the

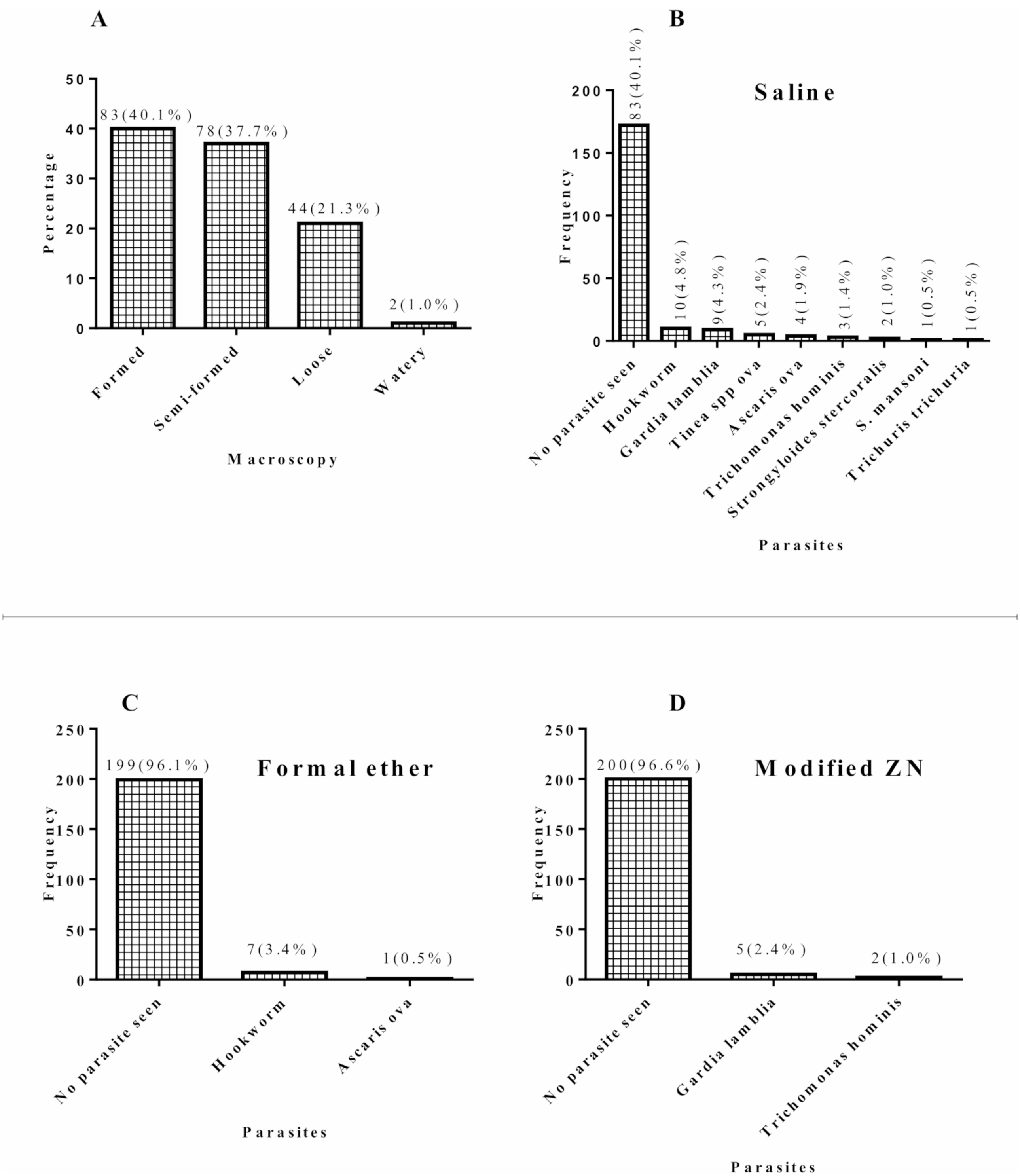

Fig. 3 Prevalence of the parasites using the various laboratory techniques: saline direct wet mount, formol-ether concentration method and modified ZN staining technique

human skin. Working with bare hands and walking barefoot are the major means of transmission of hookworm infection [29].

Paradoxically, our current study reported that pregnant women who wash their hands with soap and water were 5.976 times more likely to be infested with intestinal parasites compared to those who wash their hands with only water. This calls into question the quality of handwashing being practiced by these pregnant women, and the quality of water used for the handwashing. It is therefore

Table 4 Association between socio-demographic and obstetrics characteristics of study participants and parasite infection status

Variables	OR	95%CI	*p*-value
Age category (years)			
< 20	1		
20–29	2.654	0.585–12.032	0.206
30–39	3.833	0.793–18.524	0.095
40–49	11.500	0.505–261.95	0.126
Religion			
Christian	1		
Islam	0.8	0.326–1.961	0.626
Educational Level			
None	1		
Primary	2.500	0.431–14.514	0.307
Secondary	2.570	0.570–11.596	0.220
Tertiary	1.000		
Marital Status			
Single	1		
Married	0.914	0.429–1.946	0.815
Employment Status			
Informal	1		
Unemployed	0.613	0.285–1.318	0.210
Formal	-	-	-
Age of present pregnancy			
1st Trimester	1		
2nd Trimester	2.667	0.309–22.996	0.372
3rd Trimester	4.816	0.614–37.775	0.135
Number of pregnancies			
One	1		
Two	1.696	0.654–4.401	0.277
Three	1.155	0.443–3.012	0.768
Four	0.983	0.335–2.886	0.975
Five	1.583	0.284–8.817	0.600
More than 5	0.475	0.055–4.069	0.497
Ever lost a pregnancy			
No	1		
Yes	2.131	1.041–4.363	**0.038**
Number of pregnancies lost			
Single	1		
Multiple	0.225	0.045–1.114	0.068
Previous stillbirth			
No	1		
Yes	0.715	0.199–2.571	0.608

p-value is significant at < 0.05

very important for health authorities to intensify health education, especially, quality handwashing practices in the study area. The increased odds for parasite infection among pregnant women who washed their hands with soap and water is inconsistent with previous studies [17, 41–43].

A higher proportion of those who had ever loss a pregnancy was infected compared to those who had not experienced pregnancy loss. Contrary to our study, Brummaier, Tun [44] posited that soil transmitted

Table 5: Association of the awareness of parasitosis, socioeconomic and behavioural characteristics with parasite infection status among study participants

Variables	OR	95%CI	*p*-value
Knowledge of IPI			
No	1		
Yes	0.439	0.161–1.195	0.107
Mode of transmission			
No idea	1		
Eating and drinking contaminated food	0.500	0.049–5.083	0.558
Type of toilet facility			
Open defecation	1		
Pit latrine	0.113	0.006–2.052	0.141
Public toilet	0.250	0.014–4.353	0.342
WC	0.315	0.019–5.239	0.421
Share toilet facility			
No	1		
Yes	1.366	0.443–4.211	0.588
Wash hand after defecation			
No	1		
Yes	0.713	0.072–7.045	0.773
Main source of feeding			
Buy outside	1		
Homemade food	0.235	0.014–3.839	0.310
Before eating I wash hands with			
Water only	1		
Soap & water	3.389	0.988–11.631	0.052

p-value is significant at < 0.05. IPI Intestinal Parasitic Infection

Table 6: Association of the awareness of parasitosis, socioeconomic and behavioural characteristics with parasite infection status among study participants continued

Variables	OR	95%CI	*p*-value
Main source of drinking water			
Sachet water	1		
Pipe and sachet water	4.000	0.578–27.705	0.160
Pipe borne water	2.296	0.839–6.284	0.106
When last were you dewormed			
< 3 months	1		
3–6 months	0.742	0.212–2.604	0.641
7–12 months	0.860	0.327–2.259	0.760
> 12 months	0.613	0.263–1.430	0.258
Wash vegetables			
No	1		
Yes	0.235	0.0144–3.839	0.310
How do you wash it			
Water only	1		
Saltwater	1.048	0.511–2.149	0.897
Practice Geophagy			
No	1		
Yes	1.356	0.562–3.270	0.498
Walk barefoot			
No	1		
Yes	0.605	0.302–1.212	0.156

p-value is significant at < 0.05

Table 7 Risk factors of parasitic infection among study participants

Variables	AOR	95%CI	*p*-value
Employment status			
Informal	1		
Unemployed	0.616	0.265–1.430	0.259
Formal	-	-	-
Age of present pregnancy			
1st Trimester	1		
2nd Trimester	3.296	0.336–32.356	0.306
3rd Trimester	5.109	0.599–43.581	0.136
Ever lost a pregnancy			
No	1		
Yes	2.912	1.210–7.011	**0.017**
Knowledge of IPI			
No	1		
Yes	4.043	0.622–26.297	0.144
Type of toilet facility			
Open defecation	1		
Pit latrine	0.271	0.009–8.344	0.455
Public toilet	0.335	0.012–9.327	0.519
WC	0.784	0.029–20.896	0.885
Before eating I wash hands with			
Water only	1		
Soap & water	5.976	1.172–30.467	**0.031**
Main source of drinking water			
Sachet water	1		
Pipe and sachet water	10.044	0.632–159.613	0.102
Pipe borne water	2.1207	0.382–11.785	0.390
Walk barefooted?			
No	1		
Yes	0.611	0.273–1.368	0.231

aOR: adjusted odd ratio. P-value is significant at < 0.05

helminths were not significantly associated with stillbirth, preterm birth or being born too small for gestational age.

With regards to age, the odds for intestinal parasitic infection were approximately two folds higher in pregnant women whose age were between 30 and 34 years compared to others [40]. This agrees with the previous studies where age was independently associated with intestinal parasitic infections among pregnant women [17, 41]. Also, age was not significantly associated with parasitic infection in the current study and this agrees with other studies by Aranzales, Radon [45] and Dankwa, Addy-Lamptey [46].

Parasitic infection could occur at any stage of the three trimesters during pregnancy when the opportunity is created. However, an infection that occurs in the first three months is associated with more severe foetal and placental consequences than those occurring later in pregnancy [17]. There was no significant association between gestational age and intestinal parasitic infection in this study, and this was supported by previous findings by other researchers [17, 24, 30]. Apart from ever losing a pregnancy and the number of pregnancies lost, no other obstetric characteristics were significantly associated with the intestinal parasitic infection. Again, except knowledge on complications of parasitosis and handwashing practices, there was no association between the behavioural and demographic risk factors and the rate of intestinal parasitic infection among pregnant women.

A major strength of this study is its use of multiple diagnostic techniques, including the direct wet mount, formol-ether concentration, and modified Ziehl-Neelsen staining, which enhanced the detection of a wide range of intestinal parasites. Additionally, the study's hospital-based approach allowed for structured data collection and ensured that the participants were properly assessed. However, the study has some limitations. One is the potential selection bias inherent in a hospital-based design, as participants may have better healthcare-seeking behaviours and adherence to healthy practices, leading to a possible underestimation of the true prevalence of intestinal parasite infection compared to a community-based study. The use of a small sample size and convenience sampling method may limit the generalizability of the findings to the broader population of pregnant women in Ghana. Furthermore, self-reported data on behavioural and hygiene practices may be subject to recall bias, potentially affecting the accuracy of associations with parasitic infections. Also, our study only assessed whether participants used soap, not the quality, duration, or technique of handwashing. Lastly, the study did not include molecular diagnostic methods, which could have improved the sensitivity and specificity of parasite detection.

Conclusion

Intestinal parasitic infections were prevalent among pregnant women, with hookworm being the most common parasite. Key risk factors included a history of pregnancy loss and handwashing practices. Unexpectedly, women who washed their hands with soap and water had higher infection rates, suggesting possible concerns with water quality or hygiene practices. Public health interventions, including hygiene education, routine screening, and deworming programs, are essential to mitigate the impact of these infections on maternal and foetal health.

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Author contributions

JGD and FAO conceptualized the study idea. JGD and FAO wrote a proposal for ethical clearance. JGD, FAO, and EA designed the methodology. JGD and FAO administered the project. JGD, FAO, GEK, FSE, IB, ATL and EA provided resources. FAO carried out the investigation. JGD, and EA supervised the study.

FAO curated data. GEK, KA and IB did the former analysis. FAO, GEK, FSE, KA, ATL and IB wrote the original draft. JGD and EA writing review and editing. All authors read and approved the final version of the manuscript.

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Data availability
The data used for the study will be made available upon satisfactory request.

Declarations

Ethical approval and consent to participate
All procedures were performed in compliance with Helsinki declaration, and according to the relevant laws and institutional guidelines as approved by the University of Health and Allied Sciences (UHAS) Research Ethics Committee (REC) with Protocol identification number UHAS-REC A.10 [3]20–21. Approval of the study was sought from the authorities of Pentecost Hospital, Ayanfuri before the commencement of the study. Written informed consent was obtained from all participants before they were enrolled in the study, and their privacy was ensured. Parental consent was obtained for pregnant women who were minors. Questionnaires designed for the study did not make use of names but rather serial numbers, and were also administered to the study participants individually. All study documents were secured and only the researchers and supervisors had access to the study data. Questionnaires were kept under lock and key accessible to only the researchers.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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