






Magnitude of Intestinal Parasite Infection and Associated Factors Among Pregnant Women Attending Antenatal Care Service in Shewarobit Town Health Facilities, North Shoa Zone, Amhara Region, Ethiopia

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Introduction: Intestinal parasites are the most common infectious gastrointestinal parasites in developing countries including Ethiopia. Globally, it remains a public health problem by affecting 3.2 billion people, of which 10% were pregnant women. In Sub-Saharan Africa, pregnant women are the risky group next to children for this infection. This study aimed to assess the magnitude and associated factors of intestinal parasite infection among pregnant women.

Methods: Facility-based cross-sectional study was conducted among 365 pregnant women attending antenatal care service in Shewarobit town health facilities, North Shoa Zone, Amhara Region, Ethiopia. Data were collected using an interview questionnaire and laboratory microscopic stool examination from February 1, 2020, to March 30, 2020. Descriptive statistics and multivariable analyses were used to characterize the data and to identify the associated factors with the outcome variable at a p-value <0.05, respectively.

Results: A total of 347 (95.1%) pregnant women participated in this study. The magnitude of intestinal parasite infection was 27.7% during the study period. Among the parasites, *G. lamblia* and *S. mansoni* were the most prevalent identified parasites. Pregnant mother, who did not have handwashing practice after using the toilet [AOR: 3.89, 95% CI (1.86–8.13)], had a habit of walking on barefoot [AOR: 5.65, 95% CI (1.72, 18.56)], had uncooked food meal habit [AOR: 5.12, 95% CI (1.24, 21.14)], use of water in unimproved water source [AOR: 3.20, 95% CI (1.11–9.24)], lack of health education [AOR: 4.08, 95% CI (2.01–8.27)], and not dewormed [AOR: 3.09, 95% CI (2.01–7.94)] were predictors for parasitic infection.

Conclusion: High prevalence of intestinal parasite infection is observed in pregnant women. Personal hygiene practice, health education, and water quality were factors identified as contributors to intestinal parasite infection in pregnant women. Public health measures on water and environmental sanitation, health education for intestinal parasite infection and personal hygiene practices, and early deworming are vital to reduce the intestinal parasites' infection and assure safe pregnancy.

Keywords: pregnant women, intestinal parasitic infection, health facilities

Introduction

Intestinal Parasitic Infection (IPI) is a condition in which a parasite infects the gastrointestinal tract of humans.¹ It is the most abundant and common infectious microorganism in developing countries. Globally, it remains a public health

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problem by affecting 3.2 billion people, of which 10% were pregnant women. In Sub-Saharan Africa, pregnant women are the most at-risk group next to children for this infection.²

Even though the infection occurred worldwide, it created a considerable public health burden among populations in low-income countries with poor hygiene and sanitation practices.^{3,4} Most IPI occur due to situations of poverty, poor sanitation, and poor hygiene practice in the tropical and subtropical region's communities of sub-Saharan countries.³ In Africa, intestinal parasites have a high load and distribution in different regions of the continent and more affecting especially children and pregnant.⁵

Pregnancy affects the mother's body physically, physiologically, and immunologically.⁶ This burden is aggravated when combined with parasite infection. IPI in pregnancy is associated with serious adverse outcomes for the mother and the unborn baby.⁷ Untreated mothers with drugs for intestinal parasites have a negative health impact, including anemia, electrolyte imbalance, malabsorption, premature delivery, low birth weight of the infant, and impaired lactation.⁶⁻⁸

About 114 studies comprising 98,342 pregnant women from across 35 countries globally indicate prevalent intestinal parasites of helminth infection include *Hookworm* (19%), *A. lumbricoides* (17%), and *T. trichiura* (11%); and of protozoan infections including *Blastocystis* sp. (21%), *E. histolytica/dispar* (9%), and *G. lamblia* (8%).⁹

Sanitation practices, availability of latrine, lack of proper use of latrines, handwashing practices, water quality, barefooted, receiving deworming, use of untreated water, eating raw vegetables, and health education are reported as associated factors in a different study.¹⁰⁻¹⁴

Intestinal helminthic (like *Hookworm*) infection causes severe anemia in up to one-third of pregnant women in sub-Saharan Africa, resulting in an increased likelihood of premature births, babies with low birth weight, and impaired lactation.^{15,16} Additionally, protozoan (like *E. histolytica* and *G. lamblia*) infection causes bloody stool and diarrhea, which causes secondary effects of fluid loss, malabsorption, and electrolyte imbalance, which may adversely affect the nutrition status of women and the outcome of pregnancy including asphyxia, underweight neonate.^{7,17}

Ethiopia is one of the countries where intestinal parasites are endemic. The number of people living in soil-transmitted diseases endemic areas is estimated at

81 million and living in schistosomiasis-endemic areas is estimated at 38.3 million.¹⁸ Different intervention activities have been implemented to prevent IPI in the country despite its women are the most affected group by IPI among neglected tropical diseases.^{18,19} Standard guidelines for antenatal care in Ethiopia emphasize that every pregnant mother should receive services including health education, physical examination, blood tests for infection screening, urine test, tetanus toxoid injections, iron folate supplements, and deworming medications.¹⁹ National Neglected Tropical Diseases master plan emphasized on children and adults as whole communities, but the 2016 Ethiopian Health and Demographic Survey report indicated only 5.7% of women dewormed during the pregnancy period.¹⁸⁻²⁰

In the country, there is a paucity of information about intestinal parasite infection among pregnant women.¹⁹ The study aimed to determine the magnitude and associated factors of intestinal parasites among pregnant women attending antenatal care services.

Methods and Materials

Study Setting and Design

An institution-based cross-sectional study was conducted among three health facilities, namely, Shewarobit health center, Shewarobit district hospital, and Yifat hospital from February 1, 2020, to March 30, 2020. The facilities are providing an antenatal care service, and the town of Shewarobit is located 225 km from the nation's capital city, Addis Ababa, with an elevation of 1280 m above sea level. The town is in Shewarobit district. The district is one of the 24 districts in the North Shoa zone, Amhara region, Ethiopia.

Selected pregnant women attending an antenatal care service during the study period were included and pregnant women who had taken anti-helminthic and/or anti-protozoan drugs in the last 1 month were excluded from the study.

Sample Size Determination and Sampling Procedure

The sample size was determined using a single population formula with an assumption of 95% confidence level, 5% marginal error, and 31.5% proportion of intestinal parasites in pregnant women.¹³ After adding 10% for the nonresponse rate, the final sample size was 365. The sample size was allocated proportionally to health facilities based on the previous 2 months' data of mothers enrolled in an antenatal care service. A total of 750

pregnant women were attending the service. The study participants were selected through systematic sampling techniques with an interval of 2. At each health facility, the first participant was selected by a lottery method. The remaining participants were enrolled in every second sample interval.

Data Collection Tools and Laboratory Diagnosis

Data were collected using an interviewer-administered questionnaire and laboratory stool examination. The questionnaire was adapted from CDC Water Safety Survey, UNICEF Water and Sanitation survey, 20,210, and the previously performed study questionnaires.^{21–23} It consists of socio-demographic characteristics, hygiene practices (availability of toilet, toilet utilization, anal cleaning materials, hand washing, cutting fingernails, eating uncooked food, water source, barefooted, disposing waste), and health service (health education and deworming status). The questionnaire was reviewed for coherence, and pretest was conducted in a similar population and study setup just to check the reliability and validity of the questionnaire using Cronbach's alpha.

Intestinal parasite infection status of the participants was examined using laboratory stool wet mount microscopic examination, and formalin-ether concentration techniques.¹ A labeled, leakproof, and screw-capped container with a clean applicator stick was given to each participant. All study participants were asked to provide a sufficiently large stool sample,²⁴ after instruction was informed. The specimen was checked based on the acceptance criteria.

Laboratory sample processing was performed by laboratory technicians and technologists. The direct wet smear was prepared through mixing matchstick head amount of fresh, unpreserved stool with a few drops of 0.85% saline and added similar amount iodine to the edge of the coverslip for color contrast to identify the protozoan cysts/oocysts. The direct smear was examined by 10x and 40x microscopic magnifications with standard procedures for the identification of helminths and protozoans. Some part of the specimen was preserved by 10% formalin for the concentration process by formol ether concentration technique to detect missed parasites, which were processed within the same day of sample collection and direct wet mount processing. Using a stick, emulsify an estimated 1 g (pea-size) of feces in about 4 mL of 10% formol water contained in a screw-cap tube, add a further 3–4 mL of

10% formol water, cap the bottle, and then mix well by shaking. Sieve emulsified feces, collected the sieved suspension in a beaker. Then, transfer the suspension to a centrifuge tube and add 3–4 mL of diethyl ether. The test tubes were mixed well and centrifuged at 1000 revolutions for 3 min. Fecal debris, ether, and formol water were removed. Finally, the sediment was mixed well and transferred to a slide covered with a covered glass, and detected under a microscope. One public health profession supervisor, three medical laboratory profession, and five mid-wifery participated in the data collection.

Data Quality Assurance

Before actual data collection, the data collectors and supervisors were trained about study objectives, tools, approaches, and ethical issues. Structured questionnaire was adopted from different published literatures. The questionnaire was translated from English to Amharic (local language), and reverse translation to the English language was done by language experts to check the consistency. Furthermore, the translated questionnaire and the original English questionnaire were compared and analyzed to identify discrepancies in words, meanings, and contents of the items. A pretest study was conducted at another district health facility on 5% of the total sample size before the actual data collection. Based on the results of the pretest, essential modifications to the tool and approach were done.

The supervisor collected the filled questionnaires after checking for consistency and completeness. Stool specimen was collected with appropriate instructions and properly labeled, and laboratory investigation was performed based on standard operating procedures (SOP). Before the examination of the sample, internal quality control was performed to assure the materials and reagents. Completeness and correctness of the data were checked before data entry. Data cleaning was managed through sort, frequency, and lists.

Data Processing and Analyzing

Data were entered by using Epidata software version 3.1.1 and then exported to the Statistical Package for Social Sciences (SPSS) software version 23.0 for cleaning and analysis. Descriptive statistics were used to summarize the data. Logistic regression analysis was used to see an association between intestinal parasite infection and factors. Hosmer-Lemeshow test was performed (Chi-square=7.36, Df=8, Sig=0.50) to check the model fitness and collinearity statistics were checked (Tolerance > 0.3, Variance inflation factor <3) to see

the presence of multicollinearity. Bivariate analysis was performed to see the candidate variables for multivariable logistic regression, and variables with a p-value less than 0.05 were analyzed by using multivariate analysis to control confounders. Adjusted odds ratios with 95% confidence intervals were calculated and a P-value less than 0.05 was considered to be statistically significant.

Operational Definition

Accessible distance from water source: water source within 1 km distance from home.²⁵

Barefooted: A habit of walking on without shoe-wearing.

Deworming status: Took deworming from the last 1 month to the last 1 month.

Hand washing: the practice of washing hands after toilet or before the meal by water with soap/ash.

Health educated: pregnant women who have got health education by the health profession related to the intestinal parasite infection.

Intestinal parasitic infection: include protozoan and helminth infections which hatched in the intestine and are found on stool examination.

Unimproved water sources: water source which includes unprotected dug wells, unprotected springs, and surface water (rivers, dams, lakes, ponds, streams, canals, irrigation channels).²⁵

Result

Socio-Demographic Characteristics

From the 365 pregnant women recruited for the study, 347 (95%) pregnant women participated in the study. The mean age of the participants was 25.70 (with a standard deviation of 4.98) years old and the majority (90.2%) of the respondents were married. About one-third (33.1%) of participants' residential areas were rural and 149 (42.9%) participants' educational status was a primary school (Table 1).

Hygiene Practice and Health Service

Among the participants, almost all (92.8%) had a toilet, 309 (89%) were using the toilet for defecation, and 293 (84.4%) practiced hand washing after the toilet. Few participants, 71 (20.5%), were dewormed in the last month (Table 2).

Magnitude of Intestinal Parasite Infection

From a total respondent, 96 (27.7%) participants were infected by any intestinal parasites. Out of 96 positive

Table 1 Socio-Demographic Characteristics of Pregnant Women in Shewarobit Health Facilities, North Shoa, Amhara Region, Ethiopia, 2020 (N = 347)

Variables	Category	Frequency	Percent
Age	15–24	155	44.7
	25–34	168	48.4
	35–44	24	6.9
Marital Status	Single	21	6.1
	Married	302	87.0
	Others **	24	6.9
Religion	Muslim	116	33.4
	Orthodox	213	61.4
	Others*	18	5.2
Residence	Urban	232	66.9
	Rural	115	33.1
Education level of participant	Illiterate	51	14.7
	Read and write	34	9.8
	Primary school	149	42.9
	Secondary School	62	17.9
	Higher education	51	14.7
Occupation of participant	Gov'tal employee	64	18.4
	Private worker	105	30.3
	Farmer	74	21.3
	Daily labor	12	3.5
	House wife	92	26.5

Notes: *Protestant or Catholic; **divorced or widowed.

results, 56 (58.3%) were protozoans' infections, whereas 40 (41.7%) were helminth infections, and 23 participants had been double infected. Of intestinal parasites, *G. lamblia* accounted the highest infection 43 (36.1%) and followed by *S. mansoni* that covered 27.7% of the total infections (Figure 1).

Associated Factors of Intestinal Parasite Infection

Each variable was analyzed using bivariate logistic regression. Age, marital status, distance from water source, and disposing of solid waste were variables excluded from the multivariable logistic regression due to a $P \geq 0.05$ in bivariate logistic regression, not model fitting and collinearity. Other variables with a P-value < 0.05 were a candidate for the multivariable logistic regression. Hygiene practices, eating uncooked food and health service status were

Table 2 Hygiene, Environmental, and Health-Related Determinants of Intestinal Parasites Among Pregnant Women in Shewarobit Health Facilities, North Shoa, Amhara Region, Ethiopia, 2020 (N = 347)

Variable	Category	Frequency	(%)
Do you use toilet for defecation	Yes	309	89
	No	38	11
Do you use toilet leftover water for other purpose (N=258) *	Yes	46	17.8
	No	212	82.2
How often do wash your hand with soap/ash before meal?	Yes always	293	84.4
	Yes sometimes	54	15.6
How often do wash your hand with soap/ash after toilet?	Yes always	254	73.2
	Yes sometimes	93	26.8
How often do cut your fingernail regularly?	Yes always	184	53
	Yes sometimes	163	47
Do you eat uncooked meal frequently?	Yes	155	44.7
	No	192	55.3
Do you walk with barefoot frequently?	Yes	27	7.8
	No	320	92.2
Is toilet present in your home?	Yes	322	92.8
	No	25	7.2
What type water source do you use for home?	Improved	314	90.5
	Unimproved	33	9.5
How long is the distance of water source from you home?	=<1000m	81	71.7
	>1000m	32	28.3
What method do you use for disposing solid waste?	Burn	118	34
	Dump	116	33.4
	Compost	28	8.1
	Dustbin	85	24.5
What method do you use for disposing liquid waste?	Spill to drainage	159	45.8
	Open field	144	41.5
	Spill to river	44	12.7
Did you get health education about intestinal parasites?	Yes	158	45.5
	No	189	54.5
Did you screen for intestinal parasites at your 1st ANC visit?	Yes	49	14.1
	No	298	85.9
Did you take deworming drug in the last month?	Yes	71	20.5
	No	276	79.5

Note: *Use of water left over from toilet for hand washing, leg washing, and other cleaning purpose.

significantly associated with intestinal parasite infection in the multivariable logistic regression (Table 3).

Discussion

This study focused on the magnitude of intestinal parasite infection and its possible associated factors among pregnant women in Shewarobit town Health facilities, North

Shoa, Amhara Region, Ethiopia. A total of 96 (27.7%) [95% CI (23.1, 32.6)] pregnant women had at least one type of intestinal parasite infection. Selected hygiene practice and health service delivery status were factors associated with intestinal parasite infection.

The magnitude of intestinal parasite infection in this study was in line with the studies conducted in Bahir

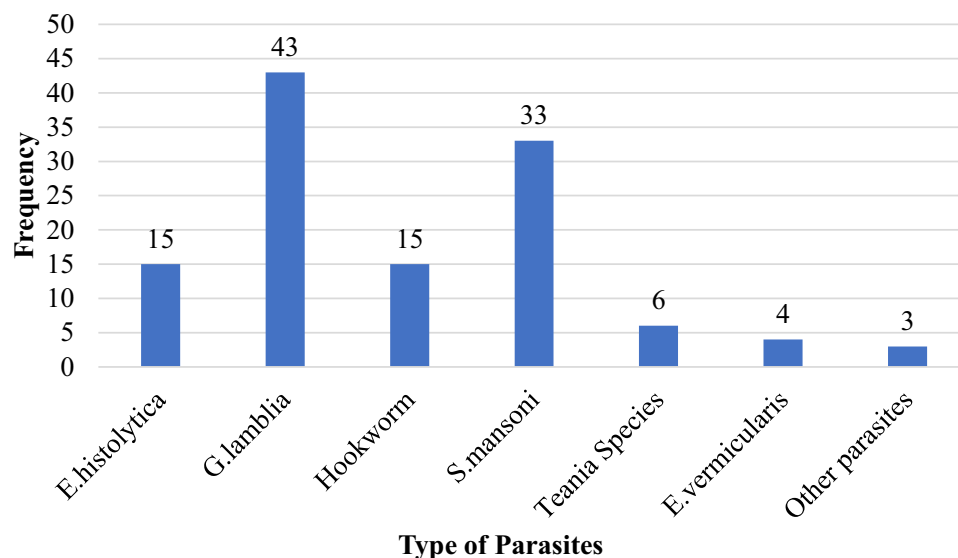


Figure 1 Frequency and type of intestinal parasites infection among pregnant women in Shewarobit health facilities, North Shoa, Amhara region, Ethiopia, 2020.

Dar, Ethiopia (31.7%), iratnagar, Nepal (29%).^{13,26} However, our finding was observed to be lower than studies in Northwest Ethiopia, 37.3%, in western Ethiopia, 43.8%, Bogota, Colombia (41%), and Venezuela (73.9%); and higher than other studies reported in Northwest Ethiopia (14.3%), North Ethiopia (17.7%), and Ghana (14.3%).^{1,11,27–30} This difference might be due to study area physical environment variation and study populations' socioeconomic status.⁴ Humidity and temperature status of any geographic location affect the viability of most parasites, ova, and cysts.³² Also, among a population with low socioeconomic status, high parasitic infection prevalence is known.^{3,4} Furthermore, the stool examination methods and the time of study might be contributed to the variation.

Out of all positive for IPI in this study, 56 (16.1%) were protozoans and 40 (11.6%) were helminths. *G. lamblia* was the leading parasite observed. This finding is in line with a study at Felege Hiwot Hospital, Amhara region, Ethiopia.¹³ However, this finding is in contrast with other studies in which *Hookworm* in western Ethiopia, Northwest Ethiopia, and Nepal; *E. histolytica* in Ghana and *A. lumbricoides* in Venezuela were reported as the predominant parasites.^{1,11,26,28,31} This disparity might be due to the warm climate of the current study area in the study period (24–29 C°) making a suitable setting for the survival of *G. lamblia* cysts in contaminated water, participants shoe-wearing habits, and socio-cultural differences between study participants.^{1,11,32–35}

Some parasites have adverse consequences for pregnant women (causing anemia, weight loss, malabsorption) and pregnancy outcome (underweight of neonate, preterm delivery asphyxia). From these parasites, *Hookworm* is one and investigated in this study that accounted for 27.7% of the total infection. Of the total participants, 4.3% were infected by this parasite, which is comparable with the finding in Nepal that showed 7.9% infection of *Hookworm*.³⁶ The other parasite that harms pregnant women is *S. mansoni* which showed 9.5% infection from total participants. This finding is similar to the review finding that *S. mansoni* had 8.7% prevalence.³⁷

Some factors like hand hygiene, eating uncooked food, water source type, bared foot, health education, and deworming were significantly associated with the risk of IPI in the multivariable logistic regression.

Pregnant mothers, who did not have washing practice after using the toilet more than three times [AOR: 3.89, 95% CI (1.86–8.13)] were more likely to have IPI than respondents who had washing practice with soap and water. This finding is consistent with similar studies conducted in western and Northwest Ethiopia.^{1,11,13} The reason might be due to Ethiopian communities' handwashing practice with soap and water being much lower (urban households, 28%, and rural households, 7%) and such situation might increase due to ingesting of the infectious agent in food. Proper handwashing practice is a prevention mechanism to break the chain of intestinal parasite transmission.^{19,38}

A habit of walking barefoot increases the odds of IPI among pregnant women by 5.65 folds [AOR: 5.65, 95%

Table 3 Multiple Logistic Regression for Selected Factors of Intestinal Parasite Infection Among Pregnant Women at Shewarobit Health Facilities, North Shoa, Amhara Region, Ethiopia, 2020 (N = 347)

Variable Category	Intestinal Parasite		COR (95% CI)	AOR (95% CI) ^a
	Yes (%)	No (%)		
What type of water source do you for home?				
Improved	73(23.2)	241(76.8)	1	1
Unimproved	23(69.7)	10(30.3)	7.59(3.46, 16.68)	5.12 (1.24, 21.14) *
What method do you use for disposing solid waste?				
Burn	15(12.7)	103(87.3)	1	1
Open dump	54(46.6)	62(53.4)	5.98(3.11, 11.49)	5.13(1.38, 19.10) *
Compost	10(35.7)	18(64.3)	3.82(1.48, 9.80)	1.24(0.22, 7.08)
Dump in yard	17(20)	68(80)	1.72(0.80, 3.67)	1.40(0.43, 4.61)
Do you use toilet leftover water for other purpose (hand and leg washing? (N=258)				
Yes	21(45.7)	25(54.3)	4.56(2.29, 9.07)	3.69(1.18, 11.59) *
No	33(15.6)	179(84.4)	1	1
How often do wash your hand with soap/ash before meal?				
Yes always	71(24.2)	222(75.8)	1	1
Yes sometimes	25(46.3)	29(53.7)	2.70(1.48, 4.90)	1.09(0.33, 3.64)
How often do wash your hand with soap/ash after toilet?				
Yes always	48(18.9)	206(81.1)	1	1
Yes sometimes	48(51.6)	45(48.4)	4.58(2.74, 7.65)	3.90(1.38, 10.89) *
How often do cut your fingernail regularly?				
Yes always	38(20.7)	146(79.3)	1	1
Yes sometimes	58(35.6)	105(64.4)	2.12(1.31, 3.43)	0.51(0.19, 1.32)
Do you eat uncooked meal frequently?				
Yes	66(41.5)	93(58.5)	2.575(1.588, 4.175)	5.78(2.18, 15.03) **
No	30(16)	158(84)	1	1
Do you walk with barefoot frequently?				
Yes	20(74.1)	7(25.9)	9.17(3.74, 22.53)	2.23(0.39, 12.88)
No	76(23.8)	244(76.3)	1	1
Did you get health education about Intestinal parasites infection?				
Yes	24(15.2)	134(84.8)	1	1
No	72(38.1)	117(61.9)	3.44(2.03, 5.80)	6.12(2.34, 12.20) **
Did you take deworming drug in the last month?				
Yes	11(12.7)	60(87.3)	1	1
No	85(31)	191(69)	2.43(1.23, 0.85)	4.82(1.22, 23.00) *

Notes: **Significantly associated p-value<0.001 on multiple logistic regression. ^aAdjusted odds ratio. *Significantly associated p-value<0.05 on multiple logistic regression.

Abbreviations: COR, crude odds ratio; CI, confidence interval.

CI (1.72, 18.56)]. This result was in accordance with previous studies conducted in Ethiopia.^{11,39} This may be due to shoe-wearing preventing the infection intensity for parasites transmitted directly through the feet.⁴⁰ Participants who had uncooked food meal habits were more than two times odd for IPI [AOR: 5.12, 95% CI (1.24, 21.14)] than those who had the opposite character. A similar previous finding was reported in Ethiopia.^{11,39} These findings were justified by the fact of raw food like fruit and vegetables are highly contaminated from the source or in the path of transportation and that food acts as a vehicle for transporting intestinal parasites.^{41–44} Use of water from an improved water source increased the odds of IPI in pregnant women by 3.20 folds [AOR: 3.20, 95% CI (1.11–9.24)]. Which agreed with study report from other areas in Ethiopia.^{11,39} Improved water sources have a chance of contamination with intestinal parasites, ova, and cysts; and the individuals who used water from such sources might have a chance of acquiring IPI compared with the individuals who use water to improve the source.^{14,33,45,46}

In this study, IPI was 4.08 folds higher among pregnant people in the lack of health education [AOR: 4.08, 95% CI (2.01–8.27)]. This finding was in line with previous studies conducted in Ethiopia.^{11,39} This might be due to the health-seeking behavior of educated pregnant women.^{38,47} Pregnant women who did not deworm had more than three times the probability to have intestinal parasites [AOR: 3.09, 95% CI (2.01–7.94)] when compared with those who did deworm. This was comparable to studies done in Ethiopia and Colombia.^{12,27} Parasite might be riding out from their body after being dewormed, and pregnant women health-seeking behavior could be due to preventive chemotherapy.^{47–50}

This study had its strengths and limitations. The study focused on increasing the quality from data collection to analysis. However, due to financial constraints, the current study was institutional-based, restricted to cross-sectional study design, and laboratory diagnosis using less sensitivity than polymerase chain reaction (PCR) in the identification and confirmation of numerous parasites.

In conclusion, high prevalence of intestinal parasite infection is observed in pregnant women. Personal hygiene practices, uncooked food, health education, and water quality were factors identified as contributors to intestinal parasite infection in pregnant women. Public health measures on water quality, environmental sanitation, health education on intestinal parasite infection, uncooked meat and personal

hygiene practices, and periodic chemotherapy are vital to reduce intestinal parasite and ensure safe pregnancy. Stool examination should be also performed for early detection and treating of infected pregnant women.

Abbreviation

AOR, Adjusted Odds Ratio; CI, Confidence Interval; IBR, Institutional Review Board; IPI, Intestinal Parasitic Infection; SOP, Standard Operating Procedure; SPSS, Statistical Package for Social Science.

Data Sharing Statement

The data sets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Approval and Consent to Participate

We declare that the research is governed by the Declaration of Helsinki. The study was conducted after ethical clearance was obtained from the Institutional Review Board (IRB) of the College of Health Sciences, Debre Berhan University, and the health facilities allowed to conduct the study. As verbal consent is allowed for the diagnosis, and this study was on the diagnosis process and no risk to pregnant women (participants), the IRB of the college approved the verbal consent on the IRB'28 decision as Informed Consent Version No: 16/2020 with the protocol No of 16/02/SPH. Before enrolling each participant in this study, the detailed purpose of the study was explained for each participant. They were also informed that free treatment service (if their sample becomes positive for intestinal parasites) is their benefit from this study, and as they had the full right to refuse at any time of the study. The principal investigator's address was given for each participant to contact for any questions and ambiguity. Withdrawal from the study was clarified that it did not affect their health-care services. Finally, verbal consent was obtained from each study participant. Participants who had positive lab results were linked to a health-care provider for treatment, and they had been treated based on the guideline.

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Author Contributions

All authors contributed to the data analysis, revising the article, have agreed to the journal in which the article will be submitted, gave final approval for the version to be published, and agreed to be accountable for all aspects of the work.

Disclosure

The authors declare that they have no conflicts of interest.

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