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Research Article

Intestinal Parasitic Infections in Pregnant Women: A Public Health Concern

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Abstract: Background: Intestinal parasitic infections affect pregnant women all over the world. The infection has been linked to the development of life-threatening conditions in both pregnant women and their developing fetus.

Objective: This study was conducted to determine the prevalence, intensity of infection and associated risk factor among pregnant women of five different wards of Hetauda sub-metropolitan city, Makawanpur, Bagmati province, Nepal.

Materials and Methods: A cross- sectional study was carried out among (100) conveniently sampled pregnant women receiving antenatal care services at Rural Urban health care center of Two, four, five, ten and 11 numbers wards of Hetauda in between July to December of 2023 after obtaining approval from the Ethical committee of the Institute of Science and Technology, Tribhuvan University, Nepal (IRB approval no. 23-0067). Structured questionnaires were administered to study participants to assess socio-demographic and other possible factors. Stool samples were collected from each pregnant woman and examined for the presence of intestinal parasites by microscopy using direct wet mount, flotation as well as formal-ether sedimentation techniques.

Result: The study revealed that of the 100 samples examined, 19 samples (19%) were found to be positive for gastrointestinal parasites. Parasites covering five genera. *Ascaris lumbricoides* (8%) was most predominant followed by *Entamoeba histolytica* (4%), *Strongyloides stercoralis* (3%), *Trichuris trichiura* (2%) and *Hymenolepis nana* (2%). Parasites are more observed amongst poorer population, independent of their age. Chi-square test conclude that there is association between parasites and financial situation (P= 0.0084).

Conclusion: Screening of the women for intestinal parasites and provision of health education during their ANC (Antenatal care) visit to prevent the adverse effects on maternal and fetal health from these infections.

Keywords: Prevalence, Gastrointestinal parasites, Pregnant women, Risk factors, Maternal mortality rate, Miscarriage, Low-weight births.

INTRODUCTION

Protozoa and geo-helminth-induced intestinal parasitic infections (IPIs) are widespread concerns, particularly in developing nations, particularly due to inadequate sanitation, as it spreads through contaminated food, water or objects. The top ten intestinal parasitic infections worldwide include trichuriasis, hookworm infection, amoebiasis, and ascariasis. It has the potential to spread from person to person. IPIs are linkage with socio-economic and environmental factors. Excessive population, little source of pure drinking water, and poor personal hygiene make IPIs prevalent. Intestinal parasitosis could be associated with conditions for the onset of anemia in prenatal stage that leads to detrimental fetal and maternal outcomes. Parasitic infection can happen at any time during the three trimesters, but the impacts on the fetus and placenta are greater when it happens in the first trimester. Additionally, among women who are expecting for the first time, the infection worsens [1-4].

During pregnancy, the Helminths parasite usually causes mild symptoms, and iron deficiency anemia, however, a protozoan infection can cause symptoms that might be dangerous like as watery diarrhea, abdominal pain, and nausea in gestation women. Lack of iron, protein, and zinc because of hookworm infection which leads to low pregnancy weight gain and low birth weight (LBW). Although it has long been known that hookworm infection is one of the main causes of anemia in underprivileged areas, knowledge of the advantages of managing the infection during prenatal stage has straggled for other primary causes of maternal anemia [5]. In contrast to hookworm infection, which is linked to delayed first pregnancies and longer inter-birth intervals, roundworm infection is associated with earlier first births and shorter inter-birth intervals [6]. A mild case of anemia is frequently the result of acute Schistosoma infection. Infertility and ectopic pregnancies are linked to tubal granulomas, which affect tubal motility and patency. Infection by schistosomes of the placenta and fetus can result in intra-uterine growth restriction IUGR, LBW, preterm labor, and stillbirth [7]. Many mothers in developing nations experience pre and postpartum malnutrition due to iron deficiency. Lack of access to iron-rich and iron-absorbable foods, especially during reproductive years or pregnancy, is a major factor contributing to iron deficiency anemia in women over the age of 35 [8]. As a result, the WHO and UNICEF advises all pregnant women in Asia to take iron supplements to negate anemia.

Infants are at risk of transmission during breastfeeding from HIV infected mothers, when the mothers have asymptomatic *Entamoeba histolytica* infections [9]. *Giardia* infection during pregnancy has negative effects on the unborn baby due to the

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associated diarrhea, fluid and electrolyte loss, and malabsorption. *Toxoplasma gondii* poses a high risk of complications because it can infect embryonic tissues and pass through the placental barrier. While infections in the third trimester are associated with late congenital problems and developmental delay, infections in the first and second trimesters are linked to less severe difficulties such hydrocephalus, low birth weight, and abnormalities of the central nervous system (CNS). It is listed as a possible miscarriage risk factor [10]. The transmission of protozoal infestations from mother to fetus can occur vertically [11]. Downgrading of mother's nutritional status and possibilities of it in the unborn child's health are among the global effects of these parasites during pregnancy. The severity of the effects, however, varies depending on several variables, including the parasite load and species, the pregnant woman's immune system, and the presence of co-occurring diseases.

Every pregnancy carries its risk. Risk during pregnancy arises due to factors like age, weight, and overall health status of a pregnant lady. Advanced maternal age, lifestyle choices, maternal health problems, pregnancy complications, multiple pregnancies, pregnancy history, anemia, and malnutrition are the specific risk factors that contribute to high-risk pregnancy. Women's health must be prioritized in every community because a healthy mother gives birth to a healthy child. Due to various factors, including differences in socioeconomic conditions, lifestyles, and health-seeking behaviors across cultures, women's communities are more susceptible to various diseases than men's communities. This is a huge hurdle in poorer countries like Nepal. There are 380 new pregnancies worldwide every 60 seconds, 110 complicated pregnancies, 40 of which result in abortions, and a pregnant woman dies [12]. The majority of these deaths are caused by preventable causes, with developed countries accounting for the remaining 1% of deaths. Of these, 99% occur in developing countries. In a similar vein, every year more than 14 million teenagers worldwide become mothers. Of course, there are such births in every society, but 12.8 million, or more than 90%, of adolescent mothers, live in developing nations. The objective of this study is to figure out the rate of helminths and protozoans present in pregnant women and the risk factors associated with pregnancy to overcome maternal mortality rate, miscarriage, low-weight births, and so on with proper use of medication knowing their embryo-feto-toxic effects on pregnant women and developing fetus [13].

MATERIALS AND METHODS

Study Area and Design

Located in the Makawanpur District of the Bagmati Province in central Nepal, Hetauda is a sub-metropolitan city, cross sectional study was done in between July to December of 2023 among the pregnant women. Ethical approval for this study was granted by the Ethical Committee of the Institute of Science and Technology (IOST) at Tribhuvan University (IRB approval no. 23-0067). It serves as both the provincial capital of Bagmati Province and the administrative center of Makawanpur District [14]. It is among Nepal's biggest cities. It is located 300-390 meters above sea level and is located in the latitude of 27°25' N and the longitude of 85°02' E. With a population of 2,466,138, the city has a total area of 261 km^2 [14]. The analysis was undertaken out in the Rural-Urban Healthcare centers of different wards of the Hetauda sub-metropolitan city. Ward numbers two, four, five, ten, and 11 of Hetauda were randomly selected for this study (Fig. **1**)

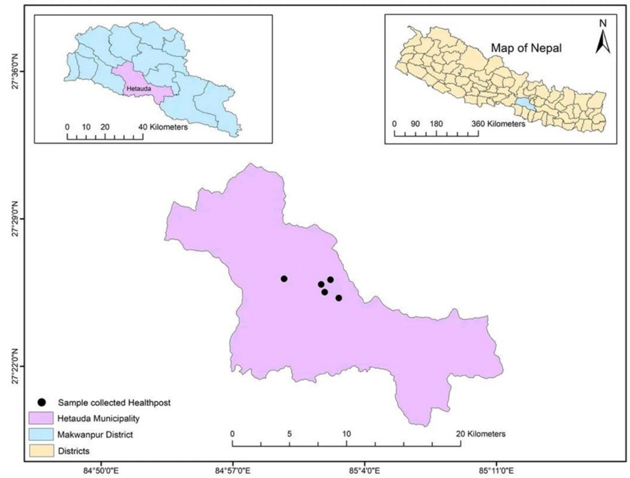

Fig. (1). Map of Hetauda Sub Metropolitan City Showing the Origin of Sample.

Sample Size

The estimated minimum sample size for pregnant women based on the following formula:

$$n = \frac{Z^2 \ p \ (1-p)}{E^2}$$

- n = Required sample size
- Z = Z-score (based on desired confidence level, 1.96 for 95%)
- p = Estimated proportion (use 0.5 if unknown for maximum variability)
- E = Margin of error (for 10%)

Sample Collection

To guarantee the quality of the sample, instruction on appropriate stool collecting techniques was provided. The samples were collected in the morning, avoiding contamination. Bamboo sticks for collecting excrement and collecting vials were given to them. The protozoan and helminth parasites were preserved in their size and shape and were stopped from developing further by immediately covering the stool in the vials with 2.5% potassium dichromate solution. After being coded for identification, the samples were sent to the Central Department of Zoology's Parasitology Laboratory for additional examination. Samples were kept at 4°C in a refrigerator.

Microscopic Examination

This procedure involved assessing the stool for its texture, color, and the detection of any adult nematodes, trematodes, or cestodes. It includes:

Unstained Preparation of Stool Smear

A small amount of stool was collected using a small stick and mixed with normal saline (0.5). A drop of this mixture was then placed on a clean glass slide, and a coverslip was gently applied to spread the emulsion into a thin, even, and transparent layer. Any excess fluid was then absorbed with cotton [15].

Stained Preparation of Stool Smear

To identify and examine the nuclear characteristics of protozoan cysts or dead trophozoites, a stained preparation was necessary. Iodine-stained preparation was used for it, with the iodine solution diluted at a ratio of 1:5 [15].

Differential Floatation Technique

14 ml centrifuge tubes that were firmly mounted in a test tube stand were filled with about 3–4 grams of fecal sample that had been preserved in 2.5% $K_2Cr_2O_7$ solution. The sample was then pulverized in a mortar using a few milliliters of 0.9% NaCl and filtered through a tea strainer. To make each tube hold a final capacity of 14 milliliters, more 0.9% NaCl was added. After centrifuging the mixture at room temperature for five minutes at 1200 rpm, the supernatant was disposed of right away. To restore the tube's volume to 14 milliliters, concentrated NaCl solution was then added, and the centrifugation procedure was carried out once more. In order to create a convex meniscus at the top, concentrated NaCl was added to the tube while it was still on the test tube stand following centrifugation. To stop air bubbles from forming, a coverslip was placed over the tube and left undisturbed for a duration of 15 to 20 minutes. Following this time, the coverslip was taken off and put on a glass slide, which was then inspected under a microscope at magnifications of 10X and 40X. Any parasites that were noticed were photographed, and their morphology was used to identify them. It is good for detecting protozoan cysts and light-weight helminth eggs [16].

Formalin-ethyl Acetate (FEA) Sedimentation

Approximately 2 grams of the fecal sample were thoroughly mixed with 12ml of 0.9% w/v NaCl in a 15ml centrifuge tube. The mixture was centrifuged at 1200 rpm for 5 minutes, and the supernatant was removed. Next, 10 ml of 10% formalin and 3ml of ethyl acetate were added to the tube, which was then centrifuged again at 1200 rpm for 5 minutes. After discarding the supernatant, the remaining sediments were examined under a microscope at 100× and 400× magnification, with or without the use of Gram's iodine, it is effective for dense eggs and larvae [15, 17].

Questionnaire Survey

A structured questionnaire was developed to address socio-behavioral aspects as well as knowledge, attitudes, and practices related to gastrointestinal parasites. This questionnaire was used to interview participating pregnant women.`

STATISTICAL ANALYSIS

This study aimed to identify various intestinal parasites, the data were analyzed using MS-Excel 2007, and statistical analysis was conducted with "R" version 3.5.2, employing the chi-squared test. A 95% confidence interval (CI) and a significance level of $P<0.05$ were used to determine statistically significant associations between the prevalence of intestinal parasites and associated risk factors.

RESULT

The duration of this study was six months, from July 2023 to December of 2023, involving 100 expectant mothers visiting the ANC center across five different wards of Hetauda Sub-Metropolitan City.

General Prevalence of Intestinal Parasites in Pregnant Women

Results showed that 19% of the pregnant women had intestinal parasitic infections.

Class Wise Prevalence of Gastrointestinal Parasites

Among the 100 samples examined, five genera of gastrointestinal parasites were identified, including one protozoan, one cestode, and three nematodes. The prevalence rates were 13% for nematodes, 2% for cestodes, and 4% for protozoans.

Genera-Wise Prevalence of Gastrointestinal Parasites

From the 100 samples gathered, from pregnant women, the prevalence of *Ascaris lumbricoids* detected at a maximum of 8% whereas *Trichuris trichiura* and *Hymenolepis nana* detected a minimum of 2% (Table **1**). Among 19 positive cases, shows *Ascaris lumbricoids* (42.10%) and *Entamoeba histolytica* (21.05%) are more prevalent followed by *Strongyloides stercoralis* (15.79%), *Trichuris trichiura* (10.53%) and *Hymenolepis nana* (10.53%).

The Pattern of Infection in Pregnant Women

The findings revealed two varieties of parasitic infections that targets the intestines. Among them, 31.57% had a single type of parasite, while 68.42% had multiple types, potentially leading to both single and multiple infections.

Table **2** shows that, among of a single infections *A. lumbricoides* comes at highest with 53.84% followed by *E. histolytica* with 23.07%, *T. trichura*, *H. nana*, *S. stercoralis* was with 7.69%.

Table 1. Prevalence of Gastrointestinal Parasites Based on Genera.

S.N.	Categories	Genera	No. of Infected Samples	Prevalence % (Infestation within Total)	Prevalence% (Infestation within Positive Cases)
1	Nematodes	*Strongyloides stercoralis*	3	3%	15.79%
		Ascaris lumbricoids	8	8%	42.10%
		Trichuris trichiura	2	2%	10.53%
2	Cestodes	*Hymenolepis nana*	2	2%	10.53%
3	Protozoan	*Entamoeba histolytica*	4	4%	21.05%

Table 2. Intensity of a Single Infection.

S.N.	Parasitic Infestation	No.	No. Positive Cases (%)
1	*T. trichiura*	1	7.69
2	*A. lumbricoides*	7	53.84
3	*H. nana*	1	7.69
4	*S. stercoralis*	1	7.69
5	*E. histolytica*	3	23.07
	Total	**13**	**100**

Table **3** shows the intensity of multiple infections where *S. stercoralis* + *E. histolytica*, *T. trichiura* + *S. stercoralis* and *A. lumbricoides* + *H. nana* comes with same number of positive cases that is 16.67%.

Table 3. Intensity of Multiple Infections.

S.N.	Parasites	No.	No. Positive Cases (%) (n=6)
1	*S. stercoralis* + *E. histolytica*	1	16.67
2	*T. trichiura* + *S. stercoralis*	1	16.67
3	*A. lumbricoides* + *H. nana*	1	16.67

Age-Wise Prevalence of Gastrointestinal Parasites

The samples were categorized into various groups in respect to pregnant women's ages: 15-19, 20-24, 25-29, 30-34, and 35-40 years. Women aged 25-29 had highest amount of gastrointestinal parasites in contrast to the lowest prevalence found in the 15-19, 30-34, and 35-40 years age groups (Table **4**).

Table 4. Prevalence of Gastrointestinal Parasites Based on Age and its Association.

Age	No. of the Sample Examined	Total Positive (%)	Prevalence% (within Groups)	P-value p<0.05 (Chi-square Test)
15-19 years	4	2 (10.53%)	50%	
20-24 years	34	6 (31.57%)	17.65%	P=0.5028
25-29 years	37	7 (36.84%)	18.92%	
30-34 years	18	2 (10.53%)	11.11%	
35-40 years	7	2 (10.54%)	28.57%	

Trimesters-Wise Prevalence of Gastrointestinal Parasites

From the 100 sample gathered 14 were in 1st trimester, 76 were in 2nd trimester and 10 were in 3rd trimester out of which 2nd trimester is highly positive for gastrointestinal parasites (Table **5**).

Table 5. Prevalence of Gastrointestinal Parasites Based on Trimesters and their Associations.

Trimester	Total Number (%)	Positive Cases%	P-value (p<0.05)
1st	14	4(21.05)	P=0.1991
2nd	76	12(63.15)	
3rd	10	2(10.53)	
Grand Total	**100**	**19**	

Socioeconomic, Demographic and Behavioral Characteristics of Pregnant Women

The 100 pregnant women participated in the study, 100% of the participants completed the questionnaires. Based on financial status (p=0.0084), the presence of GI parasites revealed a statistically significant difference among the 17 parameters that were investigated. However, the uneven sample size with 22 and 20 participants classified as having good and poor financial status respectively, compared to 58 with fair financial status along with a high overall prevalence of 19%, necessitates careful interpretation of the results (Table **6**).

Table 6. Gastrointestinal Parasitic Infection by Demographic, Socioeconomic, and Behavioral Characteristics among Pregnant Women.

S.N.	Demographic Characteristics	Subgroups	Total Persons (n)	Infected Person (n)	Prevalence% (100n/N)	P-values P<0.005
1.	Rate of Health	1	8	2	25	ns
		2	30	8	26.67	
		3	47	7	14.89	
		4	15	2	13.33	
2.	Prefer Drinking Water	Tap	66	11	16.67	ns
		Filtered	22	3	13.64	
		Boiled	12	5	41.67	
3.	Education	Yes	94	17	18.08	ns
		No	6	2	66.67	
4.	Maintenance of Hygiene	Always	40	7	17.5	ns
		Nearly always	56	12	21.42	
5.	Financial Status	Fair	58	12	20.69	P=0.0084
		Good	22	4	18.18	
		Poor	20	3	15	
6.	Weight	Gain	29	8	27.59	Ns
		Maintain	54	9	16.67	
		Loose	17	2	11.76	
7.	Hand Washing With Soap Before A Meal	Yes	55	8	14.55	ns
		No, with water	40	9	22.5	
		Sometimes	3	2	66.67	
8.	Cutting and Cleaning of Nails	Yes	70	13	18.57	ns
		No	22	3	13.64	
		Sometimes	8	3	37.5	
9.	Eating Fruits and Vegetables Without Washing	Yes	22	2	9.09	ns
		No	71	14	19.72	
		Sometimes	8	3	37.5	
10.	Covering of Food From Flies	Yes	96	16	16.66	ns
		No	2	2	100	
		Sometimes	2	1	50	
11.	Eating Fallen Food	Yes	3	0	0	ns
		No	84	15	17.86	
		Sometimes	13	4	30.77	
12.	Bite Fingernails	No	98	18	18.37	ns
		Sometimes	2	1	50	
13.	Shoe Wearing Habit	Yes	47	12	25.53	ns
		No	36	4	11.11	
		Sometimes not	17	3	17.65	
14.	Consumption of Anthelminthic Drug	Yes	95	18	18.95	ns
		No	5	1	20	

Continue

Continue

15.	Consumption of Meat in the Diet	Once or twice a week	53	12	22.64	ns
		Thrice	11	2	18.18	
		None	26	5	19.23	
16.	Consumption of Fruits in the Diet	Everyday	31	4	12.90	ns
		Once a week	36	8	22.22	
		Once a month	14	4	28.57	
		Twice a week	19	3	15.79	
17.	Rearing Free Ranging Pets	Yes	28	6	21.43	ns
		No	72	13	18.06	

DISCUSSION

The incidence, variety, and risk factors linked to GI illnesses among pregnant women in central Nepal are shown by the current study. The occurrence of 19% observed in this study was somewhat greater than the findings from pregnant women of Janakpur zonal hospital (17.82%, N=202) and slightly lower than the other findings conducted in Nepal (29-49%, N=200-264) [18-21]. Likewise, when comparing our findings with the global population of pregnant women, the present prevalence rate following findings from Southern Ethopia (19%) [22] which were higher than Ghana (14.3%, N=300) [23] and lower than reported from Columbia (41%) [24], Venezuela (73.9%) [25], Northwest Ethopia (23.4-53.4%) [26-32], Western Ethopia (48.8%, N=315) [33], Gabon (64%, N=388) [34], Uganda (100%) [35], Indonesia (69.7%, N=442) [36]. The variations in these results may be attributed to differences in sampling locations and their climatic conditions, as well as varying socioeconomic conditions and behavioral practices among the pregnant women. Additionally, varieties of laboratory techniques used in fecal assessment could have played a role. This study involved sampling from both underdeveloped regions, where some of the population is poor, illiterate, and disconnected from development activities, and from developed areas, where many of the pregnant women are affluent, educated, and have full access to development resources. The sampling was conducted during the autumn and winter seasons, utilizing direct wet mount, sedimentation, and flotation techniques for every sample. This could have contributed to the lower parasitic prevalence observed in our study.

Regarding protozoa, only *E. histolytica* (4% prevalence) was detected in this study. This finding was higher from the findings from Nepal (2.5%) [20], Columbia (1.5%) [24] and are lower from the findings from Ghana (5%) [23], Northwest Ethiopia (5.5-40.6%) [27-32], Nigeria (10.9%) [37], Southwest Ethopia (8.69%) [22], Venezuela (12.0%) [25].These findings indicate that, similar to the global population of pregnant women, *E. histolytica* plays a significant role in the current study. In addition to inducing bleeding episodes, these parasites can be fatal during pregnancies.

Noteworthy, *A. lumbricoides* was the most commonly detected nematode, with a prevalence rate of 8%. This percentage was somewhat lower than what was reported in studies from Nepal (11.1-32.3%) [18-21], Gabon (33%) [34], Nigeria (65%) [37], Northwest Ethopia (55.5%)[26], Southwest Ethopia (28%) [22], Venezuela (57%) [25], higher than the findings from Ghana (4.3%) [23], Northwest Ethopia (2.9-8.6%) [27-32] and Uganda (2.3%) [35].The increased incidence in the study area indicates the potential for Ascaris to spread from domestic animals to humans if personal hygiene is neglected. As we all know, the infective stages of *A. lumbricoides* have a remarkable ability to endure extreme environmental conditions. Additionally, Ascaris eggs are in closed within a muco-polysaccharide substance, making them sticky and capable of adhering to items like coins, paper money, fruits and veggies, dust, and door handles[37].

Strongyloides stercoralis is a nematode, which is very susceptible for infection in human population, had a frequence rate of 3%. This prevalence rate was following findings from Venezuela (3.3%), less than the findings from Uganda (12.3%), more than that of The study found a lower prevalence, which could be explained by the infrequent transmission that happens when food contaminated with fleas carrying cysticercoid larvae is consumed. from Nepal (1-1.5%), [19-20], Northwest Ethopia (0.4-2.3%) [26-27, 30-31]. *T. trichiuria* the intestinal nematode, was reported in 2% of pregnant women`s. The current prevalence rate was accordance with findings from Nepal (2%) [20], Northwest Ethopia (2.9%) [26], and higher than findings from Ghana (1.3%) [23] and are lower than the findings from Gabon (24%) [34], Nigeria (13.08%) [37], Southern Ethopia (20.29%) [22], Uganda (9.1%) [35] and Venezuela (36%) [25].

We have reported the eggs of *H. nana*, a cestode, at a prevalence rate of 2% which was slightly lower than that reported from Nepal (3%) [20], and higher than those from Ghana (0.3%) [23], Northwest Ethopia (0.3-0.7%) [30-31], Nepal (1.5%) [19] and Uganda (0.2%) [35].The study found a lower prevalence, which could be explained by the infrequent transmission that happens when food contaminated with fleas carrying cysticercoid larvae is consumed.

It is widely accepted that people's socioeconomic status and behavioral tendencies influence their propensity to become parasitic [17]. The limited sample size meant that the majority of the demographic, socioeconomic, vocational, and actionable attributes remained inconsequential. Most pregnant women who lived in mud-built homes with big families and overcrowding had a greater trend of total GI illness. The occurrence of GI parasites were higher in field workers, farmers, where practices such as open defecation, drinking water directly from unsanitary sources, negligence of basic hygiene, walking barefoot, were more prevalent. Pregnant women in rural areas typically lacked awareness, had low socioeconomic position, practiced poor personal and environmental cleanliness, and were illiterate, which results to higher rate of infection with intestinal parasites. Most gastro-intestinal parasites are spread through the mouth while consuming tainted food/water or through the skin while walking without shoes, and the abovementioned actionable factors are fitting well [33, 38].

With the exception of financial status, socioeconomic and demographic characteristics do not significantly differ in this study. which shows similarity with a study done in Northwest Ethopia [1,31] whereas a study done in Western Ethopia shows walking barefoot, farming, and not washing your hands properly after using the restroom all greatly raise your risk of intestinal parasite infection [33]. We have reported a significant difference in the financial condition in a prevalence rate, a 20.69% fair, 18.18% good, and 15% of poor who do not have proper health habits, and clean latrine systems. Financial conditions directly or indirectly affect the healthy habit of a person which plays a prompt role in a parasitic infestation.

It was also shown that intestinal parasite infections were independent of the phase of pregnancy. This observation aligns with earlier research by Espinosa Aranzales and colleagues, who found no correlation between intestinal parasite infections and pregnancy stage [24]. In contrast to these findings, women's chances of contracting intestinal parasite infections were shown to be higher in the second and third trimesters of pregnancy [39]. Pregnancy necessitates an increase in nutrients, particularly iron, and results in "physiological anemia" due to hemodilution [31]. According to the findings of Hailu, risk of intestinal parasite infection increased proportionally to consumption of leafy green vegetables [1]. The association between the total population eating vegetables and fruits without washing was statistically insignificant. This could be brought on by a lack of knowledge and understanding. It might also be because expectant mothers who work in farming and agriculture know very little about the timing and mechanism of intestinal parasite transmission. Therefore, consuming raw vegetables, feces in the open, living in contaminated environments, and consuming food contaminated with soil while pregnant are major risk factors for parasite infection.

LIMITATIONS

Several limitations of this study should be acknowledged. The primary methodological limitation is the assessment of smears, which may not be sufficient to account for day-to-day and stool sample variations in the detection of GI parasites. Additionally, the prevalence of GI parasites might not accurately reflect the severity of infection since the density of GI infections was not evaluated. Another limitation is the small sample size (n=100) used in the subgroup analysis, which could increase the risk of a type II error. Lastly, the potential for sampling bias, due to the non-random or convenient selection of participants, may restrict the generalizability of the findings. Because participants were chosen on a first-come, first-served basis, there is a possibility that individuals who visit their nearest governmental ANC with health concerns were more likely to be included as well as could be a chance that pregnant women who do not visit ANC would be excluded. Due to the cross-sectional design of the study, we are unable to determine the exact causes of the associations we observed.

CONCLUSION

In summary, the data provided by this study can be used as basis for assessing and developing effective strategies to mitigate GI parasitic diseases. The prevalence and transmission of various diversity and pattern of parasites in pregnant women can be linked to socio-economic and behavirol factors. Zoonotic GI parasites, those that can spread from domestic animals to people, highlight economic significance. It is critical to ascertain the infection dynamics of these parasites in order to manage them effectively. Also, quick intervention techniques, such testing the women for intestinal parasites and educating them about health during their ANC visit, are needed to stop the negative consequences of these illnesses on the health of the mother and fetus.

AUTHORS' CONTRIBUTION

Dipa Dhakal: Conceptualization, Study design, Methodology, Data analysis and interpretation, Writing draft, Critical review and revision the manuscript, Final approval, final proof to be published.

Janak Raj Subedi: Conceptualization, Critical review and revision the manuscript, Final approval, final proof to be published.

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ETHICAL DECLARATIONS

Data Availability Statement

Data are available upon reasonable request. The data used to support the findings of this study are available from the corresponding author upon request.

Ethical Approval

Ethical approval for this study was granted by the Ethical Committee of the Institute of Science and Technology (IOST) at Tribhuvan University (IRB approval no. 23-0067).

Consent to Participate

Informed consented.

Consent for Publication

Consented.

Conflict of Interest

Declared none.

Competing Interest/Funding

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Use of AI-Assisted Technologies

The authors declare that no generative artificial intelligence (AI) or AI-assisted technologies were utilized in the writing of this manuscript, in the creation of images/graphics/tables/captions, or in any other aspect of its preparation.

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