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Prevalence and risk factors of intestinal parasitic infections among pregnant women in Taiz Governorate, Yemen: A hospital-based study

T. ALHARAZI[1,2,*]

[1]Department of Medical Laboratory Sciences, College of Applied Medical Sciences, University of Hail, Hail, Kingdom of Saudi Arabia;
[2]Department of Medical Microbiology and Immunology, Faculty of Medicine and Health Sciences, Taiz University, Taiz, Yemen,
E-mail: *alhraziali@yahoo.com*

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Summary

Background: Intestinal parasitic infections in pregnant women have been associated with severe adverse outcomes such as anemia, low birth weight, and mother and fetus morbidity and mortality. This study aimed to determine the prevalence of intestinal parasitic infection and its associated risk factors among pregnant women in Taiz, Yemen. Methods. A cross-sectional study was conducted between July 2022 and January 2023. Sociodemographic and other explanatory variables were obtained via face-to-face interviews using a structured questionnaire. The wet-mount and formol-ether concentration techniques were applied to identify the IPIs. Data were analyzed using SPSS, version 20, and p-values < 0.05 were considered statistically significant. An analysis of descriptive statistics and multivariate logistic regression was conducted. A p-value < 0.05 was deemed statistically significant. The study included a total of 393 pregnant women. Results. Of the 393 pregnant women screened for intestinal parasites, 144 (36.6 %) had at least one parasite. The most common intestinal parasite was Giardia lamblia (12.2 %), followed by *Ascaris lumbricoides* (10.9 %), *Entamoeba histolytica/dispar* (7.4 %), *Enterobius vermicularis* (14.3 %), and *Hymenolepis nana* (1.8 %). Being a farmer (AOR = 2.7, 95% CI: 1.69-4.26, p = 0:003) and drinking from unsafe water wells, streams, rain, and dams (AOR = 2:6, 95% CI: 1.68-4.25, p ≤ 0:001) were significantly associated with IPIs. Conclusion. Pregnant women in the study area still face a severe health burden due to intestinal parasitic infection. Therefore, it is recommended that health education should be improved, and safe tap water should be provided to pregnant women to reduce the incidence of IPIs.
Keywords: Intestinal parasites; prevalence; pregnant women; risk factors; Taiz; Yemen

Introduction

The World Health Organization (WHO) reported that approximately 1.5 billion individuals, about 24 % of the world's population, are afflicted with intestinal parasites (WHO, 2020). Developing countries suffer from a high rate of parasitic intestinal infections due to poverty, illiteracy, poor nutrition, poor hygiene and unsafe drinking water (Dutta *et al*., 2013).

It is expected that tens of millions of pregnant women are infected with parasites, directly or indirectly affecting the mother and fetus. Neglected treatment for intestinal parasites during pregnancy can impose a considerable strain on the health of the mother, developing fetus, and newborn (Aschale *et al*., 2022). During any stage of pregnancy, parasitic infection can occur, but infections in the first trimester have more severe effects on the fetus and placenta. Moreover, primigravida women are more susceptible to infection than other gravida (Alula *et al*., 2021).

Pregnant women often contract parasitic infections due to

* – corresponding author

weakened immune systems, which can profoundly affect the body's physiological systems (Houweling *et al*., 2016). Furthermore, pregnant women with IPI are at greater risk of maternal complications, impaired fetal growth, low birth weight, and perinatal mortality (Mahande *et al*., 2016). IPIs can potentially induce anemia in several ways. Some may encourage the loss of native nutrients by damaging the intestinal mucosa, obstructing digestion, and inducing diarrhea. Loss of blood and inflammation-induced iron absorption restriction are results of *G. lamblia* and *E. histolytica* infection. Hookworms, schistosomiasis, and *T. trichiura* can impair nutritional intake, and decrease appetite, in addition to causing intestinal blood loss (WHO, 2023).

In Yemen, there's no strategy or program for eradicating or controlling parasitic infections, especially during the civil war since 2014. Yemen has a high prevalence of IPI infection, and the extent of infection varies from place to place, primarily due to poor quality drinking water supply and unsanitary living conditions (Alharazi, 2022; Al-Yousofi *et al*., 2022). Most previous studies conducted in Yemen involving parasitic infections have focused mainly on preschoolers and schoolchildren (Alharazi, 2021; Alsubaie *et al*., 2016; Alwabr *et al*., 2016; Edrees *et al*., 2022). As a result, this study was necessary to assess the prevalence of intestinal parasitic infection among pregnant women in Taiz city in particular, which is not well addressed in the country as a whole. The findings would provide relevant data on the prevalence and risk factors of parasitic intestinal infection in pregnant women in Taiz governorate, serving as a springboard for the regional health office and health officers and providing baseline data for future studies.

Materials and Methods

Study area

This study was conducted to identify the prevalence of intestinal parasitic infection and associated risk factors among pregnant women at public referral hospitals (Al-Thwra General Hospital, Republican General Hospital, and AL-Ta'awan Hospital) as well as some private clinics in Taiz city. The province of Taiz in Yemen is situated in the southwest region and is 280 kilometers from Sana'a, the country's capital (44.01° E, 13.34° N) (Fig. 1). It is located between the central and foothills, about 200–2000 meters above sea level. The average yearly temperature is between 20 and 30 °C with minimal seasonal change, and the humidity levels range from 40 to 60 %. The climate exhibits many subtropical characteristics. Most of the year's rainfall occurs in March, May, August, and September. Most people's primary source of income comes from agriculture. According to the Statistical Yearbook 2016, Taiz governorate had an estimated population of 2,885,000, consisting of 52 % females (Central Statistical Organization Yemen, 2016).

Study design and period

A hospital-based cross-sectional study was conducted between July 2022 and January 2023 to identify the prevalence of intestinal parasitic infection and associated risk factors among pregnant women at public and private referral hospitals in Taiz city.

Study population

Study participants included pregnant women who agreed to

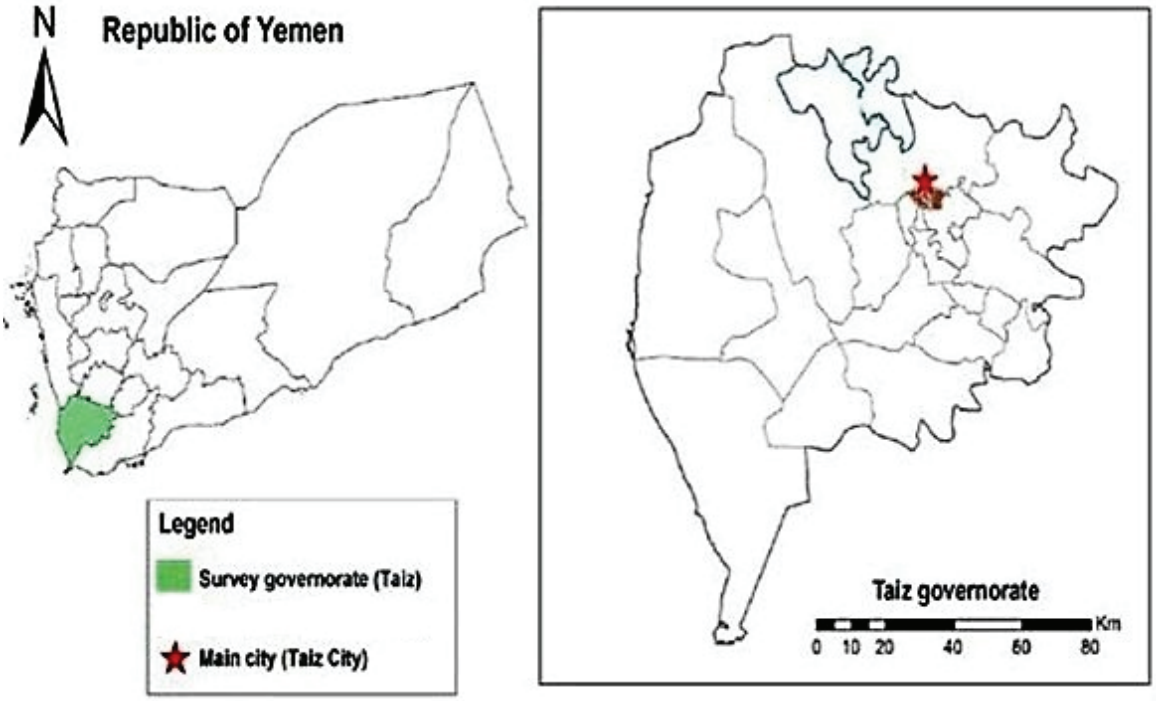

Fig. 1. A geographic map showing the study area in Taiz governorate.

participate, provided stool samples and gave information about sociodemographic and environmental sanitation.

Sample size determination

The sample size of the study participant was calculated according to formula (Naing *et al*., 2006). The prevalence of IPIs among pregnant women is unknown in the study area. Therefore, the prevalence was taken to be 50 %. A 95 % confidence level *(z)* and a 5 % sampling error *(d)* were employed.

$n=z^2P(1-P)/d^2$

where *n* represent the number of samples needed (required), *Z* is the level of confidence at 95 % (1.96, standard value), *P* represents the prevalence at 50 % (0.5, standard value), and *d* is the error margin at 5 % (0.05, standard value). *N* is $(1.96)^2$ 0.5 (1-0.5)/ $(0.05)^2$ = 384.

Stool specimen collection and examination

Each study participant was given a well-marked, clean, dry, antiseptic-free, wide-mouth plastic container with instructions to collect their stool samples immediately. The containers are marked with the study participants' names, code numbers, and collection times. The participants were asked to complete a questionnaire and submit a stool sample (5g). Samples were microscopically examined using direct wet and formol ether concentration procedures at the Parasitology laboratory of Taiz University.

Data collection and analysis

The study participants' sociodemographic and behavioral data were gathered using structured questionnaires administered through interviews by the investigators. The questionnaire items were developed with slight modifications to suit the local context and the study objectives, drawing from comparable studies conducted in other settings. The document was prepared in English, translated into Arabic, then translated back into English to verify its accuracy. Using Microsoft Office Excel spreadsheets, the data was entered and checked by two research assistants for accuracy and completeness. The data were analyzed with the Statistical Package for Social Sciences version 20 (IBM Corp., New York, USA). Descriptive statistics, including frequency and percentage, were computed and reported.

Moreover, a logistic regression analysis was performed to identify the main risk factors associated with intestinal parasitic infections in pregnant women in the study area. Univariate logistic regression was first conducted with a *p*-value cut-off point of < 0.25 (Hosmer Jr *et al*., 2013). The variables found to be statistically significant in the univariate analysis were then entered into a multivariate logistic regression model with a *p*-value cut-off point of < 0.05 at a 95 % confidence interval to identify the main explanatory variables for IPIs. The results were then summarized using tables and text.

Ethical Approval and/or Informed Consent

The Ethical Committee of the Faculty of Medicine and Health Sciences at Taiz University has reviewed and approved this study. (Ref. No ECFM/04/22).

Participants in the study provided written informed consent before the study commencement. Personal hygiene and sanitation counseling were provided to study subjects.

Results

Sociodemographic and obstetric characteristics of study participants

This study involved 393 pregnant women, with a response rate of 100 %. The participant's ages ranged from 15 to 41, with a mean of 26.5 ± 6:03 years. Among the respondents, 60.1 % were rural

Table 1. Sociodemographic characteristics and obstetric characteristics of pregnant women with respective to IPs in referral hospitals, Taiz. Yemen from July 2022 – to January 2023(*n* = 393).

Variables	Category	Total N (%)	Negative N (%)	Positive N (%)
Age	≤ 25	195 (49.6)	124 (63.6)	71(36.4)
	> 25	198 (50.4)	125 (63.1)	73 (36.9)
Residence	Urban	157(39.9)	91(58)	66 (42)
	Rural	236 (60.1)	158(66.9)	78(33.1)
Education	Illiterate (Can't read or write)	98(24.9)	33(33.7)	65(66.3)
	Primary school and above	295(75.1)	111(37.6)	184(62.4)
Occupation	Students	98(24.9)	65(66.3)	33(33.7)
	Housewife	147(37.4)	94(63.9)	53(36.1)
	Farmer	92(23.4)	47(51.1)	45(48.9)
	Government employee	56(14.2)	43(76.8)	13(23.2)
Gravidity	Primigravidae	149 (37.9)	85 (57)	64 (43)
	Multigravida	244 (62.1)	164 (67.2)	80 (32.8)
Gestation period	1st trimester	106 (27)	56(52.8)	50 (47.2)
	2nd trimester	131 (33.3)	98(74.8)	33 (25.2)
	3rd trimester	156 (39.7)	95(60.9)	61 (39.1)

Table 2. Prevalence of IPIs among pregnant women attending referral hospitals Taiz. Yemen from July 2022 – to January 2023.

Parasite species	N (%)
Giardia lamblia	48 (12.2)
Ascaris lumbricoides	43 (10.9)
Entamoeba histolytica/dispar	29 (7.4)
Enterobius vermicularis	17 (4.3)
Hymenolepis nana	7 (1.8)
Total	144

residents. Housewives accounted for 147 (37.4 %) of the 393 pregnant women. Regarding their educational status, 295 (75.1 %) have completed primary school or higher. The participants were divided into three-trimester groups. The first trimester (gestational age less than 13 weeks) accounts for 27 % (106), while 33.3 % (131) in the second trimester (gestational age between 13 and 28 weeks) and 39.7 % (156) in the third trimester (greater than 28 weeks gestation). Over Sixty-two percent (62.1 %) of the participants had given birth more than twice (Table 1).

Additionally, Table 1 displays the prevalence of IPIs based on participants' sociodemographic and obstetric characteristics. Pregnant women over 25 years old have a prevalence rate of 36.4 %. Infected participants included 42.2 % of those from urban areas and 66.3 % of those with no formal education. It was estimated that almost half of the respondents (47.2 %) had intestinal parasites in their first trimester, and 64 % of those pregnant women with first gravida were infected.

The prevalence of IPIs

Five types of intestinal parasites have been identified in a stool examination (two protozoa and three helminth species). Among the participants in the study, 144 (36.6 %) were infected with one parasite. The highest prevalence of parasites identified was *Giardia lamblia*, 48 (12.2 %), followed by *A. lumbricoides*, 43 (10.9 %). *H. nana* was the least prevalent parasite, with only 1.8 % (7) observations. All were single infections (Table 2).

Analysis of sociodemographic and obstetric risk factors potentially associated with IPIs using univariate and multivariable logistic regression

Table 3 shows the associations between IPs, sociodemographic factors, and potential risk factors for the subjects. Significant associations between intestinal parasites and occupation were found in the univariate analyses, with farmers having the highest risk (COR = 3.2, 95% CI: 1.50-6.66, p = 0:001), with primigravida (COR = 1.5, 95% CI: 1.0-2.4, p = 0:042), and with second trimester (COR =1.91, 95% CI: 1.15-3.17), p = 0:013). Additionally, the use of unsafe water (wells, streams, rain, dams) posed a greater risk than the use of safe tap water (COR = 2.7, 95% CI: 1.7-4.2, $p \leq$ 0:001) (Table 3). According to the multivariate logistic analysis, occupation and drinking unsafe water showed significant associations with IPI ($P <$ 0:05). Pregnant women who were farmers had a 2.7-fold increased risk (AOR = 2.7, 95% CI: 1.69-4.26, $p \leq$ 0:003) of intestinal parasite infection, and those who used unclean water sources such as wells, streams, rain, or dams had a 2.6-fold increased risk (AOR = 2.6, 95% CI: 1.68-4.25, $p \leq$ 0:001).

Discussion

IPIs remain a public health challenge in low-income countries such as Yemen. Designing effective intervention mechanisms for high-risk communities requires studies in different settings. According to our knowledge, this is the first study to assess the prevalence and risk factors associated with IPI among pregnant women in Yemen and Taiz city.

According to our study, the prevalence rate of parasitic intestinal infection among pregnant women in Taiz was 36.6 % which was in line with previous studies conducted in different countries, such as 36.7 % in Ethiopia (Derso *et al*., 2016), in northern Ghana (Ahenkorah *et al*., 2020) (31.7 %), and Southeastern Iran (34.2 %) (Abbaszadeh Afshar *et al*., 2020).In contrast, our findings were lower than those reported from Ethiopia (70.6 %) (Feleke *et al*., 2018), Kenya (76.2 %) (Van Eijk *et al*., 2009), Thailand (70 %) (Boel *et al*., 2010) and Venezuela (73.9 %) (Rodríguez-Morales *et al*., 2006). However, it was higher than 14.3 % among pregnant women in Gondar City, northwest Ethiopia (Alem *et al*., 2013), and 17.6 % in Ghana (Baidoo *et al*., 2010). There is a possibility that these differences are related to different sanitation and hygiene practices, as well as the socioeconomic statuses of the study participants.

G. lamblia was identified most frequently (12.2 %) among the parasites identified. A similar finding was found in northwestern Ethiopia (13.3 %) (Derso *et al*., 2016) and southeastern Iran (10.6 %) (Abbaszadeh Afshar *et al*., 2020). But, it was higher than those reported from Southern Ethiopia (5.4 %) (Bolka *et al*., 2019), Northwest Ethiopia (6.3 %) (Kumera *et al*., 2018) and Ghana (2.3 %) (Abaka-Yawson *et al*., 2020). The reason for this could be attributed to the implementation of comparable infection prevention and control measures nationwide, along with the adoption of environmental and personal hygiene practices within the community.

The prevalence rate of *A. lumbricoides* was 10.9 % in this study. This result is consistent with previous studies conducted in Ethiopia (10.0 %) (Buchala *et al*., 2022) and Nepal (11 %) (Yadav *et al*., 2020) but lower than previous results from Wondo Genet (24.9 %) (Bolka *et al*., 2019) and Mecha district, Oromia (32.7 %) (Feleke *et al*., 2018). On the other hand, it is higher than the findings from Felege Hiwot Referral Hospital (2.9 %) (Derso *et al*., 2016),

Table 3. Univariate and multivariable analysis of sociodemographic and other potential risk factors associated with IPIs among pregnant women in referral hospitals, Taiz. Yemen from July 2022 – to January 2023 (*n* = 393).

Variables	classification	COR (95% CL)	*P* value	AOR (95% CL)	*P* value
Age (Years)	≤ 25	0.98 (0.7 – 1.5)	0.925	0.98 (0.7 – 1.5)	0.925
	> 25	1		1	
Residence	Urban	1		1	
	Rural	1.5(0.97 – 2.2)	0.070	1.5(0.97 – 2.2)	0.070
Education	Illiterate (Can't read or write)	0.8(0.5 – 1.4)	0.482	0.8(0.5 – 1.4)	0.482
	Primary school and above	1		1	
Occupation	Students	1.7 (0.79 – 3.6)	0.175	1.7 (0.78 – 3.64)	0.177
	Housewife	1.9 (0.92 – 3.78)	0.084	1.7 (0.81 – 3.43)	0.164
	Farmer	3.2 (1.50 – 6.66)	**0.001**	2.7 (1.69 – 4.26)	**0.003***
	Government employee	1		1	
Gravidity	Primigravidae	1.5 (1.0 – 2.4)	**0.042**	1.0 (0.64 – 1.7)	0.916
	Multigravida	1		1	
Gestation period	1st trimester	1.4 (0.84 – 2.30)	0.195	1.3 (0.73 – 2.19)	0.405
	2nd trimester	1.91 (1.15 – 3.17)	**0.013**	0.6 (0.38 – 1.10)	0.100
	3rd trimester	1		1	
Source of drinking water	Unsafe (wells, streams, rain, dams)	2.7 (1.7 – 4.2)	**0.001**	2.6 (1.68 – 4.25)	**0.001***
	Safe (tap water)	1		1	
Eating raw vegetables	Yes	0.9(0.62 – 1.42)	0.785	0.9(0.62 – 1.42)	0.785
	No	1		1	
Hand washing before meal	No	1.5 (0.96 – 2.18)	0.079	1.5 (0.96 – 2.18)	0.079
	Yes	1		1	
Availability of toilet	No	0.72 (0.46 – 1.12)	0.140	0.72 (0.46 – 1.12)	0.140
	Yes	1		1	
Hand washing after toilet	No	1.36(0.89 – 2.08)	0.158	1.36(0.89 – 2.08)	0.158
	Yes	1		1	
Soil eating habit	Yes	1.5 (0.96 – 2.27)	0.076	1.476 (0.96 – 2.271)	0.076
	No	1		1	
Wearing shoes	No	1.4 (0.90 – 2.15)	0.133	1.392 (0.90 – 2.15)	0.133
	Yes	1		1	

COR: Crude Odds Ratio; AOR: adjusted odds ratio; CL: confidence interval

Kasoa Polyclinic, Ghana (4.3 %) (Abaka-Yawson *et al*., 2020), and Kenya (6.5 %) (Wekesa *et al*., 2014). The observed differences in prevalence rates could be attributed to variations in the health service delivery systems across countries, differences in the socioeconomic status of the study participants, and variations in the study periods and designs. The prevalence of *E. histolytica/dispar* in this study (7.4 %) was similar to that reported in northwestern Ethiopia (7.8 %) (Derso *et al*., 2016). Nevertheless, it was more significant than what was reported in Wondo Genet (3.4 %) (Bolka *et al*., 2019) and Gondar city, northwest Ethiopia (2.9 %) (Alem *et al*., 2013). The high prevalence of *E. histolytica* in this study may be explained by using contaminated water as the leading cause of amebiasis. Most participants in our study area reported drinking from unsafe water (wells, streams, rain, dams), increasing the possibility of parasitic infections.

Our study found that the prevalence of *Enterobius vermicularis* was 4.3 %, which is lower than that reported in another study (6.9 %) (Kebede *et al*., 2022) but higher than the prevalence of 0.7 % reported in Kenya (Wekesa *et al*., 2014).

According to the findings of the multivariate logistic analysis, occupation (being a farmer) and the source of drinking water was found to have a statistically significant association with IPI (P <

0.05). The odds of contracting IPIs were 2.7 times greater in pregnant women who worked as farmers than those employed by the government. This finding has been supported by several studies, including those conducted by Hailu *et al*. (2020) and Yesuf *et al*. (2019), which have identified occupation (being a farmer) as a significant contributing factor to IPI. Pregnant farmers poorly understand the transmission of intestinal parasites during pregnancy. In addition, pregnant women are not regularly educated about intestinal parasite transmission. According to our study, pregnant women who drank unsafe water (rivers, wells, streams) were approximately 3 times more likely to develop IPIs than those who drank from protected tap water. This result is consistent with the previous study conducted in northwestern Ethiopia (Shiferaw *et al*., 2017). According to Wekesa *et al*. (2014), the potential infiltration of human waste from latrines into drinking water sources may be the cause.

Limitations of the study

Due to insufficient funding, the examination of fecal samples was limited to the wet mount and concentration method, which may have led to an underestimation of the prevalence of IPIs. In addition, light microscopy does not distinguish *E. histolytica* and *E. dispar*. Furthermore, the prevalence of IPIs was estimated based on one fecal sample rather than three consecutive samples, which could have resulted in an underestimation of infection levels.

Conclusion and Recommendations

A higher prevalence of intestinal parasitic infections, such as giardiasis and ascariasis, was observed among pregnant women in referral hospitals in Taiz, Yemen. It can be attributed to the participants' farming occupation and consumption of unsafe drinking water. To address those risks, the government must implement health policies that provide health education and medical screening tests for pregnant women, particularly during their visits to referral hospitals. Additionally, ensuring access to safe drinking water not only for pregnant women but also for the entire community is essential in preventing the contraction of parasites. Furthermore, enhancing awareness of intestinal parasites among pregnant women through health education, promoting proper personal hygiene practices, and considering the co-administration of metronidazole with sulfadoxine-pyrimethamine can reduce the incidence of intestinal parasitic infections during pregnancy.

Conflict of Interest

The author states no conflict of interest.

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