Original Article

The burden of soil-transmitted helminths infections among pregnant women in Maharashtra and Rajasthan states of India

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Abstract

Context: Soil-transmitted helminths (STH) infections are among the most common and widespread infections in developing countries where sanitation facilities are inadequate. **Aims:** This study aimed to estimate the prevalence of STH infections in prenatal mothers in two states in India. **Settings and Design:** A cross-sectional survey was conducted in Maharashtra and Rajasthan state of India. We randomly selected one municipal corporation and one rural block from a selected district in each state. **Methods and Material:** Out of 2400 contacted, 2206 pregnant women gave stool samples for microscopy for parasitological study. The response rate was 89.91%. Stool specimens were transported to an accredited lab and examined microscopically within 24 hrs. **Results:** Prevalence of STH was 8.34 (95%CI 7.22–9.57). The prevalence in rural and urban areas was 10.01% (95%CI 8.51–11.74) and 5.76% (95%CI 4.39–7.52), respectively. Ascaris lumbricoides (34.7%) were the most common, followed by Entamoeba histolytica (30.43%), and 20.1% were mixed infections. Higher age, walking barefoot, weight gain during pregnancy were significantly associated with STH ($p < 0.05$). The mean hemoglobin value in women with STH was significantly less (8.75 gm%; SD 4.04) compared to those without STH (10.23 gm%; SD 1.23) ($p < 0.05$), and average weight gain during pregnancy was significantly less among women with STH (3.80 kg; 4.11) compared to women without STH (8.45 kg; 2.83); ($p = 0.000$). **Conclusion:** The study provides valuable insights into the burden and intensity of STH in pregnant women that may support the policy recommendation for deworming during pregnancy.

Keywords: India, pregnant women, prevalence, risk factors, soil-transmitted helminths

Introduction

Soil-transmitted helminths (STH) infections are widespread infections in developing countries. Improper sanitation facilities and poor hygiene practices are key risk factors for STH infections. The STH infection leads to undernutrition, anemia, and impaired cognitive development.[1] STHs comprised

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nematode, a parasite transmitted through contact with parasite eggs, or larvae that survive in the warm and moist soil.[2]

World health organization (WHO) fact sheet states that globally, one-fourth population is infected with STH infections, and nearly 300 million suffer associated severe morbidity and even death due to STH infection. Tropical and subtropical countries from sub-Saharan Africa, the Americas, China, and East Asia are heavily burdened with STH infections.[3] Globally, over 800 million preschoolers and school-age children need STH preventive interventions as they reside in high transmission settings for STH infections.[4] The STH infection is prevalent in rural populations and urban slums in developing countries.[4,5] Risk factors for transmission of STH infections are inadequate water, sanitation, and hygiene (WASH) practices and barefoot walking. Chronically infected persons may contain several different parasitic worms species.[6,7]

The STH infection during pregnancy causes severe anemia, a significant public health issue, leading to adverse pregnancy outcomes, such as low birth weight and prenatal mortality. It may lead to the link of STH infections intensity with nutritional anemia, reduced weight gain during pregnancy, intrauterine growth retardation followed by low birth weight leading to children's physical, emotional and cognitive developmental delays in children is well evidenced.[2,3,8,9]

Studies from different populations within India reported a prevalence of STH infection ranging from 11% to 90%.[10-14] However, limited information is available regarding STH during pregnancy in India. A study from urban slums of north India reported a 40% prevalence of STH infections diagnosed by RT–PCR[15] and a hospital-based study from South India reported a prevalence of 12.4% by routine stool microscopy.[16] An estimated 44 million pregnant women are infected with hookworm globally,[17] and countries have reported STH prevalence ranging from 10% to 79%.[18-21] We undertook the study to estimate the burden of STH among pregnant women in India. The results will assist in drafting new policy recommendations and informing public health program guidelines for including deworming during the antenatal period.

Methodology

We conducted a cross-sectional study in Maharashtra and Rajasthan state of India. One district was randomly chosen from each state. One municipal corporation and one rural block, the respective district was selected to represent the urban and rural population.

Sample size and sampling

For rural areas, considering 95% confidence interval, 80% power, with 1.5% design effect, and 10% non-response rate, we required the sample size of 640 pregnant women from a rural block and 430 from the urban area of each state. A cluster sampling methodology was used to collect data from both states. A district was randomly selected, and 30 clusters were selected from the respective district in both states in the rural area and urban municipal area. To achieve the desired sample size, 22 participants from a rural area and 14 from the urban municipal areas were interviewed, and stool sample was collected.

	Rural	Urban	Total	The total sample for two states
Clusters	30	30	60	120
Stool sample per cluster	21	14	36	4200
Total stool sample per state	630	420	1050	2100

Thus, the total estimated sample size was 2100 from both states.

Study participants

The study participants were pregnant women from the rural and urban areas of the selected districts from both states. In rural areas, pregnant women were selected on the basis of their registration with Accredited Social Health Activist or Auxiliary Nurse Midwife. In the urban area, the selection was based on their enrollment from the respective Anganwadi centers.

Ethical consideration

The proposal was approved by the ethics committee of Datta Meghe Institute of Medical Sciences and AIIMS Jodhpur for the Maharashtra and Rajasthan site, respectively.

Data collection

The data collection tool includes sections on sociodemographic information, pregnancy-related information, history of passing worms, and history of STH treatment. The tool also contains questions on awareness and benefits and compliance for the national health programs for reduction of morbidity due to STH. After pilot testing, the tool was converted into an electronic form, with range checks, logical checks, and other measures to ensure data quality. Information on the sociodemographic variable, risk factors of the STH, number of visits to ANC clinics, and services received, WASH practices were collected by a trained Research Associate (RA). The patient's hemoglobin was recorded from the antenatal record.

Stool sample collection, transportation, and processing

After data collection, the pregnant women were counseled for STH and need for stool examination. Pregnant women were provided with a labeled leak-proof stool container (polypots), toilet paper, and applicator stick for sample collection. Participants were advised to collect approx 5 gm of stool specimens. A second visit was be done the next morning again for collection and transport of stool samples at the optimal temperature as recommended by WHO. The RA transported the sample on the same day to the lab. The stool specimens were examined microscopically within 24 hrs of collection at the National Accreditation Board for Testing and Calibration Laboratories accredited laboratory. The magnifications of ×10 and ×40 were used, respectively, to visualize and identify intestinal geo-helminth ova. All samples were examined by the trained

microbiologist from a medical college, and 25% of the slides were subjected to internal quality control.

Statistical analysis

The primary outcome was to find the estimate of the prevalence, load, and most common species of STH in pregnant women. The data were exported to STATA version 14 from the server for analysis. Data were checked for inconsistencies and completeness. The overall prevalence of STH and prevalence in subgroups was estimated with 95% CI. The association of STH and various risk factors was tested, and the appropriate test of significance was used. We used the logistic regression analysis to study the association of a risk factor with STH.

Result

We approached 2400 pregnant women from selected districts of Maharashtra and Rajasthan state and collected data. However, 2206 pregnant women provided the stool sample. Thus, the response rate was 89.91%. Out of 2206 pregnant women, 146 (51.95%) were from Maharashtra and 1060 (48.05%) from Rajasthan state; 1338 (60.65%) were from the rural area, and 868 (39.5%) were from the urban area; on average, three visits were required to complete the data and sample collection. The mean household income of study participants was 8644.15 (SD 6210.83), 1689 (76.56%) were living with the joint family, and the remaining 517 (23.34%) had a nuclear family, 1279 (57.98%) had a pucka house, 435 (19.72%) had a kutcha house, and 492 (22.30%) had a semi pucka house. On average, 4.83 (SD 2.47) antenatal check-up visits were completed by the pregnant women at the time of data collection. Of the 2206 pregnant women, 1724 (78.15%) had anemia (hemoglobin less than 11 gm%). Table 1 presents the characteristics of pregnant women.

Out of 2206 stool samples from pregnant women examined microscopically STH, was observed in 184. Thus overall, the prevalence of STH was 8.34% (95%CI 7.22–9.57). The prevalence in a rural area was 10.01% (95%CI 8.51–11.74), and in the urban area, the prevalence was 5.76% (95%CI 4.39–7.52) [Table 2]. The difference was found to be statistically significant ($p < 0.05$). Out of the total of 184 pregnant women with STH, 27 (14.67%) had Ancylostoma duodenale, 64 (34.78%) had Ascaris lumbricoides, 56 (30.43%) had Entamoeba histolytica, and 37 (20.10%) had mixed infection.

On univariate analysis, residents from the rural area, those residing in the kutcha house, low household income, third trimester of pregnancy, non-availability of sanitary latrine in dwellings, walking barefoot around the house, and those who are not doing filtration of drinking water were more likely to be affected by the STH [Table 3]. Logistic regression analysis revealed that increasing age of pregnant women, residence in a rural area, low household income, cracks over feet, and not having a toilet in dwelling, pregnancy duration were significantly associated with STH in pregnant women [Table 4].

Table 1: Characteristics of pregnant women (*n*=2206)

Characteristics	*n* (%)
Age (Mean (SD)	24.1 (3.35)
Age at marriage (Mean (SD)	21.55 (2.52)
Duration of pregnancy - months (mean (SD))	5.28 (2.02)
1st Trimester	205 (9.29)
2nd Trimester	933 (42.29)
3rd Trimester	1068 (48.41)
IFA - Tablets/syrup	2070 (93.82)
Injection - TT	2066 (93.65)
Calcium - Tablets/syrup	1951 (90.83)
Hemoglobin; Mean (SD)	9.78 (3.89)
Normal (Hb > = 11 gm%)	455 (20.63)
Mild anemia (Hb 9-10.9 gm%)	699 (31.69)
Moderate anemia (Hb 7-8.9 gm%)	936 (43.65)
Severe anemia (Hb >7 gm%)	89 (4.03)

Table 2: Prevalence of STH among study participants

	No	Percentage (95% CI)
Overall	184	8.43 (7.22-9.57)
Rural	134	10.01 (8.51-11.74)
Urban	50	5.76 (4.39-7.52)
Maharashtra	99	8.63 (7.07-10.41)
Rajasthan	85	8.02 (6.45-9.82)

Out of 184 pregnant women with STH, 46 (25%) were anemic compared to 409 (20.23%) without STH. The mean hemoglobin value in women with STH was significantly less (8.75 gm%; SD 4.04) compared to those without STH (10.23 gm%; SD 1.23) ($p < 0.05$). The average weight gain during pregnancy was significantly less among women with STH (5.80 kg; 4.11) compared to women without STH (8.45 kg; 2.83); ($p = 0.000$). The average birth weight of the newborn delivered by women with STH was 2586 g (SD 308) compared to 2692 g (SD 302) among women without STH. The difference was not statistically significant ($p = 0.151$).

Discussion

The present study focuses on studying the burden of worm infestation among pregnant women and on documenting if helminth infection is a problem in these most vulnerable populations of society. The prevalence of STH in pregnant women in our study was 8.34%, with prevalence in the rural and urban areas of around 10% and 6%, respectively. Various determinants that show a significant effect on STH were age, duration of pregnancy, rural residents, household income, cracks over feet, and not using the toilet.

A study from an urban slum from Chandigarh, India, reported a prevalence of 32.2%, with more than two parasites in 4.6%.[15] A study from Thailand reported 17.9%[22] and a study from Tanzania reported a prevalence of 12.45% of STH.[23]

However, globally, studies reported a variable but high prevalence of STH on microscopy. A study from Columbia reported a

Table 3: Univariate analysis of determinants of STH among pregnant women

Determiants	STH (*n*=184) *n* (%)	No STH (*n*=2022) *n* (%)	*P*
Residence			
Rural	134 (72.83)	1204 (59.55)	Chi=12.46, 0.000
Urban	50 (27.17)	818 (40.45)	
Age*			
Mean (SD)	24.50 (3.52)	24.06 (3.33)	0.08
House type			
Pucca	136 (73.91)	1143 (56.53)	Chi=21.62, 0.000
Kuccha	48 (26.09)	879 (23.47)	
Income**			
Mean (SD)	8316 (5926)	12250 (7608)	0.001
Duration of pregnancy			
1st Trimester	0	205 (10.14)	Chi=22.16, *P*=0.000
2nd Trimester	78 (42.39)	855 (42.28)	
3rd Trimester	106 (57.61)	962 (47.58)	
ANC checkup			
Mean visits (SD)	3.67 (1.65)	3.60 (2.98)	
WASH practices			
Sanitary latrine facility not available	29 (15.76)	241 (11.91)	Chi=5.63, *P*=0.018
Walk barefoot around house and in toilet	95 (51.63)	767 (37.93)	Chi=7.10, *P*=0.008
Cracks over foot	48 (26.09)	889 (43.96)	chi=22.26, *P*=0.000
Do not practice drinking water purification at household	39 (21.20)	281 (13.90)	Chi 7.224, *P*=0.007

Table 4: Logistic regression analysis to find out the effect of determinants in STH

Determinants of STH	Odds ratio (95% CI)	SE	*Z*	*P*
Age	1.07 (1.02-1.13)	0.028	2.80	0.005
Residence				
Urban	1R			
Rural	2.72 (1.80-4.09)	0.56	4.78	0.000
House type				
Pucca	1R			
Kuccha	1.40 (0.80-2.42)	0.39	1.20	0.230
Cracks over feet				
No	1R			
Yes	2.65 (1.71-4.12)	0.59	4.35	0.000
Use of Footwear in toilet/moving around				
Yes	1R			
No	0.97 (0.61-1.55)	0.23	-0.11	0.912
Handwashing after defecation with soap				
Yes	1R			
No	0;96 (0.50-1.81)	0.31	- 0.12	0.901
Toilet facility in dwelling				
Yes	1R			
No	2.30 (1.34-3.94)	0.63	3.03	0.002
Pregnancy duration (months)	1.48 (1.29-1.70)	0.10	5.58	0.000
No of ANC visits	0.77 (0.66-0.88)	0.05	-3.59	0.000

1R=reference group

prevalence of 41%.[24] Studies from different regions of South America show a very high prevalence of geohelminths, like in Peru (47.2%)[18] and Venezuela (73.9%).[19] In Africa, studies have found the prevalence to be as low as 10.3% and extending up to 63%.[20,21] A study reported a prevalence of 70% of geohelminths among pregnant women from the Thai–Burmese border.[25] In Nepal, 78.8% of pregnant women have been found to be infested with hookworms.[20] A study that uses RT–PCR reported high prevalence compared to microscopy. A study from Ethiopia reported 51.5% of pregnant women were infected with at least one of the STH on RT–PCR, and hookworm was the most prevalent (78.16%) STH.[26]

The key strength of our study is a community-based approach. In contrast, most of the studies reported in the literature are conducted among pregnant women attending the hospital of

the ante-natal clinic. One of the limitations of our study is that we have not considered the seasonal variation for the prevalence of STH.[27] Our study relied on a single stool examination which may result in underreporting of the prevalence.[28] To find out the risk of reinfection during pregnancy requires a longitudinal study.[29] A study by Luoba *et al.* reported that after deworming with a single dose of mebendazole during pregnancy, reinfection rate ranging from 3% to 11% assessed at delivery.[29] The microscopy approach we used may also underestimate the prevalence of STH. The highly sensitive, rapid, and scalable nature of qPCR makes its utilization in diagnosing STH extremely appealing over traditional microscopic methods. Moreover, qPCR can give a quantitative estimation.[30,31] Thus for the accurate burden of STH in pregnant women, a seroprevalence study using RT–PCR as a diagnostic modality is preferable.

In spite of these limitations, findings from this study provide useful infromation regarding the burden and intensity of STH infections in pregnant women and support the policy recommendation for deworming during pregnancy as an important public health intervention.

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Conflicts of interest

There are no conflicts of interest.

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