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Prevalence of Intestinal Helminthic Infection in Pregnant Women

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Abstract:

- ***Background:***

A significant number of pregnant women worldwide are affected by intestinal parasitic infections, which can impact maternal health and pregnancy outcomes. The study assesses the current prevalence and associated factors of intestinal helminth infections among pregnant women in Ogun State, Nigeria.

- ***Methods:***

A cross-sectional study was conducted in four major government owned secondary health facilities in Ogun State between January 2019 and April 2020 among a cohort of pregnant women who were recruited at their first antenatal care visit and tested for soil transmitted helminths and schistosomiasis at enrolment. Stool and urine specimens were processed using standard operating procedures in accordance with structured questionnaires. Relevant demographic information was recorded from study participants. Chi-square tests were used to analyze data using Statistical Package for Social Sciences (SPSS) version 16.0.

- ***Results:***

Overall prevalence of helminth infections is 4.7% among 406 asymptomatic pregnant women. Four parasite species were identified – *Ascaris lumbricoides (2.2%), Hookworm (1.2%), Trichuris trichiura (1.0%), and Schistosoma haematobium (0.3%).* Most infections were light or moderate in intensity. Prevalence aligns with reports from other part of Nigeria and Ghana, but lower than Ethiopia, Tanzania, and Gabon. Higher infection rates were observed in older age groups and among women in their second trimester.

- ***Conclusion:***

The overall prevalence of intestinal helminth infections among pregnant women in Ogun State is low but significant. 4.7% prevalence indicates relatively low infection rates compared to other regions. Four major helminth species identified: *A. lumbricoides, Hookworm, T. trichuria and S. haematobium.* Most infections are light and moderate, with no heavy infections reported. Socioeconomic factors influence infection risk, highlighting the need for targeted health interventions.

Keywords: *Soil Transmitted Helminths, Schistosomiasis, Pregnant Women, ANC and Ogun State.*

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I. INTRODUCTION

Soil-transmitted helminths (STH) vis-a-vis *Ascaris lumbricoides, Trichuris trichiura, and the hookworms (Ancylostoma duodenale and Necator americanus)* are among the most widespread neglected tropical diseases (NTDs) (Mengist *et al*, 2017). In 2010, soil-transmitted helminths were estimated to infect more than a billion people (Sartorius *et al.*, 2021). STH infections are among the most common infections worldwide, affecting an estimated 1.5 billion people, that is over one quarter of the world's population. The global burden is estimated at nearly 5 million disability-adjusted life years (DALYs) (Osama *et al.*, 2015, Sartorius *et al.*, 2021). The parasites are mainly transmitted through the soil of impoverished nations where sanitation and average water supply are either poor or inadequate (WHO, 2023). Over 138.8 million pregnant and lactating women, 108 million adolescent girls, 260 million pre-school children and 654 million schoolchildren live in areas where these parasites are intensively transmitted, and are in need of treatment and preventive interventions (WHO, 2023).

STH infections are rarely fatal but cause chronic morbidity (Pullan *et al.*, 2014). Morbidity due to STH is related to the number of worms harboured by individuals. People with few worms (light intensity) usually do not suffer from the infection, while those with heavier infections suffer from chronic health problems and long-term sequelae (Sartorius *et al.*, 2021). Helminth infection can be asymptomatic and can cause disease in their hosts, including anaemia, nutritional deficiencies, changes in immunity, and more serious complications, such as elephantiasis and organ blockages (Tweyongyere *et al.*, 2009; WHO, 2010). Since these complications might have consequences for pregnant women or developing fetuses, the World Health Organization has recommended that pregnant women be treated for helminth infections. However, these recommendations were made largely in the absence of adequate clinical trials, and more recent studies have begun to recognize that helminth infection and helminth treatment can have complex effects on mothers and infants (WHO, 2010)

Schistosomiasis is another neglected tropical disease caused by parasitic worms; with five major species recognized worldwide. These are *S. mansoni, S. haematobium S. intercalatum, S. japonicum, and S. mekongi. S. mansoni and S. haematobium* are the most predominant species in sub-Saharan African countries responsible for intestinal and urogenital morbidities. Transmission occurs through the contamination of water bodies from the urine or faeces of an infected person and mostly common in resource-limited rural, peri-urban or urban areas (Colley et al, 2014, Salawu and Odaibo, 2016. Oyeyemi et al, 2020). Schistosomiasis cases occur in about 258 million people worldwide (Oyeyemi et al, 2020), with Nigeria having the highest burden particularly those infection due to *Schistosoma haematobium* (urogenital schistosomiasis) globally (Oyeyemi *et al*, 2020). The disease statistically affects 200 million people with 80 percent of those infections being in Sub-Saharan Africa. It is estimated that 40 million women of child bearing age are infected yearly (WHO, 2013). An estimated ten million pregnant women in Africa who are infected with schistosomiasis suffer from anaemia and almost seven million pregnant women in sub- Saharan Africa are infected with hookworms and are also at risk of developing anaemia (Mor *et al., 2010*; CDC, 2013). *Schistosoma haematobium* causes urogenital schistosomiasis in about one third of infected women, and this is considered a potential risk factor for sexually transmitted infection and adverse outcome of pregnancy (Luoba, 2005; Kawai, 2009). We embarked on this study in order to ascertain the current prevalence of intestinal helminths and schistosomiasis infections among asymptomatic pregnant women and proffer possible solution on how to minimize the burden of these infections on both the expectant mothers and foetus in the study area.

II. METHODS

- *Study Design and Duration:*

This was a cross-sectional study conducted between January 2019 and April 2020.

- *Study Area*

The study was carried out in Ogun State, South-western Nigeria.

- *Study Population:*

The study population comprises of pregnant women of reproductive age group seeking antenatal care for the first time at government own health facilities who voluntarily accepted to be part of the study that was randomly enrolled.

- *Ethical Consideration*

The study protocol was approved by Olabisi Onabanjo University Teaching Hospital, Health Research Ethics Committee and Ogun State Hospitals Management Board, Abeokuta.

- *Sample Size*

Sample size was determined using the Daniel's formula:

$$n = \frac{z^2 P(1-P)}{D^2}$$

Where n is the minimum sample size,

D is margin of error (0.05),

P is the estimated prevalence (49.5%),

Z is the standard normal deviate that corresponds to 95% confidence interval (1.96),

$n = (1.96)^2 \times 0.495(1 - 0.495) / (0.05)^2$

n = 3.8416 x 0.495 x 0.505/ 0.0025

n = 0.962243968 / 0.0025

= 384.8975

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The minimum sample size to be collected for this project will be 384, but in order to make allowance for attrition, as many as 500 pregnant women were included in the study initially.

➤ *Inclusion Criteria*

- Pregnant women both Primigravida and Multigravida registering for the first time in that particular pregnancy at any of the State Hospitals across Ogun State.
- Willingness to participate in the study

➤ *Exclusion Criteria*

- Clients too sick or those not willing to participate in the study

➤ *Source of the Samples*

Samples collected were mid -stream urine and stool. The samples were collected from pregnant women who showed up and registered at the antenatal care clinic for the first time in this particular pregnancy and who have consented to be part of the study.

III. METHODS OF RESEARCH

➤ *Samples Collection and Methods of Analyzing:*

- *Sampling Method and Data Collection*

Stratified sampling method was used in selecting the health facilities where this study was conducted across the State while convenience (purposeful) sampling was used to sample the respondents. Participants' socio-demographic characteristics including age, gravida and parity were documented. Early morning mid-stream urine and stool samples were also collected for laboratory investigations. The following investigations were determined for each respondent:

✓ Direct smear, formol-ether concentration, brine floatation concentration and kato-katz for ova of intestinal parasites
✓ Urine filtration method for ova of *Schistosoma haematobium.*

- *Specimen Collection and Processing:*

Once participants gave signed informed consent, their stool and urine samples were collected. Parasitological analysis.

- *Stool and Urine Examination*

Freshly voided stool and mid-stream urine specimens were collected from each participant into pre-labelled universal containers. While the stool samples were checked for intestinal parasites, the urine samples were checked for ova of *Schistosoma haematobium* using standard parasitological procedures vis-à-vis Formol-ether concentration, kato-katz and urine filtration methods.

➤ *Stool Examination*

- *Direct Examination (Saline and Iodine Preparation)*

These were carried out on the faecal samples collected using wet preparation. A drop of fresh physiological saline was placed on one end of a clean slide and a drop of iodine was placed on the other end of the slide. Using an applicator stick, a small quantity of stool specimen was emulsified in saline and another iodine solution. Each preparation was covered with cover slip and examined under the microscope from the presence or absence of intestinal parasite, larvae, ova or cysts. The preparation was observed under the microscope using X 10 and x40 objectives respectively with the condenser iris close sufficiently to give good contrast (Cheesbrough, 1998, 2004).

- *Saturated Sodium Chloride (Brine Floatation Concentration Method)*

A universal bottle was filled to about one quarter with saturated sodium chloride solution (brine), about 1g of faeces was then added, emulsified and mixed thoroughly using a glass rod. The universal bottle was then filled with saturated sodium chloride solution and was allowed to stand vertically. Using a Pasteur pipette saturated sodium chloride was further added to ensure that the bottle was filled to the brim. A clean cover slip was placed on the top of the bottle and left for 30 minutes; the cover slip was removed using forceps, placed on a slide and examined under the microscope using x10 and x40 objectives (Cheesbrough, 1998, 2004).

- *Formol-Ether Concentration Technique for Rapid and Wide Range Concentration*

Using a rod, about 1g from each of the faecal specimen was emulsified in about 7ml of 10% formol saline contained in a screw-cap bottle. The emulsified faeces were sieved into a beaker The suspension was later transferred into a glass centrifuge tube and about 3ml of diethyl ether was added. The tube was stoppered and shaken vigorously for 1munite and then centrifuged at 3, 000rpm.The layer of faecal debris was loosened from side of the tube using an applicator stick and the supernatant poured away. The deposit was re-suspended by tapping the bottom of the tube with finger. The deposit was transferred to a slide using a Pasteur pipette; the slide was covered with a cover slip and examined under x10 and x40 objectives of the microscope.

- *Kato-Katz Test Procedure*

The Kato-Katz test was done by following strictly manufactural instructional manual procedure.

✓ A drop of faecal sample was placed on newspaper, pressed gently with a piece of nylon sieve, scraped with the flat-sided spatula across the upper surface of the nylon sieve so that the faeces are filtered out of the sieve and accumulated on the spatula.
✓ A quantitative template was placed on the center of a microscope slide, then filled up the central hole of the template completely with the filtered faeces using the spatula. Excess faeces were removed from the edge of the hole.

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26mar356

- ✓ The quantitative template was carefully lifted up from the slide and ensured that all the faecal sample in the hole was left on the slide.
- ✓ The faeces was covered with a piece of cellophane which has been pre-soaked in dye solution for 24 hours, pressed gently on the sample with a spatula, and then spread the sample evenly.
- ✓ The slides were serially numbered, and kept on the bench with the cellophane upwards at room temperature for 1 hour (Notes 5) followed by microscope examination.

- *Interpretation of Results*

The egg number per gram faeces (EPG) is 24 times as many as the parasite egg number counted by microscope examination.

- *Urine Examination*

The membrane filtration technique was used to concentrate urine specimens for *Schistosoma haematobium* eggs as previously described by Cheesbrough, 2004. Each specimen was homogenized and 10 ml aliquot pushed through 8 µm filter membrane fitted in a 25 mm Millipore filter. The process was repeated using 10 ml of physiological saline. The filter holder was disengaged and the filters removed and placed upside down onto a microscope slide. A drop of physiological saline was added to moisten the filtrate. Slides were examined under the microscope for *Schistosoma haematobium* eggs using both ×10 and ×40 objectives. The number of eggs was counted and was reported per 10 ml of urine.

- *Data Analysis*

Data entry and validation was performed in Excel, and statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 16.0. Values were considered statistically significant when *p*-values are less than 0.05 *(p<0-05)*. Chi square was used to determine the association between variables and infections, age group and infections, gravidity and infections, and parity and infections as indicators of parasitic infections. Cross tabulations were used to determine the frequencies and percentages between variables.

IV. RESULTS

Table 1 Socio-Demographic Characteristics of Participants

Characteristics	**Frequency**	**Percentage**
Age group (year)		
<18	7	1.7
19-34	347	85.5
35-50	51	12.6
>50	1	.2
Marital status		
Married	391	96.3
Single	15	3.7
Income		
Low	218	53.7
Middle	186	45.8
High	2	.5
Occupation		
Employed	183	45.1
Unemployed	204	50.2
Student	15	3.7
Housewife	4	1.0
Education		
Primary education	15	3.7
Secondary education	199	49.0
Tertiary education	163	40.1
Vocational	29	7.1
Gravidity		
Prim gravidity	160	39.4
Multigravida	246	60.6
Trimester		
First trimester	24	5.9
second trimester	286	70.4
Third trimester	96	23.6
Type of toilet		
Pit toilet	163	40.1
Modern toilet	243	59.9
Source of water		

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Borehole	57	14.0
Tap water	243	59.9
Well/Stream	106	26.1
Gynae attended		
Always	279	68.7
Occasionally	127	31.3
Footwear		
Always	323	79.6
Occasionally	83	20.4

Table 1 displayed the socio-demographic characteristics of the pregnant women under study. The table shows the mean age of 406 women tested to be 28.8±5.6 years, with majority of them (85.7%) falling on age bracket 19 – 34 years while few (1.7%) are on age bracket ≤ 18 years. 96.3% of these women are married while 3.7% are single. Most of them fall on low- and- middle income earners (53.7% and 45.8%) with only 5% of them falls on high income earner. 45.1% are gainfully employed, 50.2% unemployed, 3.7% are students and 1.0% remain as full housewife. Educationally, 40.1% had tertiary education, 49.0% had secondary education, 7.1% vocational education while 3.7% had primary education. On the toilet facilities, water source, and footwear characteristics of the subjects; 60% of them claimed they had modern toilet facilities, 40% used pit toilets. The table also shows tap water (59.9%) as the principal water source, 14% made use of water from borehole, others especially those living in the rural areas depends on either well or stream as their major water source. On foot wear, 79.6% claimed they put on either palm sandal always while the remaining 20.4% agreed on wearing it occasionally.

Table 2 Parasitic Species and Infection Intensity

Helminths	No. Positive (%) N=406	Infection Level (%)			
		Negative	Light	Moderate	Heavy
A. lumbricoides	9 (2.2)	397 (97.8)	7 (1.7)	2 (0.5)	0 (0)
Hookworm	5 (1.2)	399 (98.3)	5 (1.2)	0 (0)	0 (0)
T, trichiura	4 (1.0)	402 (99.0)	4 (1.0)	1 (1.3)	0 (0)
S.haematobium	1 (0.3)	405 (99.8)	0 (0)	1 (1.3)	4 (0)
Total	19 (4.7)				

Table 2 details the types of parasites found and their infection levels. *Ascaris lumbricoides* was the most common, with 2.2% prevalence; mostly light infections. Hookworm prevalence was 1.2%, all light infections. *Trichuris trichiura* had a 1.0% prevalence, all light infections while *Schistosoma haematobium* was found in 0.3%, with moderate infection levels. Infections were predominately light and moderate, with no heavy infections observed.

Table 3 Association Between Age Distribution and Helminth Infection During Pregnancy

Characteristic	≤18 n (%)	19-34 n (%)	35-50 n (%)	>50 n (%)	Total n (%)	χ^2	P value
Ascaris lumbricoides	0(0.0)	8(90.0)	1(10.0)	0(0.0)	9(100.0)	0.280	0.964
Hookworm	0(0.0)	5(100.0)	0(0.0)	0(0.0)	5(100.0)	0.861	0.835
T. trichiura	0(0.0)	4(100.0)	0(0.0)	0(0.0)	4(100.0)	0.687	0.876
Schistosoma haematobium	0(0.0)	1(0.3)	0(0.0)	0(0.0)	1(100.0)	0.170	0.982
TOTAL	0(0.0)	18(95.0)	1(5.0)	0(0.0)	19(100.0)	1.596	0.660

Table 3 shows association between age distribution and helminthic agents among the pregnant women. The table revealed that age group 19 - 34 had the highest prevalence of infection 19(95%), followed by age group 35-50(5%). No infection was recorded in age groups ≤18 and >50.

Table 4 Prevalence of Helminthic Agents with Respect to Gravidity

Infections	Gravidity				
	Primiagravid n (%)	Multigravid n (%)	Total n (%)	χ^2	P value
Ascaris lumbricoides	4(40.0)	6(60.0)	10(100.0)	0.001	0.605
Hookworm	3(60.0)	2(40.0)	5(100.0)	0.872	0.387
T. trichiura	3(75.0)	1(25.0)	4(100.0)	2.112	0.171
S. haematobium	1(100.0)	0(0.0)	1(100.0)	3.362	0.187

Table 4 showed the prevalence of helminthic agents with respect to gravidity. *Hookworm*, *T.trichiura and S. haematobium* infects primigravid (60%, 75% and 100%) more than multigravid (40%, 25% and 0%). On like other helminthes, *Ascaris lumbricoides* was more pronounced among multigravid (60%) than primgravid (40%). There is no association between helminthes infection and gravidity statistically.

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Table 5 Factors Associated with Helminth Infections Among the Pregnant Women

Characteristics n=406	n (%)	Helminthes n=20		
Age				
<18	7(1.7)	0(0.0)	1.596	0.660
19-34	347(85.5)	19(5.5)		
35-50	51(12.6)	1(2.0)		
>50	1(0.2)	0(0.0)		
Marital status				
Married	391(96.3)	17(4.3)	4.554	0.032*
Single	15(3.7)	3(20.0)		
Income				
Low	218(53.7)	16(7.3)	6.417	0.040*
Middle	186(45.8)	4(2.2)		
High	2(0.5)	0(0.0)		
Occupation				
Employed	183(45.1)	3(1.6)		
Unemployed	204(50.2)	14(6.9)	13.339	0.004*
Student	15(3.7)	3(20.0)		
Housewife	4(1.0)	0(0.0)		
Education				
Primary education	15(3.7)	1(6.7)	3.561	0.313
Secondary education	199(49.0)	1(6.5)		
Tertiary education	163(40.1)	4(2.5)		
Vocational	29(7.1)	2(6.9)		
Gravidity				
Prim gravidity	160(39.4)	11(6.9)	2.142	0.143
Multigravida	246(60.6)	9(3.7)		
Trimester				
First trimester	24(5.9)	0(0.0)		
second trimester	286(70.4)	10(3.5)	8.671	0.013*
Third trimester	96(23.6)	10(10.4)		

The study explores demographic and socioeconomic factors linked to infection risk. Significant association with marital status was observed: married women had lower infection rates. On income level; low-income women had higher infection prevalence (7.3%) compared to middle and high-income groups. Unemployed women showed higher infection rates (6.9%) than employed women, and second trimester women had higher infection prevalence (3.5%) than first and third trimesters. No significant association with age, gravity, education, or toilet facilities table 5.

V. DISCUSSION

The prevalence and intensity of intestinal helminth infection among different populations are the functions of myriad factors vis-à-vis the environmental factors, socio-economic and cultural practices, and host factors (Cheesbrough, 2004; Brooker *et al.*, 2007). In this study, the prevalence of intestinal parasites recorded among pregnant women attending Antenatal care clinic in different parts of the State was 4.7%. The result of this study is akin to 4.2% reported in Bauchi, Nigeria; 6.9% in Ibadan, Nigeria and 5.0% reported in Ghana (Nnamani et al., 2021, Arinola et al., 2015 and Asundep *et al.*, 2014). Our result is lower than 31.5% reported among pregnant women in Ethiopia, 17.6% reported in Ghana, 43.4% in Nigeria and 64% reported in Gabon (Derso *et al.*, 2016; Yatich *et al.*, 2009; Egwunyenga *et al.*, 2011 and Adegnika *et al*, 2010). However, our study shows higher intestinal parasitic infection compare to 0.7% reported in Edo State, Nigeria and 0.6% reported in Tanzania (Mordi et al., 2007; Mahande and Mahande, 2016). The low level of intestinal parasitic infections observed in this study could be due improvement in the level of hygiene by the inhabitants of the communities where samples were collected or could be due to low level of environmental pollution by the parasite cysts, ova and larvae. Intestinal parasites transmission occurs via contaminated water, soil, and food. Soil-transmitted helminths are acquired through skin penetration or ingestion of contaminated materials. *Schistosomiasis* is transmitted through contact with contaminated water bodies (Roberts *et al., 2009;* Derso *et al., 2016*). Infection rates vary based on geographical, socio-economic, and environmental factors. The methods employed for stool examination and the time of the year the studies are being conducted may also contribute to the variations.

Four major intestinal helminths were identified in this study, and these include *Ascaris lumbricoides (2.2%), Hookworm (1.2%), Trichuris trichiura (1.0%) and Schistosoma haematobium (0.3%).* Our finding is comparable to report of other researchers in their studies in Nigeria (Idowu *et al.*, 2016; Adebusuyi and Amoo., 2015). *Ascaris lumbricoides* was the most common, with 2.2% prevalence; mostly light infections. However, 2.2% ascariasis

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prevalence was lower compared to 47.6% reported in a similar study in Kenya but significantly higher than 0.7% reported in Mexico (Weseka *et al.*, 2014; Ramos *et al.*, 2005). *Hookworm* prevalence was 1.2%, all light infections. This Hookworm prevalence rate of 1.2% was low in comparison with 11.2% reported in Kenya, 56.6% reported in Tanzania and 44.5% reported in Uganda among pregnant women (Luoba *et al.*, 2005; Brooker *et al.*, 2008). The finding in this present study is comparable to 3.9% reported among pregnant women in Kenya (Weseka *et al.*, 2014). The difference could be as a result of variations in the sample sizes and geographical areas where the study was conducted. *Trichuris trichiura had a 1.0%* prevalence, all light infections. This is lower than 1.7% reported in other part of Nigeria by Alakija (1986), and 4.6% reported in Nyanza province of Kenya (Luoba, 2005); but similar to 1.3% reported by Weseka *et al* (2014) in Kenya. *Schistosoma haematobium* was found in 0.3%, all moderate infection levels. The low prevalence of *S. haematobium* recorded in this study contradicted 3.7% reported in Ghana by Kofi-Tay *et al.,* (2017). Infections were predominately light and moderate, with no heavy infections reported. This finding is similar to the result of Boel *et al.*, (2010) among pregnant women on the Thai-Burmese Border.

The result of this study shows that higher infection rates were observed in older age groups than women of lower age groups. Our result here is similar to that of Bismarck *et al*., 2020 which showed helminth infection to be more pronounced among adult age group. However, this result disagrees with earlier findings by Menan *et al*., 1997 and that of Ngangnang and Payne, 2017 who observed a higher prevalence in younger age groups.

With respect to gravidity, this study confirmed the that *A. lumbricoides* increased with gravidity, the result is similar to a study conducted in Kenya among pregnant women (Van *et al.*, 2009) and Ghana (Kofi-Tay *et al.*, 2017). In the case of *Hookworm* infection, it showed a decrease with gravidity. This observation is in consonance to what was reported among pregnant women on the border of Thai-Burmese (Boel *et al.*, 2010). *Trichuriasis* occurred only in age bracket 19-34 years but more predominant among primigravid (75%) than the multigravid (25%).

Concerning factors associated with IPIs, not all the factors examined were associated with IPIs in pregnancy. Here our findings showed that factors like marital status, income, occupation and trimester were strongly associated with IPIs among the studied pregnant women. This finding was comparable with the study conducted in Lalo Kile district, Oromia, Western Ethiopia where occupation was reported to be associated with IPIs among pregnant women especially those who engaged in farming activities (Dejene *et al*., 2019)., while our results are contrary to finding from Mecha district, Northwest Ethiopia (Feleke *et al.*, 2018). The reason for this variation could be due to the fact that participants in this present study were drawn from semi-urban and urban areas.

VI. CONCLUSION

The overall prevalence of intestinal helminth infections among pregnant women in Ogun State is low but significant. 4.7% prevalence indicates relatively low infection rates compared to other regions. Four major helminth species identified: *A. lumbricoides, Hookworm, T. trichuria and S. haematobium.* Most infections are light and moderate, with no heavy infections reported. Socioeconomic factors influence infection risk, highlighting the need for targeted health interventions.

RECOMMENDATIONS AND PUBLIC HEALTH IMPLICATIONS

The study emphasizes the need for routine screening and health education.

- Routine antenatal attendance should include parasitic screening
- Pregnant women with infections should receive anti-helminthic treatment during second and third trimesters
- Improving personal hygiene and sanitations crucial
- Government should ensure funding for research and health interventions
- Education on personal hygiene and sanitation benefits is vital to reduce infection burden.

- *Study Limitations and Future Directions*

The study acknowledges its scope and suggests areas for further research.

- Limited to first-time antenatal attendees in government hospitals, may not represent all pregnant women
- Results may slightly underestimate or overestimate true prevalence
- Further studies needed in rural areas and among women with different healthcare access levels
- Longitudinal studies could better assess infection dynamics and intervention impacts.

- *Funding and Policy Aspects*

Like other researches in Nigeria, the research was a self-sponsored one. Government should adequately fund researches by making grants available and provide enabling environment for private organizations to fund researches.

- *Author's Contribution and Competing Interests*

Adebusuyi S. A and Aborisade O.B. Drafted the manuscript and performed parasitological testing. Prof. Amoo A.O.J Supervised the study design, correct the manuscript writes up and results interpretation.

All authors read and agreed to the content of the manuscript.

No conflict of interest is declared.

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