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Original Article

The burden of soil-transmitted helminthiasis in pregnancy in Kano, Nigeria

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Abstract
Background: Soil-transmitted Helminth infections are important in the tropical and sub-tropical zones of the world, where they cause significant morbidity in pregnancy; it was on this basis that the WHO recommended routine deworming in pregnancy. Several studies have shown a significant prevalence of Soil-transmitted Helminthiasis in pregnancy, but none had been done in Kano. **Objective**: The study was conducted to determine the prevalence of Soil-transmitted Helminthiasis in pregnancy and the need for routine deworming in pregnancy in Kano, Nigeria. **Methodology**: This study was a descriptive cross-sectional study, carried out on 180 pregnant women attending the antenatal clinic in Aminu Kano Teaching Hospital, Kano, Nigeria. The collection of stool samples was done at the antenatal clinic over 6 weeks, between January and February 2015. it was followed by examination under x10 and x40 microscope to determine the prevalence and intensity of infection. The data was analysed using Epi-Info version 3.5, 2008, CDC, Atlanta, USA. Quantitative variables were described using mean and standard deviation, while qualitative variables were described as frequencies and percentages. Statistical analysis was done using the Chi-square test, Student t-test and Fisher exact test to compare proportions. A P-value of < 0.05 was considered statistically significant. **Results:** The study revealed that 18.8% of pregnant women had Soil-transmitted Helminth infestation. Ascaris lumbricoides was seen in 15.3% of them, Hookworm (Ancyclostoma duodenale) in 2.9% and Trichuris trichuria in 0.6%. All infections were of low intensity and none reached endemic level. The practice of geophagy/eating soil-contaminated food or non-food substances was found to be a statistically significant risk factor for helminthiasis in pregnancy (p=0.006). **Conclusion:** The prevalence of Soil-transmitted Helminthiasis among pregnant women attending the antenatal clinic in Aminu Kano Teaching Hospital of 18.8% showed that the infestation did not reach endemic level; all infestations were of low intensity and also of interventional category III, with a low risk of severe morbidity. Routine screening and selective treatment rather than routine preventive chemotherapy is recommended.

Keywords: *Burden, Kano, Pregnancy, Prevalence, Soil-transmitted helminths.*

Introduction
Soil-transmitted Helminths (STH) include *Ascaris lumbricoides*, *Trichuris trichiuria*, and Hookworms (*Ancylostoma duodenale* and *Necator americanus*). They are parasitic nematodes that are transmitted to humans by contact with a parasite egg or larva that thrives in the warm, tropical and subtropical countries of the world including Nigeria.[1-8]

Pregnant women and children are most susceptible to infections by STH and its complications.[7] Pregnancy among other risk factors is associated with reduced immunity and pregnant women have cravings for all forms of non-food items (pica) and sometimes ingest soil (geophagy).[9-15] When infestation occurs, common among the complications is anaemia,[16,17] which is reversible with the use of anti-helminthics.[18-21] Also, helminthiasis increases susceptibility to other infections in pregnancy.[22-26]

Using the Kato-Katz technique, Ibrahim et al in Kano revealed significant helminths infection, most importantly, in females of reproductive age[7] and Ozumba et al in Enugu, showed the prevalence of helminths infection in pregnancy to be as high as 11.8%[16] and other

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studies as well, have shown higher prevalence in pregnancy.[16,19,22,23,27,28] Using the more effective Formol-ether faecal concentration technique and given that Kano has a more conducive socio-climatic condition for STH sustenance,[29,30] infection is likely to be more prevalent among Kano's pregnant population, so investigation of this assumption is therefore justified.

The WHO[31] recommended routine preventive chemotherapy against helminthiasis in pregnancy but only a few countries have implemented this. This study was conducted to lay the basis for the empirical commencement of routine deworming of pregnant women in Kano until a larger, nationwide study is done.[32,33]

Materials and Method

Study design and study population

A descriptive cross-sectional study of systematically randomly recruited, consenting 180 pregnant women, attending the antenatal clinic of Aminu Kano Teaching Hospital, Kano, Kano state, North West, Nigeria, over 8 weeks in 2015.

Sample size determination

The total number of patients recruited for the study was calculated using the formula[34]. $n=z^2p(q)/d^2$

This gave a minimum sample size of 160 which was approximated to 180 by adding 10 % (16) to adjust for attrition.

Standard operating procedure

A total of 180 consenting pregnant women, were recruited over 4 clinic days using a systematic random sampling technique.

Subjects were instructed to provide fresh stool samples at the next antenatal clinic visit, which ranged from one to six weeks, and all fresh stool samples from 170 patients were collected over 6 weeks. Stool from each patient was collected into a well-labelled, dry, clean, leakproof and sterilized container devoid of urine, water, soil or other contaminants.

Using the modified Ridley-Allen Formol-ether sedimentation technique,[35, 36] faecal samples were concentrated for helminth eggs and larvae. Two drops of concentrate/sediment mixed with some drops of Iodine on a glass slide were then examined under x10 and x40 objective microscope. Helminth eggs and larvae were identified by their physical characteristics. Stoll's technique [35] for egg counting was then used to determine the severity of infection in the affected. Major indicators of infection in the study were calculated using the formula[35,37];

I. $\text{Prevalence} = \frac{\text{number of subjects testing positive}}{\text{Number of subjects investigated}} \times 100$

The prevalence of each parasite species, the cumulative prevalence of Soil-transmitted Helminth infection (the prevalence of infection with at least one Soil-transmitted Helminth) and the prevalence of multiple infections were determined.

II. Intensity/severity of infection expressed in mean egg per gram (EPG) of stool sample; Arithmetic mean = $\sum epg/n$ Or Geometric mean = $e\sum \log(epg+1) - 1/n$

Where n is the number of subjects infested.

WHO Proposed Gradation of Infection Intensity/Severity[37]

Grade of Infection			
Helminth	**Light**	**Moderate**	**Heavy**
Ascarislumbricoides	1-4, 999 epg	5, 000-49, 999 epg	50, 000 epg or more
Trichuristrichuria	1-999 epg	1,000-9,999 epg	10,000 epg or more
Hookworm	1-1999 epg	2,000-3,999 epg	4000 epg or more

Interventional categorification of infection

The cumulative prevalence and intensity of infection allow the community under study to be classified into interventional categories viz[37];

I. Category 1; High prevalence, high intensity infection

This denotes any cumulative prevalence and heavy-intensity infection in at least 10% of subjects.

II. Category 2; High prevalence, low intensity infection

This denotes a cumulative prevalence of at least 50% and heavy infection intensity in less than 10% of subjects.

III. Category 3; Low prevalence, low intensity infection

This denotes a cumulative prevalence of less than 50% and heavy intensity of infection in less than 10% of subjects. In areas of endemic hookworm infestation (prevalence greater than or equal to 20 to 30%) and where anaemia is prevalent, they should be classified in category 1[82].

Implication for categories of infection

The implication for category 1 is mass preventive chemotherapy for all ages, sex, or other social status at

least once a year, ensuring simultaneous treatment to improve efficacy. Provision of information, education and communication (IEC) strategies, and improvement in sanitation and water supply, will help reduce transmission since sanitation is likely to be of extremely low standard in these communities[37].

The implication for category 2 is "targeted treatment" of high-risk groups and other general measures like provision of information, education and communication strategies as well as improving sanitation[37].

For category 3, "case management" following diagnosis is recommended. Information, education and communication strategies should be put in place[37].

Data collection techniques and tools

Data was collected at recruitment using a pretested interviewer-administered questionnaire. Written consent was obtained from those willing to participate in the study. Major indicators of infection in the study were determined using WHO criteria[36].

Data analysis

The data was analyzed using Epi Info version 3.5, 2008, CDC, Atlanta, USA. Absolute numbers and simple percentages were used to describe categorical variables. Similarly, quantitative variables were described using measures of central tendency (mean, median) and measures of dispersion (range, standard deviation) as appropriate. Statistical significance was determined using the Chi-square test, Student t-test, and the Fisher exact test. $P< 0.05$ was considered statistically significant. Information obtained and findings from the analysed data were presented in tabular format using different variables.

Ethical consideration

Approval for the study was given by the Ethical Committee of Aminu Kano Teaching Hospital. The provision of the Helsinki Declaration on an investigation of humans was considered.

Results

The study was carried out over 6 weeks. Of the One hundred and eighty pregnant women recruited, only 170 of them returned with their stool sample, giving a response rate of 94.4%. All the subjects who tested positive were treated with 400mg of Albendazole orally.

Socio-demographic distribution of the study population

The age of the respondents ranged from 18 to 43 years, with a mean age of 27.5 ± 2.4 years. The modal age group (58.2%) was 20 – 29 years, while those in the extremes of reproductive age i.e. less than 20 years (7.7%) and 40 years and above (4.1%) were least represented.

Among the respondents, 91(53.5%) had tertiary education, 68(40.0%) had secondary education, 8(4.7%) had primary education, 2(1.2%) had only Islamic education and only 1(0.6%) had no formal education.

Among the parity groups, 53(31.2%) of the subjects were of parity 0, while 91(53.5%) were of parity 1 – 4 and 26(15.3%) were of parity of 5 and above. The respondents' parity ranged from 0 to 11 with a mean parity of 1.7 ± 0.7.

The gestational age in the study ranged from 10 to 40 weeks, with a mean gestational age of 28 ± 2.1 weeks. Among them 7(4.1%) were in the first trimester, 68(40.0%) were in the second trimester, and 95(55.9%) were in the third trimester.

Table 1: Socio-demographic distribution of the study population

Characteristics	Frequency (n= 170)	Percentage (%)
Age		
<20	13	7.7
20 - 29	99	58.2
30 - 39	51	30.0
> 40	7	4.1
Educational status		
None	1	0.6
Primary	8	4.7
Secondary	68	40.0
Tertiary	91	53.5
Islamic	2	1.2
Parity		
0	53	31.2
1 - 4	91	53.5
>5	26	15.3
Gestational age		
1st trimester	7	4.1
2nd trimester	68	40.0
3rd trimester	95	55.9

Pattern of infestation among the study population

Table 2: Pattern of infestation among the study population

Helminths	Frequency (%) n = 170
Ascaris lumbricoides	27(15.3)
Ancylostoma duodenale (Hookworm)	5(2.9)
Trichuris trichiuria	1(0.6)
Cumulative infestation (infestation by at least one helminths)	32(18.8)

*One patient was infested by two *Helminths* (*Ascaris lumbricoides and Trichuris trichiuria).*

Pattern of intensity of infestations among the study population

Table 3 shows that all infestations were of low intensities and combined with the overall prevalence of 18%, infestation was of Interventional Category III.

Table 3: Pattern of intensity of infestations

Helminths	Mean egg per gram (epg)	Grading of infection
Hookworm	700	Low intensity
Ascaris lumbricoides	600	Low intensity
Trichuris trichiuria	200	Low intensity

Pattern of risk factors and impact on the prevalence of infection

Table 4 shows that 90% of the population studied ate undercooked or uncooked vegetables, and 17.7% of this group had STH infestation (P-value of 0.322). A significant proportion of subjects who practised geophagy/pica / picked fallen food items were found to be infested (P-value of 0.006), demonstrating a statistically significant association with STH infection. Only 4.7% drank untreated stream water and 25% of this subset of pregnant women had infestation (P-value of 0.646). Bathing outside the house (1.2%) and walking barefoot (2.4%) were the least risky behaviours among the pregnant women, but these subsets each had 50% of them infested with respective P-values of 0.342 and 0.161.

Table 4 also shows the impact of time of last deworming on the prevalence of infestation. Most of the pregnant women (58.8%) were never dewormed, 17.7% of them could not remember when they were last dewormed and 23.5% were dewormed at least once in the past. Most of those who could not remember when last they dewormed (23.3%) and who never dewormed (22.0%) were infected. Only 7.5% of those who dewormed at least once in the past were infected. Given the P-values (0.455, 0.661 and 0.281) for these subsets, the time of last deworming did not have not statistically significant impact on infestation.

Table 4: Pattern of risk factors and impact on prevalence of infection in the study group

Variable	n = 170 Frequency (%)	Proportion positive (%)	Test of significance	P - value
Risky behaviour				
Bathing outside	2(1.2)	1(50.0)	Fisher exact	0.342
Walking barefooted	4(2.4)	2(50.0)	Fisher exact	0.161
Eating uncooked/undercooked vegetables	153(90.0)	27(17.7)	Chi-square	0.322
Drinking stream water	8(4.7)	2(25.0)	Fisher exact	0.646
Geophagy/pica/picking of fallen food items				
subsistence	4(2.4)	-		
farming	28(16.5)	11(39.3)	Chi-square	0.006
Time last dewormed				
<At least once	40(23.5)	3(7.5)	Fisher exact	0.455
Cannot remember	30(17.7)	7(23.3)	Chi-square	0.661
Never	100(58.8)	22(22.0)	Chi-square	0.286

Discussion

The response rate of 94.4% in this study is similar to 89.7% from Peru in South America.[27] Most women in the study (88.2%) were between the ages of 20 and 29 years, which agrees with the finding by Ozumba et al in Enugu,[16] and has been attributed to this age being the most active phase of reproductive age. Over half of the women (54.7%) were Housewives, despite a significant proportion (93.5%) of them having secondary or, tertiary education and as such were of low parity (86.7%). Almost all the women (95.9%) were in the 2nd half of pregnancy.

The prevalence of STH in the study of 18.8% is more than the prevalence of 11.8% found by Ozumba et al in Enugu,[16] but less than 25.7% in Ghana[36] and 55.9% in Uganda,[22, 23] within the same continent. Other investigators in South America and Asia[27, 37, 38] also found greater prevalence. But for the use of the Ridley – Allen Formol ether concentration technique, the difference in prevalence between this and the Enugu study did justify the assumption that Kano is more conducive for STH. It is possible that risk factors not examined in this study contributed significantly to the difference in prevalence from other parts of the world.

Hookworm infestation was found in 2.9% of pregnant women in this study, a similar study in Kano[9] showed a greater prevalence of 8.7% in the general population and 3.7% among females of reproductive age (which does not

as such differ from 2.9% in our study). Whereas Ozumba et al[16] did not isolate Hookworm in their study, a previous study in the general population in Enugu, isolated Hookworm in 27.9% of subjects, putting doubt on the methodology used by either.

The finding of prevalence of 0.6% for *Trichuris trichuria* infestation was rather enigmatic since, the condition for survival of *Trichuris* and *Ascaris* are virtually the same,[5,8-11] as such, other studies[16, 27, 22, 23, 40] showed completely contrasting results. That all infestations were of low intensity, entirely contradicts findings in some other rural studies,[16, 27] but similar to the finding in the study by Nurduati et al.[41] The metropolitan nature of the study area could also have made infestations of interventional category III,[36] with unlikely severe morbidity.

Of all common risky behaviours examined, only geophagy or intake of soil-contaminated food had a statistically significant association with infestation (P = 0.006). However, Pica and the habit of eating soil – soil-contaminated food rather than geophagy are more likely to increase the risk of STH infestation,[12] as most geophagical soils are commercially mined or excavated from uncontaminated depth, and frequently roasted before eaten, thus rending it innocuous.

The timing of the last deworming was not found to have a statistically significant influence on the risk of infestation by geo–helminths (P values > 0.05).

Conclusion

The prevalence of STH in this study of 18.8% showed that the infestation is not at endemic level. In addition, all infestations were low intensity and of interventional category III, and so may not be enough trigger for the commencement of routine deworming of pregnant women.

Ascaris lumbricoides is the most common Geo-helminth infestation in pregnancy

The most important risk factor for Helminth infestation is pica and picking of fallen edible items from the ground. The use of anti-helminthics reduces infestation with cautious statistical significance.

Recommendation:

Routine screening and selective treatment of positive cases should be embarked upon. Pregnant women should be educated on the importance of avoiding risky behaviours and deworming. Future research should ensure a larger sample size and systematic elimination of most, if not all compounding factors.

Conflict of interest

There was no conflict of interest in the conduct of the study

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