



Characterization of Hookworm infestation in pregnant Women in a Tertiary Health Facility in North Central Nigeria

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Abstract: -

Background

Hookworm infestation is one of the commonest intestinal helminths affecting man and can be a significant cause of anaemia and malnutrition among vulnerable population. It is not only preventable but the means to treat are readily available and cheap. **Aim:** The study aimed to determine the prevalence and types of species of hookworm infestation among antenatal clinic attendees and the possible risk factors. **Materials and Methods:** A facility based cross sectional study among 200 consenting antenatal clinic clients at booking at Federal Medical centre Keffi was carried out. Systematic sampling technique was used to recruit all eligible consenting clients thereafter self administered questionnaire containing bio-data, possible socio-demographic risk factors and Obstetric history was completed by each participants. Blood and Stool samples were collected and analyzed in the laboratory for packed cell volume and hookworm respectively. The result was analyzed using SPSS 23. It was summarized as frequency and percentages for categorical variables, mean and standard deviation for normally distributed continuous variables. Independent samples t-test was used for the comparison of continuous variables. The p-value was considered to be significant if < 0.05 . **Results;** The prevalence of hookworm infestation among the studied population was 10% (n=20) with Necator americanus specie constituting 85%. The mean age of the women was 31.00 (SD ± 6.077). and majority are literate (96.5%), over 2/3rd resides in the rural communities, the associated risk factors identified include place of residence (p-0.000), sewage disposal system (p-0.029) and source of water (0.002). **Conclusion:** The prevalence is significant especially among rural dwellers with Necator americanus as the dominant specie. Urgent action is required to improve their sewage disposal system as well as provision of portal and safe water supply.

Keywords: Anaemia; Characterization; Hookworm; Pregnant women; Risk factors.



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Introduction

Hookworm infestation is one of the commonest intestinal parasites that forms part of Soil transmitted helminths (STH) infecting humans and can be a significant cause of anaemia and malnutrition amongst vulnerable populations.

It is of public health importance, affecting over 700 million people globally¹, with the majority of cases in tropical and subtropical countries, especially in middle and low-income countries where the majority live below the poverty line and compounded by poor environmental sanitation and overcrowding.^{1,2} The disease is not only preventable but can be readily treated with cheap resources requiring no high technology. It is responsible for chronic blood loss through the gastrointestinal tract and mal absorption, leading to chronic anaemia and malnutrition. The danger is that the impact is insidious and silent.³ It was projected to have caused a loss of 2.2 million disability-adjusted life-years in 2013.⁴

Hookworm is a nematode with two species known to infect man, namely *Necator americanus* and *Ancylostoma duodenale*. Traditionally, *Necator americanus* is the most predominant species in Sub-Saharan Africa, South East Asia, China, Indonesia and South America,⁵ while *Ancylostoma duodenale* is found commonly in the Middle East, India, North Africa and Southern Europe.⁶ However, evidence from some studies shows that the pattern is changing.⁷

Data from the World Health Organisation (WHO) showed that 700 million people, including 44 million pregnant women, are infected globally.¹ Of this figure, 26.6% are in Sub-Saharan Africa.⁸ The prevalence of the Federal Democratic Republic of Nepal in South Asia ranged between 24.2%⁹ and 74.2%¹⁰. In Africa, prevalence rates of 17.6% were reported in Ghana, 9.9% in Uganda, 8% in Mali and 3.9% in Kenya.¹¹⁻¹⁴ In Nigeria, the prevalence rate ranged from 6.9% to 8.2% amongst pregnant women.^{15,16} It was much higher amongst anaemic pregnant women (27%)¹⁷ in a rural community in the South Eastern part of Nigeria.

Hookworm parasites are transmitted through contacts with contaminated soil resulting from indiscriminate disposal of hookworm egg-laden human faeces. Transmission of *Necator americanus* is only through skin penetration while that of *A. duodenale* can be oral, percutaneous and possibly through vertical transmission.¹⁸ Poor sanitation with inappropriate refuse disposal, poor personal hygiene, non availability of foot protective wears and lack of regular hand washing are other additional risk factors for transmission.

Heavy hookworm infestation may result in anaemia that can be severe in pregnancy similarly it causes malnutrition and stunted growth in children. Anaemia is a significant cause of poor pregnancy outcome and contributes significantly to maternal mortality and morbidity. Anaemia affects over 50% of pregnant women in developing countries, in Nigeria the prevalence can be as high as 60%.¹⁹ Unlike most preventable contributors to poor pregnancy outcome hookworm infestation has received least attention partly due to low coverage of anti helminthic treatment in maternal health programs and the insidious nature of the disease. The study is aimed at determining the prevalence and associated risk factors for hookworm infection that may drive policies towards institutionalization of routine use of ant helminthic in our antenatal clinics.

Material and methods

Study design: This is a facility based prospective study among consenting pregnant women accessing antenatal care services at Federal Medical centre Keffi.

Sample Size:

The sample size was calculated using the Fisher's formula of sample size calculation:

$$n = \frac{z^2 pq}{d^2}$$

Where,

n = minimum sample size

z= normal deviant at the position of 95% confidence level = 1.96

p = proportion or prevalence

A prevalence rate of 8.2% from previous study²⁹ was used. Thus p = 0.082

q =complimentary proportion =1 – p = 1 – 0.08 = 0.92

d= absolute precision = 0.05

Thus,

$$n = \frac{1.96^2 \times 0.08 \times 0.92}{0.05^2}$$

n = 113

Assuming a 10% attrition rate, = 125.5 ≈ 126

However, 220 sample size was used to ensure proper representation of the ante-natal clinic population as an average of 70 new clients are booked weekly at the clinic.

During the study period there were a total of 740 pregnant women that presented for booking at the antenatal clinic. Using systematic sampling technique, 212 consenting clients that met the inclusion criteria were recruited for participation. An ethical approval was obtained from the ethical committee of the hospital.

Inclusion Criteria

All consenting women seen at the antenatal booking clinic of FMC, Keffi during the study period

Exclusion Criteria

1. Use of anti-helminthics within 4 weeks preceding the study by the women.
2. Chronic medical conditions like Sickle cell Disease and HIV positive patients.
3. Patients that was transfused within 4 weeks preceding the study

The bio-data, socio-demographic and clinical details of all consenting clients were obtained using closed-ended questions and recorded on the study proforma. The weight (in kilograms) of each client was taken using an electronic weighing balance while their height (in meters) was taken using a meter rule.

Stool and blood specimen were collected from each participant.

Stool Specimen Examination: Fresh stool specimens were examined by wet-mount method for hookworm identification, and Kato-Fatz technique for hookworm egg density estimation.

- **Wet Mount Method:** A drop of normal saline and iodine was added and mixed properly with a little amount of the stool sample in a glass slide and covered with a covered slip. The mixture was then examined on a microscope under power magnification of 10 and 40. The presence of ova was then recorded.
- **Stool Culture:** The remaining stool specimen was further cultured for a week on a moist filter paper. Based on species characteristics the larvae of *Ancylostoma duodenale* and *Necator americanus* were identified and recorded accordingly.
- **Kato-Fatz Technique:** Using the Kato-Fatz technique, the density of infection in number of eggs/gram of faeces was determined and then classified as showed below²⁰.

The egg density was classified as follows:

Nil:	0 egg/gram
Light density:	1 to 1999 egg/gram (+)
Moderate density:	≥ 2000 to 3999 egg/gram (++)
Severe density:	≥ 4000 egg/gram (+++)

Blood Sample Collection

A capillary blood sample was collected for packed cell volume estimation during same antenatal clinic visit with the stool collection and appropriately labeled.

Blood Sample Analysis

The packed cell volume (PCV) of the participant was determined using blood collected into a heparinised capillary tube. One end of

each capillary tube was occluded using plasticine. Thereafter, the capillary tube was mounted on a micro-haematocrit centrifuge and was spun for 5 minutes. Each capillary tube was then mounted on a haematocrit reader for the reading of the red cell column, measured in height (millimetres as a percentage of height in millimetres) of the whole capillary blood column. The haematocrit was taken as the volume of erythrocytes expressed as a percentage of whole blood in the sample²¹.

Data analysis: The data collected was cleaned and analysed using the Statistical Package for Social Sciences (SPSS) software version 23. It was presented as frequency and percentages for categorical variables, mean and standard deviation for normally distributed continuous variables and median and range for non-parametric data. Independent samples t-test was used for the comparison of continuous variables. The p-value was considered to be significant if $p < 0.05$.

Results

A total of 200 samples were finally analyzed from the 210 consenting pregnant women recruited for the study due to incomplete questionnaire.

The prevalence of hookworm infection among the study population was 10% ($n=20$), *Necator americanus* was the most predominant species accounting for 85% ($n=17$) of cases. 2.5% ($n=5$) of those infected have co-infection with other soil transmitted helminths. The age profile of the participants ranged between 19 and 45 years with a mean of 31.00, most of the subjects were in the age group of 30-39 years ($n=112$; 56%). Almost all the subjects were married 99.5%. The literacy level was very high, over 90% had at least secondary level of education with only 3.5% without formal education. Majority of the participants were gainfully engaged (65%) with farmers making up just 1%. Those in rural setting made up 64% of the population studied (table 1).

Table 1: Socio-demographic variables of the participants ($n=200$)

Socio-demographic Profiles of participants			
VARIABLES		Frequency	Percent
Age(years)	<20 years	2	1.0
	20-29 years	79	39.5
	30-39 years	112	56.0
	40-49 years	7	3.5
Marital status	Married	199	99.5
	Single	1	.5
Education	None	7	3.5
	Primary	12	6.0
	Secondary	75	37.5
	Tertiary	106	53.0
Occupation	Skilled	66	33.0
	Unemployed	75	37.5
	Unskilled	59	29.5
Residence	Urban	71	35.5
	Rural	129	64.5

TABLE 2: Household characteristics of the study participants (n=200)

VARIABLES		Frequency	Percent
Toilet facility	Separated	112	56.0
	Shared	88	44.0
Sewage system	open	1	.5
	Pit latrine	8	4.0
	WBC	191	95.5
Refuse disposal	Burning	4	2.0
	Incinerator	178	89.0
	Open	18	9.0
Source of water	Bore hole	1	0.5
	pipe borne water	5	2.5
	Surface water	151	75.5
	Treated water	39	19.5
	Well	4	2.0
Use of foot wear	No	5	2.5
	Yes	195	97.5
	Total	200	100.0
Regular hand wash	No	126	63.0
	Yes	74	37.0

Most of the participants (95%; n=191) uses water closet system for their sewage disposal out of which 44% (n=88) are shared, only 0.5% (n=1) of the subject practiced open defecation. Majority of the respondents (89%) disposed their refuse via the incinerator, majority (97.5%) of the subjects used footwear frequently at home, 63% (n=126) routinely wash their hands following defecation and (75.5%) accessed the borehole for drinking water

TABLE 3: Burden of Helminths infestation in the study participants (n=200)

		Hookworm		
Other intestinal helminths		Absent	present	Total
		165	15	180
Absent				
Ascaris		2	0	2
E.coli		3	1	4
E.Histolitical		10	4	14
Total		180	20	200

The prevalence of hookworm is 10% (n=20) out of which 2.5% (n=5) had co-infection with other soil intestinal helminths including entamoeba histolytical.

Table 4: Risk factors associated with hookworm infestation among participants (n=200)

		Hookworm		X ²	p-value
VARIABLES		Absent	present		
Age (years)	<20 years	2	0		
	20-29 years	74	5		
	30-39 years	98	14		
	40-49 years	6	1	2.326	0.508

Occupation	Skilled	58	7	1.062	0.588
	Unemployed	65	5		
	Unskilled	57	8		
Residence	Rural	53	18	28.827	0.000
	Urban	127	2		
Toilet facility	Separated	105	7	3.977	0.046
	Shared	75	13		
Sewage disposal	open	1	0	7.099	0.029
	Pit latrine	5	3		
	WBC	174	17		
Refuse disposal	Burning	4	0	1.373	0.503
	Incinerator	161	17		
	Open	15	3		
Source of water	Bore hole	0	1	16.794	0.002
	pipe borne water	5	0		
	Surface water	138	13		
	Treated water	35	4		
	Well	2	2		
Use of foot wear	No	4	1	0.57	0.45
	Yes	176	19		
Hand wash	No	110	16	2.755	0.097
	Yes	70	4		

The association of hookworm infestation and subject socio-demographic variables were sought and shown in table 3 above. Place of residence, hygiene habits of sewage disposal system, toilet facility and source of drinking water were found to be statistically associated with hookworm infestation (p value of 0.000; 0.029; 0.046 and 0.002 respectively).

Figure1: Prevalence of hookworm

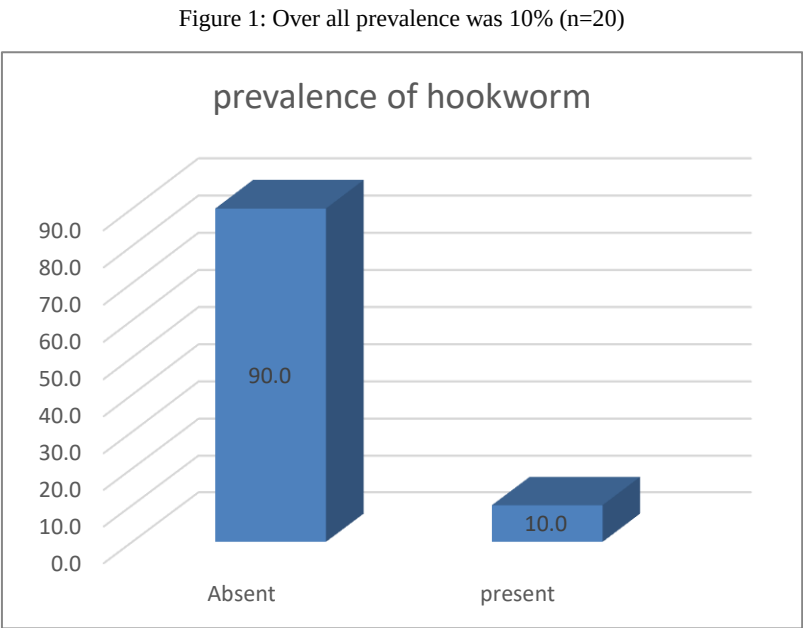


Figure 2: Species of hookworm among study population

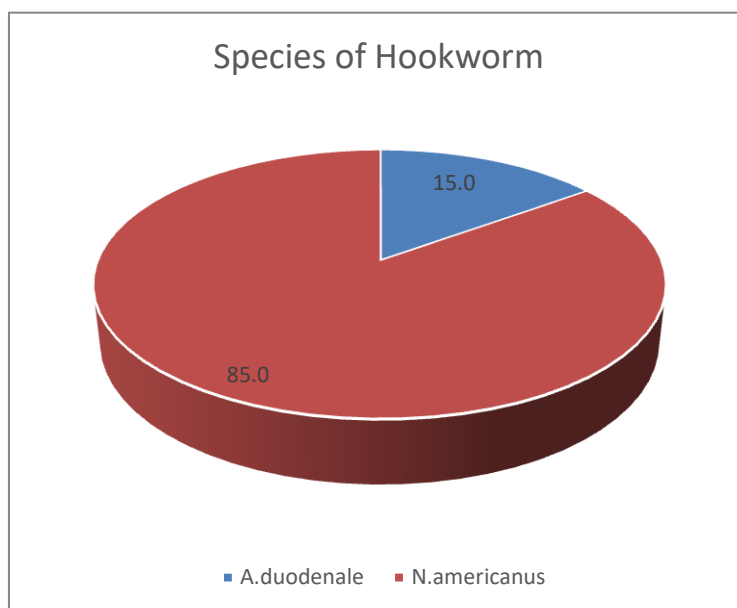


Figure 2: Necator americana species accounted for 85% (n=17)

Figure 3: Prevalence of anaemia among those with hookworm infestation

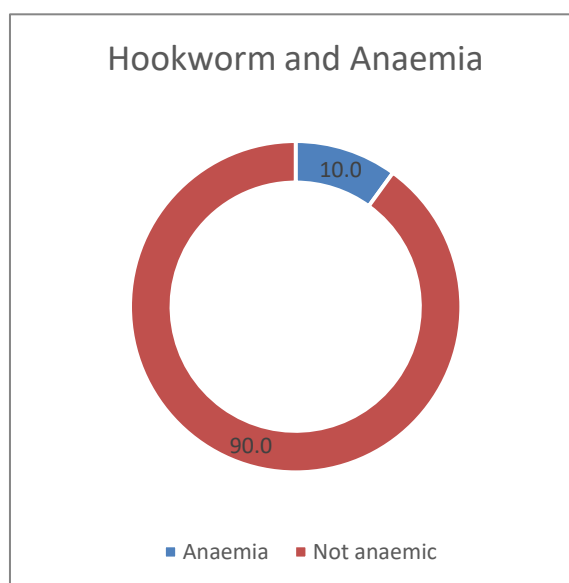


Figure 3: Only 10% (n=2) of patients with hookworm are anaemic

Discussion

In this study the prevalence of hookworm infestation among pregnant women attending the antenatal clinic services of FMC Keffi was 10% (n=20) which is similar to the 9.9% found in a study in Uganda.¹³ This is higher than the prevalence rate of 8.2%²⁹ in the Niger delta¹⁷ and 6.9% in Ibadan South West Nigeria.¹⁶ On the other hand, a higher prevalence rate of 17.6% was reported in Ghana.¹² The probable reason for this marked difference in prevalence in relation to Ghana maybe due to the study methodology and the population. The Ghana study was done in a rural setting as against this study that was facility based and in a semi urban area. The association between place of residence and hookworm showed a statistical significance in favour of those in

rural settings. It was found that people who reside in the rural areas had the highest hookworm prevalence rate of 90% (n=18) this is not surprising because people that live in the rural areas predominantly feed on fresh vegetables and less processed food which has a high risk of transmission. They are less likely to dispose their sewage and refuse properly. Most are agrarians working in their farms bare footed and therefore exposed to the disease. A high prevalence of 80% (n=16) was also found in people who don't routinely wash their hands after defecation. Routine hand washing has been proven to be one of the most effective low cost ways of infection prevention strategies.

There was no statistical significance between hookworm infestation and anaemia with a p value of 0.911. This is in contrast

to a study in Europe which revealed a direct relationship between hookworm infestation and anaemia and that in sub-Saharan Africa which also revealed that 50% of women with iron deficiency anaemia in pregnancy also had hookworm infestation.^{22 & 23} Another study done in Nepal also revealed a high prevalence of hookworm infestation with associated morbidities like anaemia and reduced immune resistance.¹¹ The reasons for this difference may not be readily deduced from the study, however, hookworm density, duration of infestation and background nutritional status plays an important role in the development of anaemia among those with hookworm parasites.

Safe disposal of human faeces is essential for the control of hookworm infestation. Sanitary measures include the provision of toilets along with training on their use as well as appropriate treatment of human waste before it is used for agriculture as manure. There was a statistical association of hookworm infestation in this study with sanitary practice. It was found that those who shared toilet facilities accounted for 65% of those infested with hookworm.

Necator americanus species was the most predominant accounting for 85% (n=17) of cases. This is consistent with the epidemiology of the disease. This species are mostly found in Sub-Saharan Africa, South East Asia, the Pacific Islands and regions where the people are living in abject poverty with poor sanitation, poor hygiene and lacking access to safe drinking water. Nigeria is in Sub-Saharan Africa with over 60% of the population living below poverty line.

Conclusion

The prevalence is significant especially among rural dwellers with *Necator americanus* as the dominant species. Urgent action is required to improve their sewage disposal system as well as provision of portal and safe water supply. There was no significant statistical relationship between hookworm infestation and anaemia.

Recommendations

The disease is not only preventable but can be readily treated with cheap resources requiring no high technology. Some of the strategies to combat the disease include:

1. Health education with emphasis on preventive measures such as regular wearing of shoes, proper hand washing after defecation and before eating and proper sewage disposal to avoid fecal contamination.
2. Robust school-based deworming campaign targeting one of the most vulnerable groups.
3. Community-directed medical outreach for sensitization and treatment approach.

Conflict of interest: No conflict of interest to declare

Funding: There is no external source of funding.

Ethical approval: Ethical approval was sought and obtained from Federal Medical Centre, Keffi Ethics Committee. Interview-based data collection and venous blood sample was taken from participants who signed informed consent form.

References

1. Brooker, S. (2010). Estimating the global distribution and disease burden of intestinal nematode infections: adding up the numbers—a review. *International journal for parasitology*, 40(10), 1137-1144.
2. Hotez P, Bethony J, Bottazzi ME, Brooker S, Buss P (2005) Hookworm: The Great Infection of Mankind, *PLoS Med* 2(3): e67
3. Stoll, N. R. (1962). On endemic hookworm, where do we stand today?. *Experimental Parasitology*, 12(4), 241-252.
4. Vos, T., Allen, C., Arora, M., Barber, R. M., Bhutta, Z. A., Brown, A., ... & Boufous, S. (2016). Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *The lancet*, 388(10053), 1545-1602.
5. Hotez, P. J., Bethony, J., Bottazzi, M. E., Brooker, S., Diemert, D., & Loukas, A. (2006). New technologies for the control of human hookworm infection. *Trends in parasitology*, 22(7), 327-331.
6. De Silva, N. R., Brooker, S., Hotez, P. J., Montresor, A., Engels, D., & Savioli, L. (2003). Soil-transmitted helminth infections: updating the global picture. *Trends in parasitology*, 19(12), 547-551.
7. Hotez, P. J., Brooker, S., Bethony, J. M., Bottazzi, M. E., Loukas, A., & Xiao, S. (2004). Hookworm infection. *New England Journal of Medicine*, 351(8), 799-807.
8. Haburchak DR, Watson CM, Dhawan VK. Hookworm Disease [Internet]. Medscape. 2018 [cited 2018 Dec 24]. p. 1–23. Available from: <https://emedicine.medscape.com/article/218805-overview>
9. Brooker, S., Hotez, P. J., & Bundy, D. A. (2008). Hookworm-related anaemia among pregnant women: a systematic review. *PLoS neglected tropical diseases*, 2(9), e291.
10. Bondevik, G. T., Eskeland, B., Ulvik, R. J., Ulstein, M., Lie, R. T., Schneede, J., & Kvåle, G. (2000). Anaemia in pregnancy: possible causes and risk factors in Nepali women. *European journal of clinical nutrition*, 54(1), 3-8.
11. Dreyfuss, M. L., Stoltzfus, R. J., Shrestha, J. B., Pradhan, E. K., LeClerq, S. C., Khatry, S. K., ... & West Jr, K. P. (2000). Hookworms, malaria and vitamin A deficiency contribute to anemia and iron deficiency among pregnant women in the plains of Nepal. *The Journal of nutrition*, 130(10), 2527-2536.
12. Baidoo, S. E., Tay, S. C. K., & Abruquah, H. H. (2010). Intestinal helminth infection and anaemia during pregnancy: A community based study in Ghana.
13. Joseph Ngonzi, M., & Julius, M. M. (2016). Prevalence, Morphological Types and Factors Associated With Anemia among Mothers Attending Antenatal Clinic at Mbarara Regional Referral Hospital, South Western Uganda. *Prevalence*, 25.

14. Ayoya, M. A., Spiekermann-Brouwer, G. M., Traoré, A. K., Stoltzfus, R. J., & Garza, C. (2006). Determinants of anemia among pregnant women in Mali. *Food and nutrition bulletin*, 27(1), 3-11.
15. Wekesa, A. W., Mulambalah, C. S., Muleke, C. I., & Odhiambo, R. (2014). Intestinal helminth infections in pregnant women attending antenatal clinic at Kitale district hospital, Kenya. *Journal of parasitology research*, 2014(1), 823923.
16. Alli, J. A., Okonko, I. O., Kolade, A. F., Nwanze, J. C., Dada, V. K., & Ogundele, M. (2011). Prevalence of intestinal nematode infection among pregnant women attending antenatal clinic at the University College Hospital, Ibadan, Nigeria. *Advances in Applied Science Research*, 2(4), 1-13.
17. Green, K. I., & Ojule, J. D. (2015). Helminthiasis in pregnancy in the Niger-Delta region of Nigeria. *The Nigerian Health Journal*, 15(2), 69-77.
18. Agu, P. U., Ogboi, J. S., Akpoigbe, K., Okeke, T., & Ezugwu, E. (2013). Impact of Plasmodium falciparum and hookworm infections on the frequency of anaemia in pregnant women of rural communities in Enugu, South East Nigeria. *Pan African Medical Journal*, 14(1).
19. Inya, A. U., Achara, A. P., Ikwuka, A. O., Udeh, F. C., Chikadibia, U., & Onazi, O. (2023). Patterns, Peculiarities and Associated Risk Factors of Anemia in Pregnancy: A Case Study of Pregnant Women Attending Antenatal Clinic in North-Central Nigeria. *European Journal of Preventive Medicine*, 11(2), 21-31. doi: 10.11648/j.ejpm.20231102.12
20. Bärenbold, O., Raso, G., Coulibaly, J. T., N'Goran, E. K., Utzinger, J., & Vounatsou, P. (2017). Estimating sensitivity of the Kato-Katz technique for the diagnosis of Schistosoma mansoni and hookworm in relation to infection intensity. *PLoS neglected tropical diseases*, 11(10), e0005953.
21. Bull BS, Koepke JA, Simson E, Van Assendelft OW. (2000). Procedure for determining packed cell volume by the microhematocrit method; approved standard. 3rd edition. National Committee for Clinical Laboratory Standards, Pennsylvania; 1-18.
22. Feldmeier, H., & Schuster, A. (2012). Mini review: Hookworm-related cutaneous larva migrans. *European journal of clinical microbiology & infectious diseases*, 31, 915-918.
23. Haider, B. A., Humayun, Q., & Bhutta, Z. A. (2009). Effect of administration of antihelminthics for soil transmitted helminths during pregnancy. *Cochrane Database of Systematic Reviews*, (2).