ASSOCIATION BETWEEN HOOKWORM INFECTION AND ANAEMIA AMONG ANTENATAL ATTENDEES IN A UNIVERSITY TEACHING HOSPITAL, IN SOUTHERN NIGERIA

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ABSTRACT

Background: Hookworm infection is among the major causes of anaemia in poor communities. Its importance in causing maternal anaemia however is poorly understood, and this has hampered effective lobbying for the inclusion of anti-helmintic treatment in maternal health packages.

Methodology: A cross sectional analytical study was conducted to assess the association between hookworm infection and anaemia among pregnant women obtaining antenatal Care at the University of Uyo Teaching Hospital, Uyo, Nigeria. Two hundred and fourteen pregnant women were recruited over a six week period. Pre-coded and structured questionnaires were administered to each eligible pregnant woman. Blood samples were obtained for determination of packed cell volume and serum iron/total iron binding capacity respectively. Stool samples were collected from each pregnant woman for microscopy. Data obtained was analyzed with Epinfo-version 3.5.2 December 2010 software. **Result:** Twenty four of 211 women had hookworm infection resulting in a prevalence of 11.4% (95% CI =7.4%-16.5%). Sixty two (29.8%) of 208 women had iron deficiency anaemia. Fourteen (22.6%) of the 62 women with iron deficiency anaemia had hookworm infection while 9 (6.3%) of 143 women without iron deficiency anaemia had hookworm infection (x^2 =11.5, p = 0.000689). **There was no statistically significant association between** hookworm infection and all the socio-demographic variables analyzed except between hookworm infection and place of residence (x^2 = 22.3 and p = 0.0000351).

Conclusion: Hookworm infection is associated with anaemia in pregnant women in Uyo. This therefore reinforces the WHO recommendation to include routine de-worming into our antenatal care package as a strategy to reduce or prevent maternal anaemia.

***Key words**: Hookworm infection, anemia, pregnancy, Uyo*

INTRODUCTION

The scientific study of human hookworm infection began at the dawn of the twentieth century. In recent years, there has been a dramatic improvement in our understanding of many aspects of this globally widespread helminth. Hookworm poses a serious public health problem in most tropical and sub-tropical countries of the world. It is estimated that presently, between 576 and 740 million individuals are infected with hookworm[1]. Most infected individuals live in Sub-Saharan Africa and East Asia with each region having estimates of 198 million and 174 million infected individuals,

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respectively. In Sub-Saharan Africa, between a quarter and a third of pregnant women are infected with hookworm[7].

Several studies in Nigeria reveal high prevalence rates of helmintic infection. In a rural community in Lagos, south-west Nigeria, the overall prevalence rate for intestinal helmintic infection was 83.3% out of which hookworm was 45.0%. In the University of Port Harcourt Teaching Hospital, Rivers State, south-south Nigeria, the overall prevalence of intestinal helmintic infection was 46.0% with hookworm coming second after *Ascaris lumbricoides*. In Abia State, south-east Nigeria, the overall intestinal helmintic infection rate was 34.67%, with hookworm being the second most prevalent intestinal helminth with a rate of 14.8% . In Enugu, south-east Nigeria, the prevalence of helmintic infestation in pregnancy was 11.8%. In the University of Jos Teaching Hospital, north-central Nigeria, hookworm accounted for 14.2% of intestinal helminths found in stool samples of malaria parasitized subjects.

Anaemia affects large numbers of pregnant women in developing countries and increases their risk of dying during pregnancy or delivering low birth weight babies, who in turn are at increased risk of dying. Human hookworm infection has long been recognized among the major causes of anaemia in poor communities. However, the understanding of the benefits of the management of hookworm infection in pregnancy has lagged behind the other major causes of maternal anaemia. An epidemiological study in 1995 highlighted the paradox presented to public health workers: An estimated one-third of all pregnant women in developing countries were infected with hookworm and yet, in the absence of safety data, the appropriate advice then was to avoid the use of anthelmintics in pregnancy.

Following the works of de Silva and colleagues in analyzing the safety profile of some 20 years of mebendazole use in antenatal clinics in Sri Lanka and other clinical trials of mebendazole administration during pregnancy with no adverse birth outcome[8,9], the World Health Organisation (WHO) in 2001 during the 54th World Health Assembly passed a resolution urging member states to provide regular drug treatment to high-risk groups. The WHO also in 2002 published new guidelines indicating that pregnant women should be treated for hookworm infection, ideally after the first trimester. In addition, where the prevalence of hookworm is more than 20% to 30%, the WHO recommended that pregnant women should receive antihelmintic treatment after the first trimester.

Despite the potential benefits of antihelmintic treatment during pregnancy, few countries have included de-worming in their routine antenatal care (ANC) programmes, with only Madagascar, Nepal and Sri Lanka doing so routinely.

The University of Uyo Teaching Hospital (UUTH) has not included routine de-worming of pregnant women as recommended by WHO. However, suspected cases are investigated and given mebendazole. This study seeks to assess the prevalence of hookworm infection as well as the association between hookworm infection and anaemia among pregnant women in UUTH.

MATERIALS AND METHODS

This hospital based cross-sectional analytical study was carried out in the booking clinic of the University of Uyo Teaching Hospital over a six-week (2nd September 2012 – 15th October 2012) period. Structured questionnaires were administered by trained resident doctors to each consenting eligible respondent at the booking clinic after the purpose, general content and confidentiality of the study had been explained to them. A prior questionnaire testing involving 40-

subjects was done to correct initial undetected errors in the interpretation of the questionnaire.

Blood samples were subsequently collected by laboratory scientists working in the antenatal side laboratory into 2 different pre-coded bottles (***a*** and ***b***): The bottle labeled ***a*** was an Ethylene Diamine Tetra-acetic acid (EDTA) bottle for packed cell volume determination while that labelled ***b*** was a plain bottle for Serum Iron and Total Iron Binding Capacity (TIBC) estimations. Finally, each woman was provided with yet another pre-coded sterile bottle and instructed to bring her stool sample within two weeks for microscopy.

Determination of Sample Size

In Abia State, South-East Nigeria, hookworm prevalence was 14.8% [8]. Akwa Ibom state and Abia state are neighboring states with almost the same climatic condition. The minimum sample size was calculated assuming a 95% confidence level using the formula below:

$$n^0 = \frac{Z_{1-\alpha}^2 \times Pq}{d^2}$$

95%)[1]

Where n^0 = minimum sample size

$Z_{1-\alpha}$ = 1.96 (at a confidence level of

P = 14.8% (prevalence)

q = 1 minus P (1-P)

d = 0.05 (degree of freedom)

$$n^0 = \frac{1.96^2 \times 0.148 \times 0.852}{0.0025} \qquad n^0 = 193.7$$

However 214 pregnant women were recruited into the study.

SAMPLING TECHNIQUE

A systematic sampling technique was used. Every K^{th} number from the sampling frame was selected every week on Wednesdays during the booking clinic where k is the sampling interval (which is 3). The starting number was the first pregnant women to have presented for booking for that day if such woman met the criteria.

Exclusion Criteria

Any pregnant woman who withheld her consent to participate in the study was excluded from the study. Other women who were excluded from the study were those with sickle cell anaemia, multiple pregnancy, hypertensive disorders of pregnancy and diabetes mellitus ;any parturient who had taken any anti-helmintic drugs six months prior to the commencement of the study and those who had started taking iron supplements in the index pregnancy were also excluded

Formal approval for the study was obtained from the research ethical committee of the University of Uyo Teaching Hospital. Participation of pregnant women in this study was voluntary and the principle of patient confidentiality strictly adhered to. Women with hookworm infestation were followed up and treated with mebendazole from the second trimester.

Data Analysis: Data obtained was analyzed with Epi info-version 3.5.2 December 2010 software. For determining significant association chi-square was used and a p-value of < 0.05 was considered statistically significant.

RESULTS

The prevalence of hookworm infection in this study was 11.4% while that of Iron deficiency anaemia was 29.8% (figure 1a & 1b)

There was an inverse relationship between hookworm infection and iron deficiency anaemia: Fourteen (22.6%) of 62 pregnant women with iron deficiency anaemia had hookworm infection while 9 (6.3%) of the 143 women without anaemia had hookworm infection. This association was statistically significant ($x^2 = 11.5$, $p = 0.000689$) (figure 2).

Table 1 below illustrates the distribution of hookworm infection with variables. Hookworm was found more in women residing in rural areas. While twelve (32.4%) of 37 pregnant women with hookworm infection resided in rural areas, only 6 (4.8%) of 126 women with hookworm infection

lived in urban areas. This distribution was statistically significant [$x^2 = 22.3$, $p = 0.00000351$]. Fifty one (51) of the pregnant women in this study had not indicated their place of residence, 6 of them had hookworm infection and were excluded from the analysis. {Assuming the 6 hookworm cases were added to the urban dwellers, this association will still be statistically significant with a $x^2 = 12.9$ and p value of 0.000326}

There was no statistically significant association between hookworm infection and occupation, educational status and knowledge of hookworm infection of the women in the study.

Two (8.3%) out of 24 women with low educational status and 21 (11.5%) out of 182 women with higher educational status had hookworm infection. This distribution was not statistically significant (X^2 = 0.22 Fischer exact: 1 tailed P-value = 0.479).

Seventy nine (38.0%) of 208 pregnant women had knowledge of hookworm infection having scored 50% and above while 129 (62.0%) of 208 women who scored less than 50% were classified as having no knowledge. Thus, majority of the women [62.0% (95% CI = 55.1% - 68.5%)] had no knowledge on mode of transmission of hookworm, effect of hookworm on pregnancy and prevention of hookworm.

With further stratifying educational status into lower status (none, primary, junior secondary) and higher status (senior secondary, post secondary- table 2}39.3% of the women with higher educational status had knowledge of hookworm infection against 26.9% of women with lower educational status. Overall, there was still no statistical significant association between educational level and knowledge of hookworm infection ($x^2 = 1.49$ p = 0.22).

DISCUSSION

Twenty four of 211 women in this study had hookworm infection. Thus the overall prevalence of hookworm infection in this study is 11.4%. Hookworm was the most isolated helminth. The prevalence rate of 11.4 % in this study is similar to 11.8 % reported in University of Nigeria Teaching Hospital, Enugu. It is however lower than those reported from studies conducted in Port Harcourt(46.0%), Ishiagu in Abia state (34.6%) and a rural community in Lagos (83.3%): all in Nigeria. It is also lower than 46.5% reported from Nepal.

The low incidence of hookworm infection can be explained by the general cleanliness of Uyo metropolis. Uyo where this study was carried out has in the last 5 years witnessed unprecedented development in the areas of housing, provision of social amenities, drainage systems, pipe-born water and general environmental sanitary condition. All these have great impact on the transmission of the parasite, and also on anaemia. More so, only one stool sample from each woman was used in investigating for intestinal helminthes, meaning that a proportion of women with low-intensity infection will have been misclassified as uninfected and the helminthes estimate imprecise.

The prevalence of anaemia, iron deficiency and Iron deficiency anaemia among pregnant women in this study were 54.1%, 84.6% and 29.8% respectively. The prevalence of iron deficiency anaemia recorded in this study is lower than the 43.7% reported for Nigeria in the National Food Consumption and Nutrition Survey of 2003. The probable explanation for the low proportion of pregnant women with iron deficiency anaemia in this study is due to the fact that this study was not community based but was done in a hospital setting, which is located in the City. Also, the majority of the women were literate, slightly better informed with good health awareness. This is in addition to the improved sanitary condition of Uyo metropolis previously mentioned.

Most of the anaemia in this study was of the mild-to-moderate type with a mean Packed Cell Volume of 29.5%. This corroborates with earlier findings among pregnant women in South Eastern Nigeria. Iron deficiency anaemia constituted 55.1% of total anaemia. This finding is also in support of the general belief of iron deficiency being the most common cause of anaemia is pregnancy.

Parasitic infestation, micronutrient deficiency and anaemia are significantly related problems. In a Nepal study, there was a strong association between anaemia and hookworm infestation. Likewise in this study, there was a statistically significant association between hookworm infection and iron deficiency anaemia. Approximately 1 out of every 3 women infected with hookworm among the rural dwellers had iron deficiency anaemia. Since association of anaemia with adverse maternal outcome is no longer a debatable issue, hookworm infection in pregnancy still constitutes a health hazard in Uyo metropolis. Various strategies have been tried in the world to cub the menace of hookworm and anaemia. In Nepal , cooking in iron pots and de-worming showed a significant reduction of iron deficiency. Therefore de-worming with anti-helminthes, combined with iron supplementations for pregnant women residing in rural areas of Uyo and environs where hookworm infestation is more prevalent is worth considering.

In this study, the prevalence of iron deficiency anaemia was higher than that of hookworm infection. The reason for this relationship is not known but anaemia in pregnant women may be a result of combination of factors including iron and folate deficiency, parasitic infections other than hookworms, HIV/AIDS and haemoglobinopathies. Thus, the iron deficiency anaemia recorded in this study may be a result of combination of factors and not exclusively due to hookworm infection, a fact supported by the Sharma et al. that anaemia in pregnancy is sometimes not corrected despite iron supplementation

This study also confirms that hookworm infection in pregnancy has a statistically significant association with place of residence. Twelve (32.4%) of 37 women residing in rural areas against six (4.8%) out of 120 women residing in urban areas were infected with hookworm. The probable explanation for the higher incidence of hookworm in the rural communities includes poor environmental sanitation, lack of portable water and poor methods of waste disposal: Portable water supplies are lacking in most parts of the rural areas, with majority of this populace relying on streams and shallow wells for domestic chores. There is little or no drainage system and where it exists is usually blocked with sand and refuge. Household waste is thrown into nearby bushes, many families share toilet system and others defecate indiscriminately in bushes all making the environment a fertile ground for hookworm and other health related problems. Thus apart from the de-worming combined with iron supplementation highlighted above, there is urgent need for environmental sanitation in these areas.

Of the socio-demographic variables analyzed in this study, it was found that women generally had no knowledge of hookworm infection. However, a greater number of pregnant women with higher educational status had relatively more knowledge about the mode of infection, effects of hookworm on pregnancy and prevention of hookworm infection with over 50% of pregnant women with post secondary educational status having knowledge about them. Surprisingly, like in the study by Shah BK et al , overall, educational status had no effect on the proportion of women with hookworm infection. As would be expected from above findings, the association between **knowledge of hookworm infection** and hookworm infection was not statistically **significant**. This therefore implies that

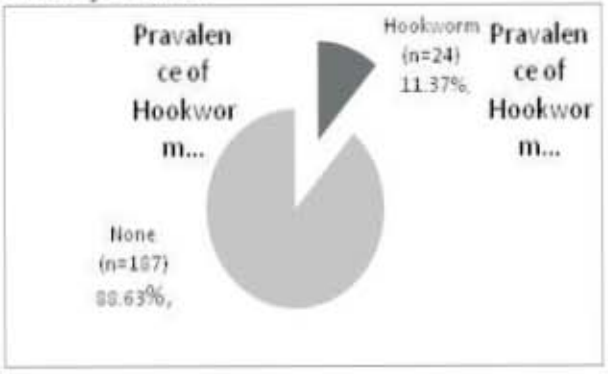
pregnant women in Uyo irrespective of their educational status need to be better informed about hookworm infection and its effect on pregnancy. This indirectly could protect them from helminthic infestations and by extension anaemia.

Hookworm infection was found more commonly among the unemployed and unskilled workers compared to the semi-skilled and the professionals though the association was not statistically significant.

In conclusion, this study shows that the prevalence of hookworm infection among pregnant women receiving antenatal care in Uyo is relatively high and hookworm infection in pregnancy is significantly associated with anaemia. Hence, antenatal health talks should include causes of anaemia with emphasis on helminthic infestations specifically the mode of transmission and prevention of hookworm infestation. Pregnant women presenting for antenatal care especially those from the rural areas should be screened for hookworm infestation and the antenatal package should include routine de-worming with antihelminthics in combination with iron supplementation for the prevention of anaemia. Awareness about hookworm infection, its mode of transmission, adverse effects, as well as modes of prevention should also be created in various communities in our society through the media, town criers, market women, community and religious leaders and through outreach programs.

CONFLICT OF INTEREST: The authors declare they have no conflict of interest.

Figure 1a & 1b : Prevalence of hookworm infection and iron deficiency anaemia



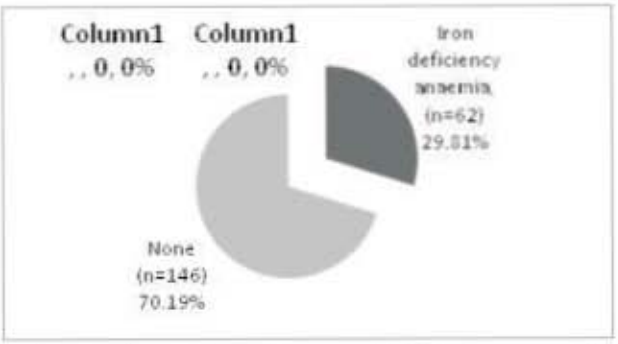


Figure 1a. Prevalence of Hookworm infection
Figure b. Prevalence of Iron deficiency anaemia

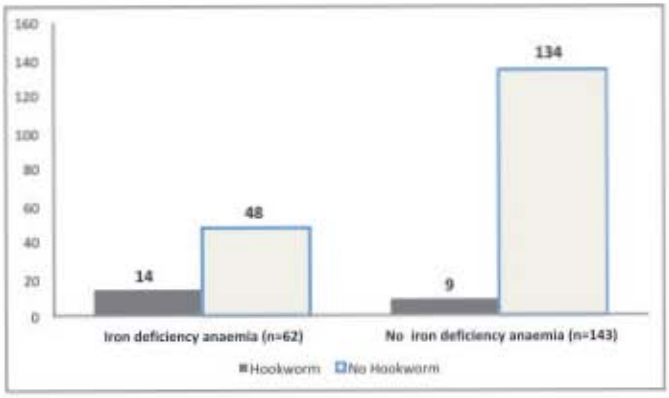


Figure 2 Distribution of hookworm infection with iron deficiency anaemia

Table 1 The Distribution of Hookworm with Variables

	Present	Absent	Total	x^2	P Value
Residence (n=163)					
Rural	12(32.4%)	25	37	22.3	
0.00000851 Urban		6(4.8%)	120	126	
Occupation (n=196)					
Unemployed	11(14.5%)	65	76		
Unskilled	9(17.0%)	44	53	6.1	
0.1051					
Semi-Skilled	0(0%)	25	25		
Professional	3(7.1%)	39	42		
Educational status (n=206)					
Lower Educational status	2(8.3%)	22	24	0.22	0.479
Higher Educational status	21(11.5%)	161	182		
Knowledge of hookworm(208)					
Yes	13(16.5%)	66	79	3.77	0.052
No	10(7.8%)	119	129		

Table 2. The Distribution of Knowledge of hookworm with educational status

Knowledge of hookworm (n=209)	Yes	No	Total	x^2 P Value
Higher Educational status	72 (39.3%)	111	183	1.49 0.22
Lower Educational status	7 (26.9%)	19	26	

REFERENCES

1. Brooker S, Bethony J, Hotez P J. Human Hookworm Infection in the 21st Century. *Adv Parasitol* 2004; 58: 197
2. Bethony J, Brooker S, Albonico M. Soil-transmitted helminth infections: ascariasis, trichuriasis, and hookworm. *Lancet* 2006; **367** (9521): 1521–32.
3. Hotez PJ, Bethony J, Bottazzi ME, Brooker S, Buss P. Hookworm: the great infection of mankind. *PLoS Med* 2005; **2** (3): e67.
4. Brooker S, Hotez PJ, Bundy DAP. Hookworm-Related Anaemia among Pregnant Women: A Systematic Review. *PLoS Negl Trop Dis* 2008; 2(9): e291
5. Gyorkos TW, Larocque R, Casapia M, Gotuzzo E. Lack of risk of adverse birth outcomes after deworming in pregnant women. *Pediatr. Infect. Dis. J* 2006; **25** (9): 791–4
6. Stoltzfus RJ, Dreyfuss ML, Chwaya HM, Albonico M. Hookworm control as a strategy to prevent iron deficiency. Nutr Rev 1997; 55: 223–232.
7. Ibidapo CA, Okwa O. The Prevalence and Intensity of Soil Transmitted Helminths in a Rural Community, Lagos Suburb, South West Nigeria. *Int J Agric Biol* 2008; 1560–8530
8. Wariso BA, Ibe SN. Prevalence of some intestinal helminths in Port Harcourt University of Port Harcourt Teaching Hospital, Nigeria. *West Afr J Med* 1994; 13(4):218-22.
9. Nduka FO, Nwaugo VO, Nwachukwu NC. Human Intestinal Parasite Infections In Ishiagu, A Lead Mining Area Of Abia State. *Animal Research International* 2006; 3(3): 505 – 507 505.
10. Ozumba UC, Ozumba NA, Anya S. Helminthiasis in Pregnancy in Enugu, Nigeria. *J Health Sci* 2005; 51(3) 291-293
11. Egwunyenga AO, Ajayi JA, Nmorsi OP, Duhlinska-Popova DD. Plasmodium/intestinal helminth co-infections among pregnant Nigerian women. *Mem inst Oswaldo Cruz* 2001; 96(8):1055-9
12. WHO. Report of the WHO informal consultation on the use of praziquantel during pregnancy/lactation and albendazole /mebendazole in children under 24 months. *Geneva*, 2002. Available at http://www.whqlibdoc.who.int/hq/2003/WHO_CDS_CPE_PVC_2002.4. Assessed 15 November 2012.
13. de Silva NR, Sirisena JL, Gunasekera DP, Ismail MM, de Silva HJ. Effect of mebendazole therapy during pregnancy on birth outcome. *Lancet* 1999; 353: 1145–1149
14. Larocque R, Gyorkos TW. Review: Should deworming be included in antenatal packages in hookworm-endemic areas of developing countries? *Can J Public Health* 2006; 97(3):222-4
15. Ndibazza J, Muhangi L, Akishule D, Kiggundu M, Ameke C, Oweka J et al. Effect of deworming during pregnancy on maternal and perinatal outcomes in Entebbe, Uganda: a randomized controlled trial. *Clin Infect Dis* 2010 ;50(4):531-540
16. Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD. Meta-analysis of observational studies in epidemiology: a

proposal for reporting. Meta-analysis Of Observational Studies in Epidemiology (MOOSE) group. *JAMA* 2000; 283: 2008–2012

17. Welffens-Ekra CH, Kibora M, Koume P, N'Diaye A, Koffi M. Efficacy and ***tolerance*** of ***Helmintox*** in pregnant women in Cote D'Ivoire. *Med Afr Noire* 1990; 37: 800–803
18. Wayne E. Sample Size Estimation Centre for Infectious Disease Preparedness 2007; 1-2
19. John E. Radiology and Radiologists, Research and Statistical Analysis. Radiology 2003;227:309-31350
20. Shah BK, Baig LA. Association of anemia with parasitic infestation in pregnant Nepalese women: results from a hospital-based study done in eastern Nepal. *J Ayub Med Coll Abbottabad* 2003;17(1):5-9
21. **Akwa Ibom State Infrastructure Development**. Available at http:// www.aksgonline.com/devInfra.aspx. Assessed 20th February 2013
22. Nigeria Food Consumption and Nutrition Survey 2001–2003 © International Institute of Tropical Agriculture (IITA), 2004. Available at http://www.old.iita.org/cms/details/Executive Summary. Assessed 19th February 2013
23. Ugwuja EI, Akubugwo EI, Ibiam UA, Onyechi O. Impact of Maternal Iron Deficiency and Anaemia on Pregnancy and its outcomes in a Nigerian Population. *Int J Nutr Well* 2010;10 (1):68
24. Nyuke RB, Letsky EA. Aetiology of anaemia in pregnancy in South Malawi. *Am J **Clin** Nutr* 2000; 72: 247-256
25. Ugwuja EI, Akubugwo EI, Ibiam UA, Onyechi O. Impact of Maternal Iron Deficiency and Anaemia on Pregnancy and its outcomes in a Nigerian Population. *Int J Nutr Well* 2010;10 (1):68
26. Sharma DC, Kiran R, Ramnath V, Khushlani K, Singh PP. Iron deficiency anaemia in vegetarian mothers and their newborns. ***Indian** J Clin Biochem* 1994; 9: 100-102.