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NUTRITIONAL CONSEQUENCES OF PARASITIC INFECTION DURING PREGNANCY

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Abstract

The effects of gastro-intestinal helminth infection on nutritional status of pregnant women was investigated in a semi-urban community, southeast, Nigeria. A total of 282 pregnant and 243 non-pregnant women were enlisted for this study. Stool samples were examined for intestinal helminths using formalin-ether sedimentation technique. Haemoglobin (Hb) and Packed Cell Volume (PCV) levels were evaluated in venous blood samples using Sahli's and microhaematocrit methods respectively. Anthropometry-based nutritional assessment of subjects was done to determine their body mass index (BMI). Nutritional assessment showed that only 34.4% of the pregnant women had normal BMI. BMI was found to increase significantly ($p<0.05$) with trimester of pregnancy. Haematological assessment showed that the mean Hb (9.66$\pm$ 1.22) and PCV (29.68 $\pm$ 3.24) of pregnant women were significantly lower than those of their non pregnant counterparts ($p<0.05$). The prevalence of anaemia among pregnant women was 58.9%. Anaemia was found to be highest in the second trimester with a prevalence rate of 63.6%. The percentage of infected anaemic pregnant women (82.6%) was significantly higher ($p<0.05$) than those of the uninfected ones (54.2%). least level of nutrition during the first trimester and the primagravidae parity and anaemia was more severe during the second trimester. Greater public health attention should be paid to the impact of gastro-intestinal infection in pregnancy.

Keywords: *Nutrition, gastro-intestinal helminth, primagravidae, pregnancy.*

Introduction

The health status of young women before pregnancy is a critical determinant of the risk that may ensue during pregnancy. "Parasitic infections affect tens of millions of pregnant women worldwide, and directly or indirectly lead to a spectrum of adverse maternal and fetal/placental effects, with pregnant women experiencing more severe infections than their non-pregnant counterparts" (Whitty *et al*., 2005). Intestinal parasite infection leads to anaemia and malnutrition, both of which are associated with an increased incidence of adverse pregnancy outcomes (Richard, 2003). Young women who are underweight or stunted, those with anaemia from one or more causes (e.g. intestinal helminth infection, iron deficiency, etc) and those with certain chronic infectious diseases are at increased risk of delivering low birth weight (LBW) infants (Stephenson *et al*., 2000; Shulman *et al*., 2001). LBW and premature infants have a much increased risk of early child mortality (Steketee *et al*., 1996), impaired growth and cognitive development (McCormick *et al*., 1992), impaired milk production, as well as increased risk of death for the mother and the baby. There is a dearth of literature on the effects of most parasitic infections on nutritional factors affecting pregnancy and their eventual outcomes. This study therefore, investigates the consequences of gastro-intestinal helminth infection on the nutritional status of women during pregnancy.

Materials and Methods

A total of 282 pregnant and 243 non-pregnant women between the ages of 18 - 45 years were enlisted for this study (Table 1). The pregnant women were in their various trimesters and of various parities (0 - 10). They were enlisted at various antenatal clinics (ANC) in Isiala Mbano, southeast Nigeria. The Mbano Joint Hospital laboratory was used as the base analytical centre.

Determination of Helminth Infection

Fresh stool sample for helminth screening was collected from each of the subjects in a dry, clean, leak proof and sterilised sample container, while making sure that no urine, water, soil or other contaminants got into the container. Four grams of each faecal sample was measured out using an Ohaus Havard trip balance (Florham Park USA) calibrated in 0.1gram. The samples were examined for consistency and presence of cysts, proglottids and adult worms. Concentrated saturated sodium chloride floatation and formol-ether concentration techniques were used for faecal analysis. The total number of eggs was counted under X40 magnification of a compound microscope Stool samples were processed within 8 hours of collection and examined microscopically within one hour of preparation to avoid over clearance of hookworm ova (Okoye, 2009).

Nutritional Assessment

Anthropometry-based nutritional assessment of the study subjects was done by measuring body weight to the nearest 0.1kg and height to the nearest 0.1cm. Then the body mass index (BMI) was calculated to determine the weight status of the study subjects using the formula (weight in kg/[height in m]^2). In classifying the weight status of the study subjects, the standard weight status categories associated with BMI ranges were used for overweight and obesity in adults

(WHO, 1995). In addition, for underweight (thinness), three cut-offs namely grade-1 thinness (BMI < 16kg/m^2), grade-2 thinness (BMI 16-16.9kg/m^2) and grade-3 thinness (17-18.4kg/m^2) were also evaluated.

Determination of Haemoglobin Concentration

Using a sterile syringe, 3mls of venous blood was collected from each of the subjects and transferred into a capillary tube. The specimens were centrifuged using a microhaematocrit centrifuge at 3000 rpm for 5 minutes. The PCV of each specimen was determined using a Hewkley microhematocrit reader and the World Health Organization (WHO, 1994) benchmark for anaemia which defines anaemia as Hb<11g/dl was used.

Data Analysis

Data entry and validation was performed in excel, and statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 17.0. Values were considered statistically significant when p-values were less than 0.05 ($p<0.05$). Pearson Chi-square, t-test and correlations were used to determine the association between haemoglobin concentrations and helminth infection as indicator of anaemia.

Permission and Ethical Approval

Prior to the commencement of the study, the community and household heads were well briefed on the objectives of the study. Thereafter, they were given informed consent forms to sign for their communities and households after their contents were translated to them in local languages. The study protocol was approved by the State Health authorities.

Results

Nutritional assessment of Pregnant and Non-pregnant women

Anthropometry-based nutritional assessment of the study subjects revealed that 65.0% of the non-pregnant women had normal BMI as against 34.4 % of the pregnant ones. There was a significant difference observed in the prevalence of BMI among pregnant and non-pregnant women ($p<0.05$) – Table 2.

Distribution of body mass index in relation to age, trimester and parity

Age specific prevalence among the pregnant women shows that 67.7% of pregnant women within the age bracket of 18 – 20 years (Table 3) had the highest prevalence in the normal category while the least was by those of 41 - 45 years (50.0). The observed differences in BMI status by age was however not significant ($p>0.05$).

Table 3 also shows that women in their third trimester had 75.0% BMI status which was highest in the 'normal' category while those in the first trimester had the least rate (46.3%). The difference in the BMI within the trimesters was statistically significant ($p<0.05$).

On the basis of parity, 76.9% of pregnant women in the gravidae ≥7 category had the 'normal' BMI status, while the least rate was by the Primigravidae (55.1%). The differences in BMI status by parity was not statistically significant ($p>0.05$).

Prevalence of Body Mass Index by Helminth infection

The pattern of distribution of BMI in relation to helminth infection among pregnant women is shown in Table 4. A total of 43.5% of the pregnant women infected with one helminth or the other were found to have normal BMI, none was obese and only 2.2% were overweight. Of the women infected with *A. lumbricoides*, only 35.7% had normal BMI compared to 50% for those infected with *T trichiura*, while 50% of those with mixed infection had normal BMI. The difference in BMI related to type of helminth infection was not significant ($P>0.05$).

Haemoglobin (Hb) and Packed Cell Volume (PCV) measurements

The mean haemoglobin (Hb) and packed cell volume (PCV) levels of the study population were 10.2±1.2g/dl and 31.0±3.2%, respectively (Table 5). Pregnant women were observed to have a mean Hb of 9.66±1.22g/dl and PCV of 29.67±3.24% which is considerably lower than that of the non-pregnant women with mean Hb of 10.29±1.36g/dl and PCV of 31.35±3.57%. Significant difference was observed in the mean Hb and PCV levels of the pregnant and non-pregnant women ($p<0.05$) in the study population.

Indicator of Anaemia among study population

A total of 242(46.1%) of the study population were found to be anaemic (Hb <11g/dl), out of which 166(58.9%) were pregnant women and only Of the 76(31.3%) non-pregnant women who were anaemic, 43(17.7%) had mild anaemia (Table 6). Further statistical analysis shows that there was significant difference ($p<0.05$) in the haemoglobin levels of the anaemic pregnant and non-pregnant women.

Distribution of anaemia among infected and uninfected study population

The distribution of anaemia among infected and uninfected study population is described in Table 7. Forty six (16.3%) of the 282 pregnant women examined were found to be positive for helminth infection with a mean± SD of 8.5±1.1g/dl. while 128(54.2%) of the 236 uninfected pregnant women, were anaemic with mean value of 9.5±0.9g/dl. Infected pregnant women were observed to have a highly significant ($p<0.001$) lower Hb than the uninfected.

Discussion

The significantly lower nutritional level of infected pregnant women compared to their non infected counterparts observed in this study is in line with the observation that the natural immune response to pregnancy causes women to be

more susceptible to parasitic infections when pregnant than in the non-pregnant state (Muhangi *et al.*, 2007).

Body mass index among pregnant women shows that infected women had a lower BMI and most of them are in the thinness category. In developing countries, most pregnant women generally become anaemic (WHO, 1996). This study revealed that pregnant women were more anaemic than their non-pregnant counterparts (58.9% vs. 31.3%). This is in line with the report by Ekejindu *et al*. (2010). This observation can be attributed to the fact that pregnant women experience pregnancy-induced immunosuppression which predisposes them to infections (e.g. malaria, helminthes, etc) and when this occurs, they become anaemic. Pregnancy requires extra nutrients, especially iron and folate, and produces a "physiological anaemia" (Steer, 2000; Pena-Rosas *et al*., 2004).

Anaemia results in both decreased appetite, lowered aerobic and physical work capacity and malnutrition. The total amount of work a woman can do in a day definitely decreases when she is anaemic, whatever the cause is, pregnancy plus helminth infections produce a double burden for women in farming communities (Stephenson *et al*., 2002).

This study further shows that the least level of nutrition during the first trimester and the primagravidae parity and anaemia was more severe during the second trimester. This is in line with the assertion of some authors (Muhagi *et al*., 2007) that infection occurring during the first trimester is associated with more severe fetal and placental consequences than those occurring later in pregnancy. Maternal infection is often more severe in the primagravidae, and tends to result in a higher degree of parasitemia (Muhagi et al, 2007).

Thus, in populations with a high risk of exposure to infectious diseases, particularly malaria and helminth infection, the vicious cycle of infection and impaired immunity, there may be a stronger association between helminth infections and anaemia.

Iron-deficiency anaemia has, however, assumed a major maternal health problem in the sub region mainly because many people cannot afford foods rich in haem iron and other dietary factors or use cooking methods which may inhibit absorption of iron (WHO, 1979). This may have had a considerable contribution to anaemia observed in this study. Although, it was reported that the dietary intake of iron by people living in developed countries is generally high (Harvey *et al*., 2000), iron deficiency remains prevalent in most developing countries, including Nigeria (Ezeonu *et al*., 2002).

We recommend personal hygiene and environmental sanitation through the provision of waste disposal facilities, proper toilet systems, supply of safe drinking (portable) water, in addition to public enlightenment (health communication). Also, administration of prophylactic antihelminthic treatment as a component of the ante-natal routine for pregnant women after the first trimester.

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Annexure:

Table 1: Demographic and obstetric characteristics of study population in Isiala Mbano Nigeria

Parameter	Pregnant (n=282)	Non-pregnant (n=243)
Age (Years)		
18 - 20	37(13.1%)	70(28.8%)
21 - 30	177(62.8%)	109(44.9%)
31 - 40	62(22.0%)	49(20.2%)
41 - 45	6(2.1%)	15(6.2%)
Trimester		
First	67(23.7%)	
Second	99(35.1%)	
Third	116(41.1%)	
Parity		
Primigravidae	69(24.5%)	
Secondigravidae	55(19.5%)	
Gravidae 3 - 6	145(51.4%)	
Gravidae ≥7	13(4.6%)	

Table 2: Distribution of body mass index among pregnant and non-pregnant women in Isiala Mbano, Nigeria

Study population	Body mass indices (kg/m^2)						
	Number examined	G-1 thinness <16	G-2 thinness 16 – 16.9	G-3 thinness 17 – 18.4	Normal 18.5 – 24.9	Overweight 25 – 29.9	Obesity 30 – 39.9
Pregnant	282	108(38.3%)	37(13.1%)	39(13.8%)	97(34.4%)	15(0.4%)	0(0.0%)
Non-pregnant	243	14(5.8%)	20(8.2%)	34(14.0%)	158(65.0%)	13(5.3%)	4(1.6%)
Total	525	122(23.2%)	57(10.9%)	73(13.9%)	255(48.6%)	14(2.7%)	4(0.8%)
							(X^2 =24.092, df =3, p<0.05

Table 3: Obstetric specific prevalence of body mass index among pregnant women in Isiala Mbano, Nigeria.

Parameter	Body mass indices (Kg/m^2)							
	Number examined	G-1 thinness<16	G-2 thinness 16-16.9	G-3 thinness 17-18.4	Normal 18.5-24.9	Overweight 25-29.9	Obesity 30-39.9	Significance
Age (years)								
18-20	37	2(5.4%)	5(13.5%)	6(16.2%)	23(62.2%)	1(2.7%)		
21-30	177	11(6.2%)	11(6.2%)	28(15.8%)	118(66.7%)	8(4.5%)	1(0.4%)	
31-40	62	2(3.2%)	7(4.0%)	40(64.5%)	6(9.7%)	0		
41-45	6	1(16.7%)	1(16.7%)	1(16.7%)	3(50.0%)	0	0	
Total	282	16(5.7%)	24(8.5%)	42(14.9%)	184(65.2%)	15(5.3%)	1(0.4%)	**X^2 = 13.092, df = 15, p > 0.05**
Trimester								
First	67	9(13.4%)	7(10.4%)	20(29.9%)	31(46.3%)	0	0	
Second	99	5(5.1%)	9(9.1%)	14(14.1%)	66(66.7%)	5(5.1%)	0	Third
Third	116	2(1.7%)	8(6.9%)	8(6.9%)	87(75.0%)	10(8.6%)	1(0.9%)	
Total	282	16(5.7%)	24(8.5%)	42(14.9%)	184(65.2%)	15(5.3%)	1(0.4%)	**X^2 = 38.944, df=10, p < 0.05**
Parity								
Primigravidae	69	5(7.2%)	6(8.7%)	16(23.2%)	38(55.1%)	4(5.8%)	0	
Secondgravidae	55	2(3.6%)	5(9.1%)	10(18.2%)	37(67.3%)	1(1.8%)	1(0.7%)	
Gravidae 3-6	145	9(6.2%)	11(7.6%)	15(10.3%)	37(67.3%)	1(1.8%)	0	
Gravidae ≥ 7	13	0	2(15.4%)	1(7.7%)	10(6.9%)	0	0	
Total	282	16(5.7%)	24(8.5%)	42(14.9%)	184(65.2%)	15(5.3%)	1(0.4%)	**X^2= 14.183, df=15, p > 0.05**

Table 4: Prevalence of body mass index by helminth infection among pregnant women in Isiala Mbano, Nigeria.

Helminth	Body mass indices (Kg/m^2)						
	Number examined	G-1 thinness < 16	G-2 thinness 16 – 16.9	G-3 thinness 17 – 18.4	Normal 18.5 – 24.9	Overweight 25 – 29.9	Obesity 30 – 39.9
Hookworm	24	4(16.7%)	7(29.2%)	1(4.2%)	11(45.8%)	1(4.2%)	0
A. humbricoides	14	2(14.3%)	3(21.4%)	4(28.6%)	5(35.7%)	0	0
T. trichiura	2	1(50.0%)	0	0	1(50.0%)	0	0
Mixed infection	6	0	0	3(50.0%)	3(50.0%)	0	0
Total	46	7(15.2%)	10(21.7%)	8(17.4%)	20(43.5%)	1(2.2%)	0
							X^2 = 13.549, df=12, p> 0.05

Table 5: Mean and standard deviation of haemoglobin and packed cell values of study population in Isiala Mbano, Nigeria.

Study Subjects	Number examined	Haematological parameters	
		Hb(g/dL) (mean ±SD)	PCV (%) (mean±SD)
Pregnant	282	9.66±1.22**	29.67±3.2**
Non-pregnant	243	10.29±1.36	31.35±3.57
Total	525	10.27±1.22	31.0±3.20

Significantly different at $p<0.05$

Table 6: Haemoglobin (Hb) levels as an indicator of anaemia among the pregnant and non-pregnant women in Isiala Mbano, Nigeria.

Study Subjects	Number examined	Indicator of anaemia (Hb-g/dL)				
		Mild <11	Moderate <9	Severe <8	Total	Mean ±SD
Pregnant	282	92(32.6%)	58(20.6%)	16(5.7%)	166(58.9%)	9.3±1.0
Non-pregnant	243	43(17.7%)	18(7.4%)	15(6.2%)	76(31.3%)	9.5±1.1
Total	525	135(25.7%)	76(14.5%)	31(5.9%)	242(46.1%)	9.4±1.0
						X^2=44.219, df=3, p<0.05

Table 7: Distribution of anaemia among infected and uninfected study population in Isiala Mbano, Nigeria.

Study population	**Number examined**	**Haemoglobin level (g/dl)**				
		Mild (<11)	**Moderate (<9)**	**Severe (8)**	**Total**	**Mean±SD**
Pregnant women						
Infected	46	9(19.6%)	15(32.6%)	14(30.4%)	38((82.6%)	8.5±1.1
Uninfected	236	83(35.2%)	43(18.2%)	2(0.8%)	128(54.2%)	9.5±0.9
Total	282	92(32.6%)	58(20.6%)	16(5.7%)	166(58.9%)	9.3±1.0
						X^2=27.984, df=3, p<0.001
Non-pregnant women						
Infected	34	3(8.8%)	10(29.4)	13(38.2%)	26(76.5%)	8.4±1.3
Uninfected	209	30(14.3%)	18(8.6%)	2(1.0%)	50(23.9%)	9.1±0.7
Total	243	33(13.6%)	28(11.5%)	15(6.2%)	76(31.3%)	9.5±1.1
						X^2=22.453, df=3, p<0.05