Original Research Article

MALARIA PARASITAEMIA AND SOME IRON PARAMETERS OF PREGNANT WOMEN IN RURAL NIGERIA

ABSTRACT

Aims: This study aimed at investigating maternal malaria and its impact on red cell indices of pregnant women in rural Nigeria.

Study design: Case-control study.

Place and Duration of Study: This study was carried out in rural Cross River State of Nigeria between May and November, 2018.

Methodology: This study was carried out among consenting pregnant women at Akpet central, Biase Local Government Area of Cross River State. A total of three hundred and eighty pregnant women and three hundred and eighty non-pregnant women were enrolled. Blood samples were collected into ethylene diamine tetra-acetic acid bottles and plain bottles for analysis of red cell indices by automation and to obtain serum for iron tests respectively. Serum iron and TIBC were analyzed by standard colorimetric methods while serum ferritin was assayed by enzyme-linked immunosorbent assay technique. Malaria microcopy was carried out on stained thick and thin blood films.

Results: The red cell indices and iron levels of pregnant women were significantly lower ($p \leq 0.05$) compared to non-pregnant women. These parameters were also significantly lower ($p \leq 0.05$) among malaria-infected pregnant women compared to their counterparts who did not have malaria.

Conclusion: Malaria and anaemia remain important health challenges for pregnant women in rural communities of Nigeria.

Keywords: Malaria, pregnancy, anaemia.

1. INTRODUCTION

Maternal health has continued to receive attention globally and has implications that often extend to infant health [1, 2]. Malaria in particular affects not just the health of an infected pregnant woman but contributes to such outcomes as low birth weight, abortion, malaria infection transmission to the newborn and other complications that may attend the condition [2-4]. It becomes imperative that pregnant women should be protected from malaria infection by encouraging the practice of malaria control measures in the communities. Popular among the measures is the use of insecticide-treated mosquito nets compared to vector control and use of preventive medication [5-8]. Efforts to achieve wide-spread distribution in Nigeria have been made by the government, however, part of the drawback to this approach has been the gap between acquisition and utilization of the nets [7-9]. Unfortunately, malaria among pregnant women is far from being eradicated.

Much of the outcome of malaria infection among pregnant women is evidenced by increased hospital visitations and admissions, and in extreme cases maternal mortality [2,10]. The occurrence of malaria disease comes from developmental cycle of the parasite through the pre-erythrocytic and erythrocytic phases that contribute to the symptoms of chills, fever and nausea among others [3,10]. The infection of red cell apparently is cardinal to the propagation of the malaria parasite in the human host. Thus, of particularly significance in the pathophysiology of malaria infection is the invasion and consequent destruction of red blood cells. This undoubtedly has implications regarding anaemia especially in pregnancy [11-14]. Already, gestational anaemia is a health threat in developing countries mainly due to malnutrition. To what extent malaria may be affecting blood indices of pregnant women in rural Nigeria remains to be fully investigated.

2. MATERIAL AND METHODS

This study was carried out among pregnant women at Akpet central, Biase Local Government Area of Cross River State. A total of three hundred and eighty pregnant women and three hundred and eighty non-pregnant women were enrolled. Ethical approval was granted by the departmental ethical board, while each participant consented after being duly informed of the study. Blood samples were collected into ethylene diamine tetra-acetic acid bottle and plain bottles for analysis of red cell indices by automation using Sysmex KX-21N (from Sysmex Corporation, Japan) and to obtain serum for iron tests respectively. Serum iron and TIBC were analyzed by standard colorimetric methods while serum ferritin was assayed by enzyme-linked immunosorbent assay technique. Thick and thin blood films on clean grease-free slides were made directly from collected blood. Malaria parasite detection was conducted by standard microscopy after staining the films with Giemsa stain. Malaria parasite density was determined by multiplying the number of malaria parasites counted with the standard white cell count and dividing with the number of white cells counted. Statistical analysis of data was done using SPSS 20.0. Student t-test was used to compare means between pregnant and non-pregnant women as well as between malaria-infected pregnant women and pregnant women without malaria parasite. Pearson's correlation was carried out between malaria parasite density and other measured parameters. A two tailed p-value of ≤ 0.05 was considered indicative of a statistically significant difference.

3. RESULTS AND DISCUSSION

3.1 RESULTS

The red cell parameters considered in this study include; haematocrit (HCT), haemoglobin concentration (Hb), mean cell volume (MCV), mean cell haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC). The iron parameters of concern comprised serum iron (SI), total iron-binding capacity (TIBC) and serum ferritin (SF). The HCT (33.60±4.32% vs 37.20±1.68%), Hb (11.07±1.55g/dl vs 12.38±0.83g/dl), MCV (80.87±3.66fl vs 84.18±1.81fl), MCH (26.04±2.32pg vs 27.62±1.41pg), SI (55.66±10.14(µg/dl vs 83.37±6.77(µg/dl), and SF (21.19±4.47ng/ml vs 64.89±7.57ng/ml) of pregnant women were significantly lower ($p \leq 0.05$) compared to non-pregnant women. The TIBC (162.89±92.33(µg/dl vs 67.28±6.77(µg/dl) of the pregnant women was significantly higher ($p \leq 0.05$) compared to the non-pregnant women (Table 1).

Out of the 380 pregnant women investigated, 153 (40.26%) were infected with *Plasmodium falciparum*. The HCT, Hb, MCV and MCH (30.14 ± 3.53%, 9.96 ± 1.31g/dl, 78.7 ± 3.55fl and 24.76 ± 49pg respectively) of pregnant women who were positive for malaria with mean parasite density of 225.71±159.64 was significantly lower than that of their counterpart (35.94 ± 3.06%, 11.82 ± 1.21g/dl, 82.32 ± 2.95fl and 26.90 ± 1.76pg respectively) who did not have malaria. While SI (48.55±10.82(µg/dl) and SF (7.90±1.83ng/ml) of malaria-infected pregnant women reduced significantly, their TIBC (234.02±71.62(µg/dl) increased compared to the controls (60.47±6.11(µg/dl, 30.20±7.08ng/ml and 114.71±71.75(µg/dl respectively) as seen in Table 2.

Malaria parasite count correlated negatively with HCT, Hb, MCH, SI and SF but positively with TIBC among those pregnant with malaria infection (Table 3).

Table 1: Some red cell and iron parameters of pregnant women and non-pregnant women

PARAMETER	PREGNANT WOMEN n=380	NON-PREGNANT WOMEN n=380	p-VALUE
HCT %	33.60±4.32	37.20±1.68	0.000
Hb g/dl	11.07±1.55	12.38±0.83	0.000
MCV fl	80.87±3.66	84.18±1.81	0.000

MCH pg	26.04±2.32	27.62±1.41	0.000
MCHC g/dl	32.75±1.48	32.84±1.13	0.732
SI µg/dl	55.66±10.14	83.37±6.77	0.000
TIBC µg/dl	162.89±92.33	67.28±6.77	0.000
SF ng/ml	21.19±4.47	64.89±7.57	0.000

Table 2: Effect of malaria parasitaemia on some red cell and iron parameters of pregnant women

PARAMETER	PREGNANT WOMEN WITH MALARIA PARASITES n = 153	PREGNANT WOMEN WITHOUT MALARIA PARASITES n = 227	p-VALUE
HCT %	30.14±3.53	35.94±3.06	0.000
Hb g/dl	9.96±1.31	11.82±1.21	0.000
MCV fl	78.71±3.55	82.32±2.99	0.000
MCH pg	24.76±2.49	26.90±1.76	0.001
MCHC g/dl	33.09±1.73	32.52±1.26	0.169
Parasite Density	225.71±159.64	0.00±0.00	0.000
SI µg/dl	48.55±10.82	60.47±6.11	0.000
TIBC µg/dl	234.02±71.62	114.71±71.75	0.000
SF ng/ml	7.90±1.83	30.20±7.08	0.013

Table 3: Correlation of malaria parasite density against red cell and iron parameters of pregnant women

PARAMETER	r	p-VALUE
PCV	- 0.950	0.000
Hb g/dl	- 0.822	0.000
MCV fl	- 0.046	0.842
MCH pg	- 0.490	0.024
MCHC g/dl	0.117	0.612
SI µg/dl	- 0.810	0.000
TIBC µg/dl	0.717	0.000
SF ng/ml	- 0.609	0.003

3.2 DISCUSSION

The increased nutritional demands of pregnancy on maternal health are such that blood parameters associated with nutritional status become altered [15, 16]. Individual awareness and socio-economic status often play roles in how women cope with the extra demands during pregnancy [7,8]. Thus, it is not unlikely to find differences at the various population levels. The pregnant women from the study setting

had lower mean values of HCT, Hb, MCV and MCH compared to the control subjects. These mean values from the red cell parameters however fall within the ranges accepted in pregnancy implying that generally, the subjects were not anaemic as at the time of the study. Effective red cell production relies on the bioavailability of certain nutritional factors including iron, Vitamin B12 and folate. The current study also observed lower mean values of serum iron alongside higher TIBC, and lower serum ferritin among the pregnant women in comparison to values from the control subjects. The finding that the mean values for these iron parameters occurred close to borderline suggests the presence of some level of risk towards possible future manifestation of anaemia.

The pregnant women who also had malaria infection were observed to have much lower mean values of HCT, Hb, MCV and MCH compared to the pregnant ones who had no malaria infection. Both the haematocrit and haemoglobin concentration, as indices for screening of anaemia, clearly reveal an anaemic state while the reduced MCV and MCH has thrown more light on the nature of the anaemia to be microcytic and hypochromic. The aftermath of intra-erythrocytic phase in the development of the malaria parasite involves the rupturing of the infected cell. Unfortunately, haemolysis from rupture of infected cells brings about the reduction in most red cell parameters accounting for the presence of anaemia [17, 18]. The marked differences in the affected red cell parameters on the basis of malaria infection, however, brings to light the magnitude of the malaria menace in Nigeria. Availability of circulating iron and stored iron show immense depletion among the pregnant women with malaria infection. Obviously in coping with the demands of pregnancy, the burden of malaria infection further puts the maternal body into a state of deficit. The pregnant women with malaria infection were also plagued with iron deficiency unlike their counterparts without malaria infection.

4. CONCLUSION

Malaria and anaemia remain important health challenges for pregnant women especially in rural communities of Nigeria. The prevalence of maternal malaria among the studied population was 40.26%.

REFERENCES

1. de Boo HA, Harding JE. The developmental origins of adult disease (Barker) hypothesis. Aust N Z J Obstet Gynaecol, 2006; 46(1):4-14.
2. Nour NM. An Introduction to Maternal Mortality. Rev Obstet Gynecol, 2008; 1(2): 77-81.
3. Luxemburger C, McGready R, Kham A, Morrison L, Cho T, Chongsuphajaisiddhi T et al. Effects of Malaria during Pregnancy on Infant Mortality in an Area of Low Malaria Transmission. Am J Epidemiol. 2001; 154(5): 459-65.
4. Menendez C, Ordi J, Ismail MR, Ventura PJ, Aponte JJ, Kahigwa E, et al. The impact of placental malaria on gestational age and birth weight. J Infect Dis, 2000; 181(5): 1740-5.
5. Enato EF, Mens PF, Okhamafe AO, Okpere EE, Pogoson E, Shalling HD. Plasmodium falciparum malaria in pregnancy: prevalence of peripheral parasitaemia, anaemia and malaria care seeking behavior among pregnant women attending 2 antenatal clinics in Edo State Nigeria. J of Obstet Gynaecol, 2009; 29(4): 301-6.
6. World Health Organisation. Communicable Disease Control and Prevention and Eradication WHO Pesticide Evaluation Scheme (WHOPES) and Protection of the Human Environment Programme on Chemical Safety (PCS), Safety of pyrethroids for public health use. http://whqlibdoc.who.int/hq/2005/ WHO_CDS_WHOPES_GCDPP_2005. 10. Pdf. Accessed March 18, 2010.
7. Gamble C, Ekwaru JP, ter Kuile FO. Insecticide-treated nets for preventing malaria in pregnancy. Cochrane Database of Syst Rev. 2006, Issue 2. Art No: CD003755. DOI: 10.1002/14651858. CD003755. pub2.
8. Enato EF, Okhamafe AO, Okpere EE. A survey of knowledge, attitude and practice of malaria management among pregnant women from two health care facilities in Nigeria. Acta Obstetrica et Gynaecological scandinavica, 2007; 86(1): 33-6.
9. Okpere EE, Enabudoso EJ, Osemwenkha AP. Malaria in Pregnancy. Nigerian Medical Journal, 2010; 51(3): 109-13.
10. Rogerson SJ, Hviid L, Duffy P, Leke R, Taylor DW. Malaria in Pregnancy: pathogenesis and immunity. Lancet Infect Dis. 2007; 7(2): 105-17.
11. Wickramasinghe SN, Abdalla SH. Blood and bone marrow changes in malaria. Baillieres Best Pract Res Clin Haematol, 2000; 13(2): 277-99.
12. Erhart LM, Yingyuen K, Chuanak N, Buathong N, Laoboonchai A, Miller RS et al. Hematologic and clinical indices of malaria in a semi-immune population of western Thailand. Am J Trop Med Hyg, 2004; 70(1): 8-14.
13. Price RN, Simpson JA, Nosten F, Luxemburger C, Hkirjaroen L, ter Kuile F, et al. Factors contributing to anemia after uncomplicated falciparum malaria. Am J Trop Med Hyg, 2001; 65(5): 614-22.
14. Bashawri LA, Mandil AA, Bahnassy AA, Ahmed MA. Malaria: hematological aspects. Ann Saudi Med, 2002; 22(5-6): 372-6.
15. Wahed F, Latif SA, Nessa A, Bhuiyan MR, Hossain MB, Akther A et al. Gestational anemia. Mymensingh Med J, 2010; 19(3): 462-8.
16. Breymann C. Iron deficiency anaemia in pregnancy. Semin Hematol. 2015; 52(4): 339-47.
17. Ekvall H. Malaria and anemia. Curr Opin Hematol, 2003; 10(2): 108-14.
18. Desai M, ter Kuile FO, Nosten F, McGready R, Asamoa K, Brabin B et al. Epidemiology and burden of malaria in pregnancy. Lancet Infect Dis. 2007; 7(2): 93-104.