ORIGINAL ARTICLE

A Comparison of the Prevalence of Malaria Parasitaemia in Pregnant and Non Pregnant Women

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Abstract

Background: *To compare the prevalence of malaria parasitaemia and the mean parasite density in pregnant women at first antenatal visit with those of the control subjects at Nnamdi Azikiwe University Teaching Hospital, Nnewi.*

Method: *A case control prospective survey using a structured questionnaire to collect data from pregnant women attending antenatal clinic between 1 April and 30 September 2001 and matched controls at the GOPD during the same period. Peripheral blood smears were examined in 420 pregnant women at their first antenatal visit and 200 control subjects to compare the prevalence of malaria parasitaemia and mean parasite density in pregnant women and controls.*

Results: *The prevalence of parasitaemia was 79.3 percent (i.e. 333 of 420) for pregnant women and 31.5 percent (or 63 of 200) for the control. For both pregnant women and controls, an overall prevalence of 63.1 percent was observed. The study found the mean parasite density for the pregnant women to be 1978± 1531 (Mean±SD), while that of the controls was 766±1923.*

Conclusion: *This study demonstrates the higher prevalence of malaria parasitaemia and mean parasite density in pregnant women when compared with the matched controls.*

Key Words: *Malaria Parasitaemia, Pregnancy, Mean Parasite density, Prevalence and Controls*

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Introduction

Malaria continues to be one of the main public health problems in the world, especially in the majority of African countries[1]. In Nigeria, malaria is the commonest cause of out patient visits and it ranks among the three most common causes of death[2]. It accounts for about one million deaths in Africa and nine out of ten cases of malaria worldwide occur in Africa, south of the Sahara[3]. About 200 million people in the world are at risk from malaria and the disease kills about 2 million people every year[1].

Although anyone can get malaria, two groups of people are at a special risk from malaria such as children under five years of age and pregnant women. This is especially so during the first and second pregnancies[4]. The direct effect of heavy placental parasitization by malaria parasites includes the reduction of placental blood flow and the available oxygen to the fetus. Consequently, this may manifest as low birth weight, abortion, intra uterine growth retardation, intra uterine death, premature labour, stillbirth, prenatal asphyxia, and neonatal asphyxia[5,6].

The effect of malaria on a population is dependent on whether malaria is stable or unstable. Stable malaria exists in regions where there is perennial transmission of malaria parasites. The intensity of attack in such areas remains constant through out the year. In contrast, unstable malaria is found in areas with intermittent transmission of malaria parasites due to some natural phenomenon enhancing transmission at certain periods. In the unstable malaria community, immunity to malaria is variable and epidemics could occur with a very high incidence of severe malarial complaints including cerebral malaria[7].

The immunity to malaria is dependent upon a persistently low-grade parasitaemia, which could be natural or acquired and is passively transmitted through the placenta[8].

The acquired immunity is both humoral (antibodies to the parasites) and cellular (macrophages and phagocytes) and is provoked only by the asexual erythrocyte stage of the malaria parasites, not by the liver stages or by gametocytes[8]. Although, gametocytes have some antigenic properties, provoking antibodies that are apparently not protective.

The increased susceptibility of pregnant women to malaria has been thought to be due either to

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sequestration of the parasites in the placenta or to depression of selected components of the immune system in association with the increased production of several hormones or other proteins[9]. The placenta sequesters parasites that are able to cytoadhere to chondroitin-4-sulfate, a glycosaminoglycan molecule expressed by the placental syncytiotrophoblast, while parasites from a non-pregnant host do not bind to chondroitin-4-sulfate[10].

Parasites adhere to the surface of trophoblastic villi, eliciting the accumulation of inflammatory leukocytes in the intervillous space, and the necrosis of adjacent placental tissue. Maternal malaria results in poor pregnancy outcome, although the responsible mechanisms have not been defined [10,11].

Patients and Methods

Study Design

The study design is a case control prospective study of pregnant women as cases and non-pregnant women as controls.

Location of Study:

This study was conducted at the antenatal clinic of Nnamdi Azikiwe University Teaching Hospital, Nnewi. The hospital is a Federal Government owned tertiary health institution in Nnewi, a high population density area of Anambra State. Nnewi has a projected population of 480,000 inhabitants in 2001 and is located in the South Eastern zone of Nigeria [12]. The climatic condition in this zone include an environmental temperature between 20 and 28 degrees centigrade; mean monthly rainfall greater than 10 centimetres, relative humidity greater than 60 percent; and topography with altitude less than 2000 metres above sea level [13].

The town has a rain forest type of vegetation and the area is Holoendemic for malaria. The predominant malaria vectors include Anopheles Gambiae, A. Funestus, A. Darlingi, and A. Punctulatus[8]. Plasmodium falciparum is the parasite that is found in over 80 percent of malaria patients while P. malaria causes 15 percent and P. ovale causes less than 5 percent of malaria cases in Nnewi [14, 15]. However, mixed infections with all three species of plasmodium occur [14].

An average of five new booking of antenatal women was enrolled daily on their own accord with a few referred from nearby towns by private, missionary and general hospitals. Most referrals were cases with complicated pregnancy, labour, or puerperium. Antenatal services have a backup of laboratory and blood bank, Ultra sound, and other ancillary services.

Ethical precepts in relation to the research

The ethical committee of NAUTH, Nnewi approved this study. Standard pre-test counselling for HIV screening was first carried out and confidentiality in the handling of the result of the screening was observed. The subjects who declined were left out of the study while those who accepted gave an informed consent for HIV screening; haemoglobin genotype and blood smear investigations. The subjects understood their rights not to participate in the study if they so wished and could at any point opt out. The subjects did not pay for the investigation.

Patients/subjects

All pregnant women attending their first antenatal visit at the antenatal clinic, Nnamdi Azikiwe University Teaching Hospital, Nnewi during the study period of 1 April to 30 September 2001 who met the inclusion criteria were enrolled for the study. Four hundred and twenty (420) consecutive pregnant women were enrolled. The period coincided with the rainy season when malaria transmission is most intense. These women were predominantly Igbo and resided in Nnewi.

Controls

A comparison group was chosen among patients attending the General Out Patient Department of the same hospital in the same period. For every pair of pregnant woman, one non-pregnant woman whose age and parity matched was chosen as control.

Inclusion Criteria

All pregnant women on their first antenatal visit during the study period of 1 April to 31 September 2001 after an informed consent were obtained from them. These pregnant women and the controls were normally resident in Nnewi during the period of the study and at least one year previously. They were HIV sero-negative and were not on cytotoxic drugs or on any immuno suppressive therapy. They did not have sickle cell disease, were not recently transfused with blood and did not have any debilitating illness.

Exclusion criteria

The subjects excluded were pregnant and non pregnant women who were HIV sero-positive; sickle cell disease as confirmed by Haemoglobin genotype screening; or had a recent blood transfusion.

Data Collection

A well-structured questionnaire was used for data collection by personal interview. The subjects' weight

was recorded in kilograms, while the height was recorded in metres. Thereafter, blood was withdrawn from the cubital vein (about 5mls) of each subject for the preparation of thick blood films, haemoglobin electrophoresis, and HIV screening.

Method

Sixty-five samples were excluded (HIV sero-positive samples (61), haemoglobin SS sample (1) and (3) of doubtful quality). Slides were prepared using the Geimsa method. After drying, the stained slides were examined in batches using (x 100 objective) lens in oil immersion. The parasite count per microlitre (1) of blood from the thick film was estimated by multiplying the average number of parasites per high power field (100 x objective) by 500.

The average number of parasite per high power field was established by examining 10-50 fields (depending on parasitaemia). The average number of trophozoites per high power field (HPF) was then multiplied by a factor of 500. The product gave the estimated number of parasites per microlitre of blood.

A control group of non pregnant women between the ages of 15 years and 45 years normally resident in Nnewi and sharing the same characteristics as those pregnant had their thick blood smears examined for malaria parasites using the same Giemsa staining technique and parasite density estimation method as that used with the pregnant subjects.

Results

A total of 620 subjects were studied between the period 1 April 2001 and 30 September 2001; made up of 420 consecutive pregnant women attending first ante-natal visit (booking) at NAUTH, Nnewi and 200 control subjects (non pregnant women) attending General Out Patient Department, after the exclusion of 64 observations; both groups satisfied the set criteria. An average of four pregnant women and two controls per day were studied.

Table I shows that the mean age for the pregnant women and controls were (mean±SD) 28.6±5.7 years and 28.5±5.18 respectively. Those below 20 years of age constituted 5.2% for pregnant women and 4% for the controls while the most frequent age group was 25 to 29 years in both pregnant women and controls. About 36.2% of pregnant women and 39.5% of the controls were in the 25-29 years age group.

About 124 of 420 or 29.5% of the study population and 53 of 200 or 26.5% of the controls were nulliparous while the least frequent parity (para 3) were 7.1% and 7.5% for pregnant subjects and controls respectively.

About 65.2% of study group or 274 of 420 attained secondary education. The corresponding figures for the control group were 65% or 130 of 200. Those with body mass index (BMI) less than 25 kg/m^2 constituted 40.5% (or 170 of 420) for pregnant women and 34% (or 68 of 200) for controls. 314 of 420 or 74.8% pregnant subjects had spouses in the middle class. The corresponding figures in the control group were 74.5% or 149 of 200.

Table II shows that about 333 of the 420 pregnant women (study group) had malaria parasitaemia giving a prevalence rate of 79.3% while 63 of 200 controls had malaria parasitaemia i.e. a prevalence rate of 31.5%. P.value 0.000 (P<0.05). This is statistically significant. The ratio of the prevalence rate of malaria parasitamia of pregnant to non pregnant women is 2.5: 1.

The mean parasite density of 1978 microlitre in the pregnant women is much higher than that found in the control subjects 762 microlitre. The ratio of mean parasite density of pregnant to non pregnant women is 2.6: 1. However, the spread as shown by the standard deviation is greater in the control than in the pregnant women.

Table I: Summary of the distribution of comparable selected socio-demographic characteristics of pregnant women and controls

	Pregnant Women	*Controls*
Mean Age (Mean±SD) years	28.6± 5.7	28.5 ± 5.18
No. of women aged less than 20 years	22 (5.2%)	8 (4%)
Most frequent age group 25-29 years	152 (36.2%)	79 (39.5%)
Nulliparous women	124 (29.5%)	53 (26.5%)
Literacy (secondary school leavers)	274 (62.5%)	130 (65%)
Least frequent parity (para 3)	30 (7.1%)	15 (7.5%)
Body Mass Index (BMI) < 25 kg/m^2	170 (40.5%)	68 (34%)
Occupation of spouse (middle class)	314 (74.8%)	149 (74.5%)

Table II: Prevalence of malaria parasitaemia in pregnant women and controls at NAUTH, Nnewi

	No. With malaria Parasitaemia	*Total studied*	*Percentage positive for parasitaemia (%)*
PREGNANT WOMEN	333	420	79.3
CONTROLS	63	200	31.5
	393	620	63.38

Table III: Comparison of the mean parasite density in pregnant women at booking and controls in NAUTH, Nnewi.

Pregnant women				*Controls*			
No. with MP	No. studied	Prev. rate	MPD per microlitre (meanÿSD	No. with MP	No. studied	Prev. rate	MPD per microlitre (meanÿSD)
333	420	79.3	1978ÿ1531	63	200	31.5	762ÿ1923

MP = Malaria parasitaemia.

Prev. = Prevalence.

MPD= Mean Parasite Density

Discussion

This study revealed a high prevalent rate of malaria parasitaemia of 79.3 percent among pregnant women at their first antenatal visit in NAUTH, Nnewi and 31.5 percent among the control subjects studied. Overall, the prevalence for both groups together was 63.8 percent. The finding agrees with what has been reported in literature by researchers in other parts of the world. The prevalent rate of malaria parasitaemia in pregnant women was about 2.5 times of the non pregnant women, while the mean parasite density was about 2.6 times. These figures suggest that pregnant women are more susceptible to parasitaemia in terms of spread and severity.

In Central India, Singh et al[5] observed high malaria prevalent rate among pregnant women (17.16%), when compared with non-pregnant women (7.56%). The mean parasite densities for both P falciparum and P vivax were significantly higher in the pregnant women than in the non-pregnant women.

Diagne et al[16] working in Senegal observed an incidence rate of malaria attack that was about 4.2 times higher in pregnancy than during control period in the same women during the year which preceded or followed their pregnancy. The survey revealed that the parasite rate was significantly higher during pregnancy. Although, this study included women in their immediate postpartum period, which could affect the conclusion that pregnant women were more susceptible to malaria than their non-pregnant counterparts. However, some researchers have shown that the increased susceptibility to malaria continued into the early postpartum period [17].

Okonofua et al[18] reported 72 percent parasite rate among pregnant women at Ile-Ife ; although, the study was not done with controls.

The very high figure in this study may be accounted for by the fact that the study location, Nnewi is an area with perennial malaria transmission without organized mosquito or malaria control programmes[19]. The period also coincided with the rainy season when water drains and gutters are usually blocked with refuse. The dirty stagnant water pools have generally provided breeding places for the mosquito vectors.

Susceptibility to malaria infection and the severity of clinical manifestation are determined by the level of pre-pregnancy immunity, which in turn depends largely on the intensity and stability of malaria transmission [20].

The reason for the increased susceptibility of pregnant women to malaria parasitaemia has been a subject for many research. Tian et al [21] found an increased population of young red cells in pregnant women and this he pointed out as contributing to the increased malaria susceptibility during pregnancy. Another probable reason is that the placenta provides an immunologically privileged site where the proliferation of the malaria parasites can proceed unbridled. It is more likely that many factors interplay to make the pregnant women more susceptible to malaria parasitaemia than the non-pregnant ones.

In conclusion, the prevalence rates and parasite density of malaria parasitaemia in pregnant women is more than twice the figures in their non pregnant counterparts at NAUTH, Nnewi.

For health workers in this environment, it is therefore recommended that all pregnant women be offered presumptive treatment and preventive regimen in line with WHO's recommendation. The authors agreed with the recommendation by Shultz et al[22] that intermittent therapy be coupled with the tetanus vaccination as an antenatal policy. Full doses of Sulphadoxine/Pyrimethamine should be given to pregnant women at the beginning of second and third trimesters. Pregnant women should be counselled on the need to undertake individual malaria vector control measures such as sleeping under insecticide treated bed nets (ITBN), protective clothing, destruction of mosquito breeding places and prompt treatment of fevers.

Limitation of the Study

The number of the controls enlisted was fewer because of the caution exercised in matching controls with the pregnant subjects. Women of child bearing age (15 to 45 years) who attended the GOPD during the study period were fewer. However, the sample size is large enough to give the study a power greater than 80%.

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