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Malaria Parasitaemia among Pregnant Women Possessing Freely Donated Insecticide-Treated Nets (ITNs) in Ado-Ekiti, Nigeria

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Abstract

A study of malaria parasitaemia was carried out between June and December, 2012 among 285 volunteered pregnant women who had freely donated Insecticide Treated Nets (ITNs). Conclusive diagnosis of *plasmodiunm sp* was based on finding the parasite in Giemsa-stained blood smears. Both thick and thin blood smear were prepared, using standard procedures. One hundred and one (26.2%) had malaria parasites. Seventy one (70.3%) of the 101 positive cases were anaemic. Pregnant women in the age group 36-40 years had the highest prevalence of malaria infection (86.2%). The prevalence of infection decreased significantly with parity, gestational age, the level of education and socio-economic status (P<0.01). Only 211 (54.8%) complied absolutely by using the net, while 95(24.7%) were absolute defaulters. The use of ITNs in malaria prevention and control is very promising. Health education and awareness promotion should be intensified to achieve absolute compliance, especially among pregnant women.

Key Words: *Malaria, Parasitaemia, Prevalence, Intensity, Pregnant-women.*

Introduction

Of the seven diseases initially earmarked for global control and/or eradication by Tropical Disease Research (TDR) of the World Health Organisation (WHO), malaria ranks first because of its morbidity, mortality, problems of diagnosis, lack of ideal drugs and effective vaccine as well as other behaviours of the vector. Human factors such as poor environmental hygiene, rapid population mobility and human aggregation at refugee camps are added complications [1].

As a devastating global public health problem, malaria accounts for 300 to 500 million cases per year, resulting in over 1,000,000 deaths yearly, especially in the developing countries. Approximately 750,000 children under five years of age die of malaria per year (the equivalent of almost 3000 children per day or one child every 30 seconds), and this accounts for 10% of the total disease burden measured in disability adjusted to life years [2].

Generally children under five years of age, pregnant women, sickle cell individuals, non-immune visitors and immuno-compromised individuals are at higher risk of severe malaria than those living in endemic areas [3].

WHO[2] estimated that about 25% of childhood deaths and half of fever episodes among African children under five years in endemic areas are as a result of malaria.

Insecticides-Treated Nets (ITNs) offer a form of personal protection and have repeatedly been shown to reduce severe diseases and mortality due to malaria for both the pregnant women and children in endemic regions. Community-wide trials in several African settings, ITNs have been shown to reduce all-cause mortality by about 20% [4].

The insecticides used for treating the nets kill mosquitoes and other insects. This insecticides also have repellent properties that reduce the number of mosquitoes that enter the house and attempt to feed thereby offering protection not only for the person under the net but also for those in the same room with the net owner [4].

Malaria infection during pregnancy can have adverse effects on both mother and foetus, including maternal anaemia, foetal loss, premature delivery, intrauterine growth retardation and delivery of low birth-weight infants (< 2.5kg or 5.5 pounds). It is a peculiar problem for women in their first and second pregnancies and for women who are HIV positive [5]. Each year, thirty million pregnancies are threatened by malaria in endemic Countries throughout Africa [6].

In Sub-Saharan Africa, the region of the world hardest hit by malaria, the infection is estimated to cause 400,000 cases of severe maternal anaemia and from 75,000 to 200,000 infant deaths annually. Maternal anaemia contributes significantly to maternal mortality and causes an estimated 10,000 deaths per year [6].

There have been several efforts at combating malaria which generally point towards early diagnosis and effective treatment of affected persons but unfortunately, the control of malaria is less than a success story because malaria parasites are becoming increasingly resistant to anti-malarial drugs, therefore control cannot be based on treatment only. Thus, the need to include preventive measures arose.

In response to this problem, the Heads of Government and International Agencies at the African Summit on Roll Back Malaria (RBM) held at Abuja in year 2000 declared that malaria burden must be reduced by at least 50% by the year 2010 [7,8]. One of the well accepted measures involves the use of Insecticide Treated Nets (ITNs) particularly in malaria endemic regions. Subsequently, there have been free distribution of the ITNs donated by the Roll Back Malaria to children under five and pregnant women [8].

The free donation and distribution of ITNs in Nigeria as part of Roll Back Malaria (RBM) initiatives began in the year 2000. Since then, no concerted attempt to carry out an impact assessment of the use of ITNs on malaria parasitaemia

had been made in the current study area (a subset of Nigeria) about twelve years after the free donation of ITNs commenced.

Objectives

This study determines the impact of the use of ITNs and malaria parasitaemia among pregnant women who had free donation of the ITNs and were attending the University Teaching Hospital, Ado Ekiti, Ekiti State, Nigeria.

Methodology

Ekiti State is one of the thirty-six states (and the Federal Capital Territory, Abuja) which constitute the Federal Republic of Nigeria. It is located between Longitude 4º 45¹ and 5º 45¹ East of the Greenwich Meridian and Latitude 7º 15¹ and 8º 5¹ North of the Equator.

The State has tropical climate with two distinct seasons, the rainy season (April - October) and the dry season (November - March). The mean annual rainfall is about 10,047mm/yr. Temperature ranges between 21ºC and 28ºC with average relative humidity of about 74%. The South West -wind and the North-East Trade winds blow in the rainy and dry (Harmattan) seasons respectively. Tropical forest exists in the South while Guinea Savannah occupies the Northern peripheries.

The people of the State are predominantly farmers but women engage in trading and other entrepreneurial activities. There are educational and health institutions at primary, secondary and tertiary levels including a University Teaching Hospital. The central part of the town is densely populated with overcrowded structures and populations that are clustered together to form compounds where family members cohabit. Some of these houses have deplorable drainages and gutters around which are constantly being blocked thereby providing suitable breeding sites for mosquitoes.

A sample size of three hundred and eighty five (385) volunteered pregnant women used in this study was determined by using Fisher's formular [9].

Ethical clearance was sought and obtained from the Ethical Committee of the University Teaching Hospital Ado-Ekiti before the commencement of this study.

Participation was voluntarily and the consent of the volunteered pregnant women was obtained before the commencement of sample collection.

Structured questionnaires, which had been pre-tested and standardized, were administered to the volunteered pregnant women through which demographic and clinical status of the participants were obtained.

All pregnant women who had received insecticide treated bed net freely donated by the government, registered and are attending the Antenatal Clinic of University Teaching Hospital, Ado Ekiti and were not on anti-malaria drugs before or 7 days as at the time of sample collection were included in this study.

Blood Sample Collection and Transportation.

After the participants were allowed or assisted to fill the questionnaires administered to them, a 2ml of their blood samples were collected with the aid of sterile needle and syringes (one for each participant) into anti-coagulated (EDTA) bottles through venepuncture technique. The blood was mixed with the anticoagulant in the sample bottles.

The well mixed, well oxygenated blood samples capillary tubes (two for each participant) were filled with blood for making blood smears and the second spun with microhaematocrit centrifuge in order to obtain the packed cell volume (PCV).

The blood smears (thick and thin) were kept inside slide boxes and transported to Laboratory Department of the University of Ilorin Teaching Hospital, Ilorin for further processing.

Procedures for the Preparation of Blood Films, Microscopic Examination, Establishing Parasite Density and Counting of Malaria Parasites against White Cells in a Thick Film were as described by Monica[10].

Data obtained were analysed using the Statistical Packages for Social Sciences (SPSS Version 17.00)

Results

Of the 385 participants whose blood samples were examined microscopically for malaria parasitaemia, 101 (26.2%), were positive for *Plasmodium falciparum* while 284 (73.8%) were negative.

On compliance with the use of ITNs among volunteer pregnant women, 211 (54.8%) complied adequately with the use of ITNs, 79 (20.5%) complied partially using the net only 50% of the times, while 95 (24.7%) were absolute defaulters i.e never used the nets once.

Adequate compliants with the use of ITNs had the least prevalence of malaria parasitaemia (19.4%) while the highest prevalence, 38.9% was recorded among absolute defaulters. Parasitaemia decreased significantly ($p< 0.01$) with increase in compliance with the use of ITNs.

Mean parasite load was also significantly reduced among the adequate compliants ($p<0.01$). The mean parasite load of partial compliants was higher than that of the absolute defaulters, however, the difference was not statistically significant ($P>0.05$) Table 1.

TABLE 1: Prevalence and mean Parasite Load of Malaria Parasitaemia in Relation to Compliance with the Use of ITNs (N= 385).

ITNS USE	**NO/(%) EXAMINED**	**NO/(%) POSITIVE**	**MEAN PARASITE LOAD (µI)**
Adequate (100%) Compliant	211 (54.8)	41(19.4)	2,570.7
Partial (50%) Compliant	79 (20.5)	23(29.1)	2,873.0
(0%) Compliant (Absolute Defaulters)	95(24.7)	37(38.9)	2,782.7
TOTAL	**385 (100)**	**101(26.2)**	

P = 0.001, p<0.01

Prevalence of malaria parasitaemia in relation to age of volunteer pregnant women (N= 385)

The highest number 153 (39.7%) were in the age group 26 - 30 years. This was closely followed by 116 (30.1%) in the age group 31 – 35; 73 (19%) in the age group 21 – 25; 29 (7.5%) in the age group 36 – 40 and 10 (2.6%) in the age group 16 – 20. The least 4 (1.04%) were recorded in the age group 41- 45.

Prevalence of malaria parasitaemia was highest (86.2%) among the pregnant women in the age group 36 – 40 while pregnant women in the age group 26- 30 recorded the least prevalence of 13.7%. (Table 2).

Table 2: Prevalence of Malaria Parasitaemia in Relation to Age of the Pregnant Women (N= 385)

AGE-GROUPS (YEARS)	**NO/(%) EXAMINED**	**NO/(%) POSITIVE**
16 – 20	10 (2.6)	3 (30.0)
21 – 25	73 (18.96)	23 (31.5)
26 – 30	153 (39.74)	21 (13.7)
31 -35	116 (30.13)	29 (25.0)
36 – 40	29 (7.53)	25 (86.2)
41- 45	4 (1.04)	0 (0.0)
TOTAL	385 (100%)	101 (26.2%)

t= 2.588, p= 0.049, p<0.01

Malaria parasitaemia and mean parasite load in relation to parity of pregnant women (N=385)

Women carrying their first pregnancy (primigravidae) had the highest prevalence 61(39.1%) of malaria parasitaemia while those who had had more than two pregnancies (multigravidae) had the least prevalence 17(14.2%) of infection (Fig 4.4 and Table 4.3). However, there was no significant difference (p>0.01) in the mean parasite load of the volunteered pregnant women in their different parity (Table 3).

Table 3: Malaria Parasitaemia and mean parasite load in relation to Parity, Gestational age as well as symptomatic and asymptomatic pregnant women carriers of Plasmodium spp.

Status	**No. (%) Examined**	**No. (%) positive**	**Mean Parasite Load**	**P Value**
Parity=N=385				
Primigravidae	156(40.5)	61(39.1)	7,573.3	t=3.079
Secundigravidae	109(28.3)	23(21.1)	2,779.1	p=0.091
Multigravidae	120(31.2)	17(14.2)	10,545.9	p>0.01
Gestational age(months)=N=385				
1-3	27(7.0)	13(48.2)	2,473.8	t=15.03
4-6	94(24.4)	31(33.0)	3,078.7	p=0.004
7-9	264(68.6)	52(21.6)	2,628.8	P<0.01
Symptoms status=N=385				
Symptomatic	31(8.1)	14(13.9)	3,011.4	95% confidence
Asymptomatic	354(91.9)	87(86.1)	2,518.2	interval. P=0.006 <0.01

Prevalence and mean parasite load in relation to gestational age of pregnant women (N= 385)

Of the 385 volunteer pregnant women examined for malaria parasitaemia 27(7.0%) were at first trimester, 94(24.4%) were at second trimester and 264 (68.6%) were at third trimester. Infection rate decreased with increase in gestational age as indicated in table 3. The highest mean parasite load found among pregnant women in the second trimester was statistically significant (p<0.01) (Table 3)

Prevalence and mean parasite load of malaria among symptomatic and asymptomatic carrier of malaria parasite (N= 101)

Of the 101volunteer pregnant women whose blood samples were positive for *Plasmodium*, a significant percentage 86.1% were not having symptoms resembling that of malaria, while only 13.9% were having symptoms of malaria as at

the time of sample collection (Table 3). The mean parasite load of febrile and symptomatic carriers of *Plasmodium spp* was significant ($p<0.01$) at 99% confidence level approach. (Table 3).

Malaria parasitaemia in relation to occupation of pregnant women (N= 385)

Of the 385 volunteered pregnant women examined, a predominant number 158(41.0%) were civil servants and 36(22.8%) were positive for malaria. This was followed by 101(26.2%) traders, of which 30(29.7%) were positive. The highest prevalence (100%) of infection was recorded among the farmers who were just 2(0.5%) while the least prevalence (22.8%) was found among the civil servants.

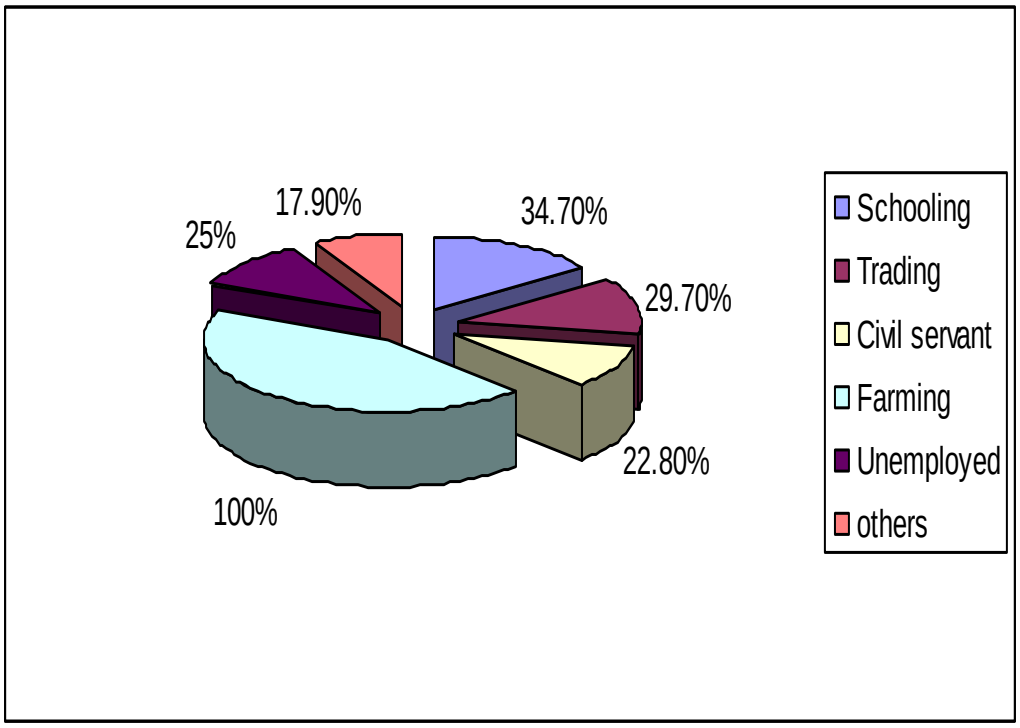

Fig.1: Malaria Parasitaemia in Relation to Occupation of the Pregnant Women (n= 385)

Relationship between Malaria Parasitaemia and Packed Cell Volume (PCV) of the Pregnant Women (N=101)

Of the 101 volunteer pregnant women whose blood samples were positive for malaria parasite, 70.3% were anaemic (had PCV≤ 32%), 24.8% had PCV within the range of 33 – 36% and 4.9% had PCV of 36 – 38%. Figure 2 below shows a linear regression curve between the degree of positivity of malaria parasitaemia and the packed cell volume of the pregnant women. The Packed cell volume decreased significantly with increase in mean parasite load.

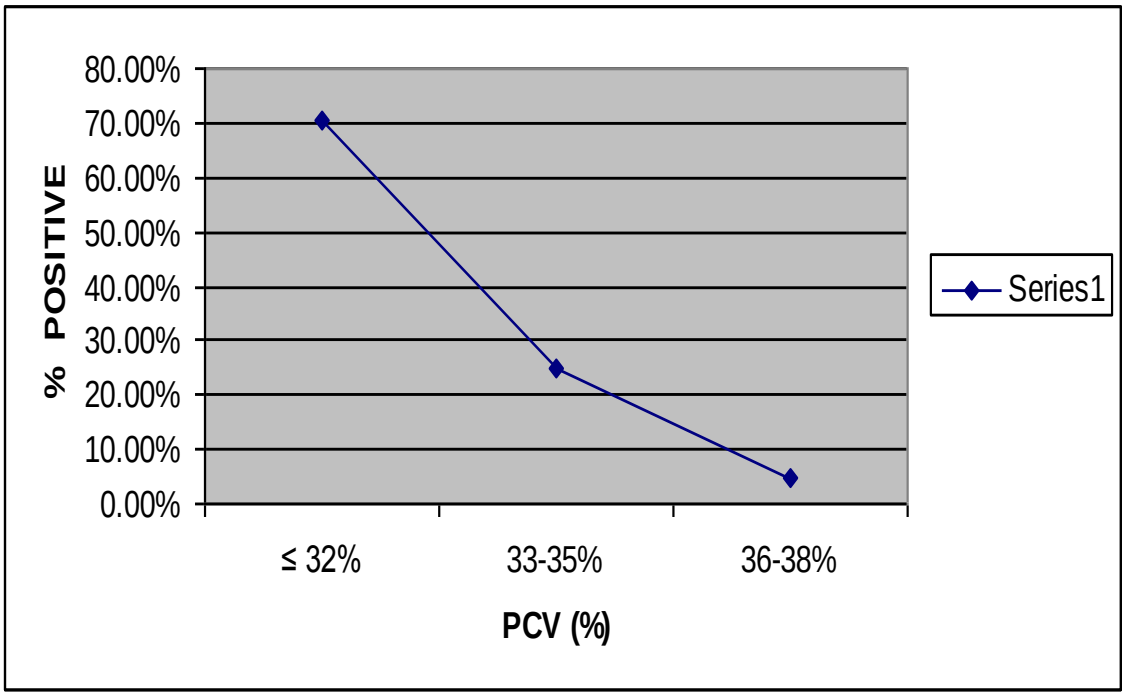

Fig. 2: A Linear Regression Curve between Degree of Malaria Parasitaemia Positive and PCV Value

Discussion

This study conducted among volunteer pregnant women who had received freely donated insecticide treated nets (ITNs) and who were attending antenatal clinic of the University Teaching Hospital, Ado Ekiti, showed that 101

(26.2%) of the women had parasitaemia. Previous studies in Nigeria reported parasitaemia rates among pregnant women ranging from 7.7% to 80% [6, 11,12,13,14]. Similarly, studies from other malaria endemic parts of Africa have also reported significant variations in the prevalence of malaria parasitaemia among pregnant women. In Kenya,for instance, Feiko [15] reported a prevalence of 26.1%, in Cameroun; Walker- Abbey [16] reported a prevalence of 82.4% while in Burkina Faso, Sheick [17] reported a prevalence of 21.5%.

The wide ranges in the reported prevalences of malaria parasitaemia may be due to multiple factors, including; method of diagnosis either Polymerase chain reaction (PCR) or microscopy, seasonal changes, intensity of transmission, characteristics of the study population (i.e age, knowledge of the cause of malaria and preventive measures against mosquito bite, parity, HIV status) and environmental conditions.

Because of the devastating effect and consequence of malaria in pregnancy, several strategies for its prevention have evolved. One of the latest of these is the use of insecticide treated nets (ITNs). Its uniqueness and merits include; being provided free of charge to all pregnant women in the study area; non-invasive, non-toxic, easy to fix and devoid of adverse reactions.

This study however reveals that despite this free donation and other benefits, only 54% of the pregnant women complied adequately with the usage, 21% were using it only about 50% of the time while 25% had never slept under their own nets. This finding is consistent with the reports of Sheick [17] who reported low compliance with ITNs usage among pregnant women in Ibadan Burkina faso.

In this study, the prevalence (19.4%) and the mean parasite load (2570.7ul) of *Plasmodium spp* were both significantly lower among adequate compliants while the absolute defaulters recorded the highest prevalence (38.9%) Various studies have shown that ITNs is effective in the control of malaria among pregnant women. Feiko [15] and Thomas[18] demonstrated that the use of ITNs significantly reduced prevalence and mean parasite load of malaria parasitaemia in villages where it was used compared to control villages. However Sheick [17] found no difference in malaria prevalence between women using or not using ITNs. This may be due to mosquito bites that occur during outdoor activities. Also, the degree of compliance whether absolute or partial has a great impact on the effectiveness of ITNs.

Prevalence of malaria parasitaemia according to age distribution of the volunteers showed the highest prevalence of infection (86.2%) occurring within the age group 36- 40. This finding is also consistent with the work of Adefioye [19] in Osogbo who got the highest prevalence of *Plasmodium* infection among the age 36- 39 years. The reason for the high prevalence of infection among this group may be because of the relative small number of pregnant women examined in the group and it may also be the direct effect of parity because a high percentage of the group may be older but younger first time mothers. The finding is however, not compatible with some reports where younger maternal age were declared as having significant association with malaria parasitaemia [11, 19.]

This study also, found that parasitaemia was closely associated with parity and gestational age of the pregnant women. Several other studies have reported similar associations [11, 17]. Primigravidae have been reported to be at greatest risk of malaria in pregnancy because of the lack of specific immunity to malaria which is acquired from exposure to malaria parasites during pregnancy [20, 21]. This immunity builds up with successive pregnancies provided there is exposure to malaria parasite [21]. As observed in this study, primigravidae had the highest prevalence (39.1%), followed by secundigravidae (21.1%) and the least prevalence was found among the multigravidae (14.2%). However, there was no significant difference in the mean parasite load of the pregnant women in relation to parity.

The Prevalence of infection was higher during the first trimester of pregnancy and decreased steadily during the second and third trimesters. This finding is consistent with the observation that the peak prevalence of *P. falciparum* infection is between 9 and 16 weeks of gestation [15]. Another reason may be because pregnant women generally do not attend antenatal clinic early in pregnancy and a large proportion of them might have unrecognised and untreated malaria infection as most infections are asymptomatic

Prevalence of malaria infection decreased with increase in educational status of the pregnant women while 2.9% of the studied sample had primary education, 72.5% of the same volunteers had tertiary education. Despite the high level of education, this study shows the low usage of ITNs among the study populations. The highly educated ones would have been better informed about the cause of malaria and thereby might have applied adequate preventive measures against mosquito bite. On the other hand the semi- illiterates and illiterates are more exposed to malaria parasite due to their general life style, their non-befitting environmental conditions which encourage the breeding of mosquitoes as well as the low level of knowledge of the benefit of using ITNs. The drop in Packed Cell Volume (PCV) is as a result of the extra-vascular destruction of both parasitized and unparasitized erythrocytes that takes place in the spleen during malaria infection [21].

Most cases of malaria in area of stable malaria transmission are asymptomatic; this is attributed to the immunity acquired during previous exposures which protects against clinical malaria [20]. This statement was confirmed in this study as 86.1% of those infected with malaria were not having symptoms suggestive of malaria as at the time of sample collection. In Lagos, Falade [12] also gave a similar prevalence (89%). Several other studies have also reported similar findings [6, 11]. Among those having symptoms suggestive of malaria 31(8.1%), only 14(45.2%) had parasitaemia confirmed in their blood.

In Conclusion, total compliant in the use of freely donated ITNs is taking among pregnant women. The observed general prevalence (26.2%) of infection and the fact that 86.1% of infected pregnant women in this study were asymptomatic suggest that malaria remains a silent killer especially during pregnancy.

Insecticide treated net significantly reduced the prevalence of malaria but it does not offer 100% panacea against it as 19.4% of adequate complaints to its usage were still positive for *Plasmodium falciparum.*

The fact that 20.5% were using their ITNs only about 50% of the time and 24.7% were absolute defaulters despite the free donation and high educational status of this people, underscore the need for a more concerted effort to address the control of malaria in pregnancy.

For the goals of the RBM to be achieved, we, strongly recommend that, Health Education focussing on the benefits of ITNs should be instituted and intensified at homes, market places and other public places.

Awareness promotion to achieve large scale compliance and Integrated control measures (such as the use of intermittent preventive therapy (IPT) during pregnancy, indoor residual spraying (IRS) and other vector control measures) should be identified and addressed at all times among the pregnant women not only in Ekiti state but in Nigeria as well as other malaria endemic African countries.

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