Abstract

Background: Malaria parasitemia during pregnancy is a most important public health problem to governments and to individuals in malaria endemic regions of the world. Moderate or severe anemia during pregnancy may be associated with heavy parasitic infestation. However, malaria may not be the only cause of anemia in pregnant women in developing countries.

Objective: To determine the prevalence of malaria and anemia in different trimester, gravidity and age group

Study design: A cross-sectional study that recruited 113 pregnant women who were screened for the malaria parasites and anemia.

Setting: The study was conducted in the antenatal clinic of two general hospitals in Ikorodu Local Government Area (LGA) in Lagos, Southwest Nigeria.

Participants: The pregnant women recruited for this study were living in communities on the coasts of the Lagos Lagoon.

Measurements: Socio-demographic profile, obstetrics and gynecologic history and other relevant data of the pregnant women were collected using a semi-structured questionnaire instrument in an interview. Blood samples were analyzed for Packed Cell Volume (PCV) level and malaria parasites

Results: Malaria prevalence was 19.5% and the prevalence of anemia was 81.4%. The highest prevalence of malaria (27.5%) occurred in the 3rd trimester and among primigravida. The highest prevalence of anemia was in the 2nd trimester and among the multigravida. Those with severe anemia were approximately five times more likely to have malaria parasitemia ($\chi^2=8.16$, $P$-value$=0.004$, OR$=4.84$, 95% CI: 1.53, 15.35) compared to all other pregnant women. Women in the third trimester were 1.25 as likely to develop severe anemia than those in first or second trimester ($\chi^2=0.18$, $P$-value$=0.69$, OR$=1.25$, 95% CI$=0.41$, 3.82). Secundigravida were 1.60 times more likely to develop moderate anemia ($\chi^2=1.20$, $P$-value$=0.27$, OR$=1.60$, 95% CI$=0.69$, 3.76) and multipara were 1.35 times more likely to develop mild anemia ($\chi^2=0.24$, $P$-value$=0.62$, OR$=1.35$, 95% CI$=0.41$, 4.47). Regardless of whether the pregnant woman was parasitized or not, the mean PCV of those who consumed herbal tea (28.2±5.2) was significantly lower ($t=2.24$, $P$-value$=0.01$) than those who did not consume herbal tea (30.8±6.5) in pregnancy.

Conclusion: The prevalence of anemia in pregnancy was very high while the prevalence of malaria was very low. Anemia was commoner in the 2nd trimester and among multigravida while malaria was more prevalent in the 3rd trimester and among primigravida. Consumption of herbal tea was associated with low Packed Cell Volume.

Keywords: pregnancy, malaria, anemia, maternal age, trimester, gravidity, South-west Nigeria

Introduction

It is estimated that, annually, about 30 million pregnant African women are exposed to the risk of malaria infection and 56 million suffer anemia. In regions of intense transmission, infection with Plasmodium falciparum is usually asymptomatic and therefore undetected and untreated although the malaria parasites are incubated in the placenta. Various studies have reported main adverse effects of malaria in pregnancy such as maternal anemia and low birth weight babies. Individuals in endemic areas build up immunity against malaria by acquiring specific antibodies capable of hindering parasite sequestration. However, pregnant women are susceptible to infection, despite previously acquired immunity probably because of her lowered immune response and reduced ability to effectively clear malaria parasites from her system. Furthermore, probably because of its high nutrient and oxygen content, malaria parasites sequester in the placenta, more than in the peripheral blood, though Pereira et al. stated that the specific adherence of malaria parasites to placenta tissues is mediated by a certain protein, the VAR2CSA protein, which binds to placental chondroitin sulfate (CS) on chondroitin sulfate proteoglycans (CSPGs) in the placental syncytiotrophoblast. Clinical complications such as anemia, pulmonary edema, hypoglycemia, cerebral malaria, puerperal sepsis, miscarriage, premature delivery, low birth weight, congenital infection, and/or perinatal death are possible outcomes of malaria...
infection during pregnancy.\textsuperscript{10–16} It is pertinent to note however that anemia is especially problematic because hemoglobin level falls due to greater expansion of plasma volume relative to increase in red RBC volume, especially so in the second trimester of cases. It has been shown that anemia increase when there is elevated number of malaria cases\textsuperscript{17} and the incidence of anemia during pregnancy is aggravated in malaria high-transmission settings. These adverse effects of \textit{P. falciparum} infection in pregnancy are most pronounced for women in their first pregnancy.\textsuperscript{18,19} In addition to malaria parasite-induced hemolysis during infection, iron deficiency heightened by nutritional deficiencies can result in iron-deficiency anemia; folate-deficiency anemia or Vitamin B12-deficiency anemia and worm infestation worsen the anemia situation in the general populace and in pregnancy, foretells poor maternal outcomes.\textsuperscript{20–22} Interventions are therefore targeted at this group of people to abate the problems and surveillance of the affected population becomes necessary to monitor the impact periodically. The objective of this study was to examine the pattern of anemia among pregnant women in Lagos Nigeria and describe the proportion of the anemia due associated with malaria parasitemia. Intervention can therefore be better targeted. Furthermore, proportion of anemic pregnant women due from malaria infection can be deduced separate from anemia due to other causes.

**Materials and methods**

This cross-sectional study, implemented from January to April of 2009, at the antenatal clinics of Ijede General Hospital and Ikorodu General Hospital in Ikorodu Local Government Area (LGA), two government operated facilities in Lagos, Southwest Nigeria, has been reported elsewhere.\textsuperscript{23} Ikorodu General Hospital is located in the urban center of the LGA whereas Ijede General Hospital is located in its rural parts, approximately 8 km further eastwards. Both Health facilities are located within communities adjacent to the northern fringe of the Lagos lagoon. Ikorodu, a semi-urban town, is the headquarters of Ikorodu LGA which lies between latitude 6°37'N- 6°45'N and longitude 30°3’East-305’East. Population migration from metropolitan Lagos and other parts of Nigeria has increased the population of this LGA from about 400,000 in 2000 to over 700,000 in 2009, though Ijede residents were still mainly a homogenous population of approximately 10-15,000, made up of farmers, fishermen and petty traders. There were three primary schools and one secondary school in Ijede. Due to its proximity to Lagos, the community still has good access road, pipe bore water and relatively stable electric supply. By contrast, because of its size and semi-urban features, has a network of tarred roads, more public and private health and educational facilities and is supplies with large markets where entrepreneurs ply their trade. Some of the residents at Ikorodu and Ijede work in offices in metropolitan Lagos, commuting either by road or by water transportation over the lagoon of Lagos.

**Sample size calculation for each health facility**

Sample size was calculated assuming a prevalence of 20% for malaria in pregnancy, for an error rate of 10% and a confidence interval of 95%, the sample size needed is

\[
\frac{Z^2pq}{d^2} = \frac{1.96^2 X 0.2 X 0.8}{0.1^2} = 62
\]

where

\[Z = \text{z-score at 95% confidence interval} = 1.96\]

\[P = \text{prevalence rate (20\%)}\]

\[q = \text{Failure rate (80\%)}\]

\[d = \text{error rate (10\%)}\]

Sixty-two participants were required in each facility of study.

**Results**

**Malaria in pregnancy**

Table 1 & Figure 1 of the 113 pregnant women enrolled in the study, only 22 (19.5\%) were positive for malaria parasites with a geometric mean parasite density of 7,300 and a mean PCV of 26.8±6.6\%. In all,
19 (16.8%) of the study subjects were in the first trimester of whom 3 (15.8%) were parasite-positive with a GMPD of 339.7, 54 (47.8%) were in the second trimester among whom 8 (14.8%) were positive for malaria parasites with a GMPD of 1077.4 and 40 (35.4%) were in their third trimester among whom 11 (27.5%) had malaria parasitemia with a GMPD of 715.3. Malaria parasites were observed more among women in their first pregnancy (8/32, 25.0%; GMPD = 390.3) than among those in the second (4/32, 12.5%, GMPD = 5040.4) or more than two (10/49, 20.4%, GMPD = 590.3) pregnancies. Figure 1 illustrates the status of malaria parasitemia among the study subjects showing that malaria was most prevalent among pregnant women aged 26-30 years and least among those aged 20 years or less. Women in the third trimester of pregnancy were more than twice likely to be positive for malaria parasite (OR=2.14, 95% CI: 0.83, 5.50) than those in other trimesters. Those in their first pregnancy were 1.60 times as likely to be positive for malaria parasites than secundigravida or multipara women. Overall, malaria parasitemia was observed more in the 3rd trimester (11, 27.5%) and among those pregnant for the first time (8, 25.0%).

| Table 1 | Frequency distribution of parasitized and non-parasitized pregnant women with anemia and in various trimester and gravidity with malaria parasitemia |
|---------|--------------------------------------------------------------------------------------------------------------------------|
| Variable          | Item                  | Anemia | PCV | Trimester | Gravidity |
|                   |                       | None   | Mild | Moderate | Severe |
|                   |                       | Freq.  | %   | Freq.    | %     | Mean   | Std | Freq. | % | Freq. | % | Freq. | % | Freq. | % |
| Malaria parasites | Pos.                  | 3      | 14.3| 0        | 0.0   | 12     | 18.5| 46.7 | 26.8| 6.6  | 3   | 15.8 | 8 | 14.8 | 11 | 27.5 | 8 | 25.0 | 4 | 12.5 | 10 | 20.4 |
|                   | Neg.                  | 18     | 85.7| 12     | 100.0 | 53     | 81.5| 53.3 | 30.8| 6.0  | 16  | 94.2 | 46 | 85.2 | 29 | 71.5 | 24 | 75.0 | 28 | 87.5 | 39 | 79.6 |
| χ²                |                       | 0.44   | 2.00| 0.75   | 8.16  | 1 = 0.42| 0.02 | 1.43  | 2.55| 0.87 | 0.8 | 0.05 |
| P-value           |                       | 0.51   | 0.16| 0.75   | 0.004 | 0.27  | 0.90  | 0.33  | 0.11 | 0.35 | 0.36 | 0.82 |
| OR                |                       | 0.64   | undefined | 0.86 | 4.84 | -   | 0.74  | 0.56  | 3.14 | 1.60 | 0.50 | 1.11 |
| 95% CI            |                       | 0.17   | 2.40 | undefined | 0.34 | 2.20 | 1.53 | 15.35 | -   | 0.19 | 2.80 | 0.31 | 1.46 | 0.43 | 1.50 | 0.09 | 4.28 | 0.15 | 16.1 | 0.44 | 2.83 |
| Geometric Mean    | Parasite Density      | 1,900  | 497.4| 1018.3 | 7500 | 339.7 | 1074.7 | 717.4 | 390.3 | 5040.4 | 590.3 |
| 95% Confidence     | Interval              | 2.21   | 1.62   | 4.52 | 0  | 57.68 | 4290.03 | 68.27 | 1587.12 | 0.16 | 718.19 | 35.64 | 2297.55 | 4997.28 | 2675.82 | 1244222 | 6893.95 |
| PCV               | Mean                  | 39.1   | 34.4 | 28.6   | 20.3 | -   | 30.9 | 29.5 | 30.4 | 29.6 | 30.4 | 30.1 |

| Variable | Sub-variable | Statistics | Anemia |
|----------|--------------|------------|--------|
|          |              | None       | Mild    | Moderate | Severe |
|          |              | Freq. %    | Freq. %  | Freq. %  | Freq. %  |
| First    | χ²           | 0.90       | 1.53    | 0.30    | 0.0003   |
|          | P-value      | 0.34       | 0.21    | 0.59    | 0.99     |
|          | OR           | 1.74       | 0.00    | 1.33    | 0.73     |
|          | 95% CI       | 0.55, 5.52 | undefined | 0.48, 3.67 | 0.15, 3.55 |
| Total    | χ²           | 3.82       | 2.86    | 0.13    | 0.01     |
| Second   | P-value      | 0.05       | 0.09    | 0.72    | 0.93     |
|          | OR           | 0.37       | 3.73    | 1.15    | 0.95     |
|          | 95% CI       | 0.13, 1.03 | 0.95, 14.61 | 0.54, 2.42 | 0.32, 2.82 |
| Total    | χ²           | 2.89       | 0.23    | 0.64    | 0.18     |
| Third    | P-value      | 0.09       | 0.63    | 0.42    | 0.69     |
|          | OR           | 0.44       | 0.58    | 0.73    | 1.25     |
|          | 95% CI       | 0.17, 0.15 | 0.15, 2.26 | 0.33, 1.59 | 0.41, 3.82 |

Figure 1 Proportion of pregnant women who were positive or negative for malaria parasites by age group in the study.

Table 2 Frequency distribution of anemia categories in various trimesters and gravidity of study subjects

Citation: Olukosi A, Afolabi BM. Malaria and anemia among pregnant women living in communities along the coast of Lagos Lagoon, South-west Nigeria. Int J Pregn & Chi Birth. 2018;4(6):175–182. DOI: 10.15406/ipcb.2018.04.00122
Table Cont...nded...

Table 3 Frequency distribution of anemia, malaria infestation, trimester and gravidity according to age group

| Variable | Sub-variable | Participant | Anemia | None | Mild | Moderate | Severe | Within group | Total with Anemia |
|----------|--------------|-------------|--------|------|------|----------|--------|--------------|------------------|
|          |              |             | Freq. | %    | Freq. | %        | Freq. | %       | Freq. | %    | Freq. | %    |
| Total    |              |             | 113   | 100.0 | 21   | 18.6     | 12    | 10.6    | 65   | 57.5 | 15    | 13.3 | 92    | 81.4 | 92    | 81.4 |
| ≤20      |              |             | 4     | 3.5   | 1    | 4.7      | 0     | 0.0     | 0    | 0.0  | 2     | 1.8  | 3     | 75.0 | 3     | 2.7  |
| 21-25    |              |             | 24    | 21.2  | 7    | 33.3     | 3     | 25.0    | 10   | 15.4 | 4     | 26.7 | 17    | 70.8 | 17    | 15.0 |
| 26-30    |              |             | 36    | 31.9  | 4    | 19.1     | 2     | 16.7    | 27   | 41.5 | 3     | 20.0 | 32    | 88.9 | 32    | 28.3 |
| 31-35    |              |             | 31    | 27.4  | 4    | 19.1     | 4     | 33.3    | 17   | 26.2 | 6     | 40.0 | 27    | 87.1 | 27    | 23.9 |
| >35      |              |             | 18    | 15.9  | 5    | 23.8     | 3     | 25.0    | 9    | 13.9 | 1     | 6.7  | 13    | 72.2 | 13    | 11.5 |
|          |              | Malaria     |       |       |       |          |       |         |      |      |       |      |       |      |       |      |
| ≤20      |              | None        | 1     | 4.5   | 1    | 33.3     | 0     | 0.0     | 0    | 0.0  | 0     | 0.0  | 0     | 0.0  | 115.0 | -    |
|          |              | Yes         | 3     | 3.3   | 0    | 0.0      | 0     | 0.0     | 2    | 3.8  | 1     | 12.5 | -     | -    | -     | -    |
|          |              | 21-25       | 6     | 27.3  | 1    | 33.3     | 0     | 0.0     | 2    | 16.7 | 3     | 42.9 | 81.4  | 93.08 | 7127.27 |
|          |              | No          | 18    | 19.6  | 3    | 33.3     | 3     | 25.0    | 8    | 15.1 | 1     | 12.5 | -     | -    | -     | -    |
|          |              | 26-30       | 9     | 40.9  | 0    | 0.0      | 0     | 7      | 58.3 | 2    | 28.6  | 1445.3 | 94.16 | 22183.77 |
|          |              | No          | 27    | 29.7  | 4    | 22.2     | 2     | 16.7    | 20   | 37.7 | 1     | 12.5 | -     | -    | -     | -    |
|          |              | 31-35       | 4     | 18.2  | 0    | 0.0      | 0     | 2      | 16.7 | 2    | 28.6  | 274.4  | 1.21 | 6231/80.89 |
|          |              | No          | 27    | 29.7  | 4    | 22.2     | 4     | 33.3    | 15   | 28.3 | 4     | 50.0 | -     | -    | -     | -    |
|          |              | >35         | 2     | 9.1   | 1    | 33.3     | 0     | 0.0     | 1    | 8.3  | 0     | 0.0  | 584.2 | -    | -     | -    |
|          |              | Yes         | 16    | 17.6  | 4    | 22.2     | 3     | 25.0    | 8    | 15.1 | 1     | 12.5 | -     | -    | -     | -    |
|          | Trimester    |             |       |       |       |          |       |         |      |      |       |      |       |      |       |      |
|          | First        |             | 4     | 3.5   | 2    | 10.5     | 3    | 3.7     | 0    | 0.0  | 0     | 0.0  | 2     | 6.3  | 2     | 6.3  | 0     | 0.0  |
|          | Second       |             | 24    | 21.2  | 7    | 36.8     | 16    | 29.6    | 13   | 32.5 | 10    | 40.6 | 15    | 46.9 | 8     | 16.3 |
|          | Third        |             | 36    | 31.9  | 2    | 16.7     | 27    | 39.0    | 13   | 44.7 | 6     | 27.8 | 17    | 20.0 | 15    | 16.3 |
|          | Primigravida |             | 31    | 27.4  | 6    | 21.6     | 17    | 31.5    | 8    | 20.0 | 2     | 6.3  | 7     | 21.9 | 22    | 44.9 |
|          | Secundigravida|            | 18    | 15.9  | 2    | 10.5     | 8    | 14.8    | 8    | 20.0 | 3     | 9.4  | 0     | 0.0  | 15    | 30.6 |
|          | Multipara   |             | 113   | 100.0 | 19   | 16.8     | 54    | 47.8    | 40   | 35.4 | 32     | 28.3 | 32    | 28.3 | 49    | 43.4 |

Anemia in pregnancy

Table 1 shows that 21 (18.6%), 12 (10.6%), 65 (57.5%) and 15 (13.3%) pregnant women had no, mild, moderate and severe anemia respectively. The mean PCV of malaria-positive pregnant women in the study was lower (26.8±6.6) than that of parasite-negative women.

Citation: Olukosi A, Afolabi BM. Malaria and anemia among pregnant women living in communities along the coast of Lagos Lagoon, South-west Nigeria. Int J Pregm & Chi Birth. 2018;4(6):175–182. DOI: 10.15406/ipcb.2018.04.00122
Malaria and anemia among pregnant women living in communities along the coast of Lagos Lagoon, South-west Nigeria

A total of 21 (18.6%) women had no anemia, of whom 3 (14.3%) were positive for malaria parasites with a geometric mean parasite density of 1900 and mean (±sd) PCV of 39.1 (±0.5). Interestingly, none of the 12 women with mild anemia had malaria parasitemia with a mean (±sd) PCV of 34.4 (±0.5). The mean (±sd) PCV of the 65 women with moderate anemia was 28.6 (±2.8) and 12 (18.5%) of them had malaria parasitemia with a GMPD of 497.4. A total of 15 women with severe malaria had a mean (±sd) PCV of 20.3 (±1.1) and GMPD of 1018.3. Pregnant women with no anemia were not likely to have malaria parasitemia (χ²=0.44, P-value=0.51, OR=0.64, 95% CI: 0.17, 2.40). The odds of pregnant women with moderate anemia to have malaria parasitemia was stronger (χ²=0.75, P-value=0.75, OR=0.86, 95% CI: 0.34, 2.20) than the odds among those without anemia. However, those with severe anemia were approximately five times more likely to have malaria parasitemia (χ²=8.16, P-value=0.004, OR=8.84, 95% CI: 1.53, 15.35) compared to all other pregnant women. Table 3 also shows the distribution of anemia, malaria parasitemia, trimester and gravidity by the age of study subjects, indicating in all 92 (81.4%) had one level or the other of anemia, that anemia occurred mostly among those aged 26-30 years (32, 28.3%), that 12 (10.6%), 65 (57.5%) and 15 (13.3%) presented with mild, moderate or severe anemia and that only 21 (18.6%) had no anemia. Among those with no anemia, 7 (33.3%) were aged 21-25 years while most (6, 40.0%) of those with severe anemia were aged 31-35 years. The Table also shows that most (9, 40.9%) of the 22 parasite-positive pregnant women were aged 26-30 years, majority (7, 58.3%) of whom were moderately anemic. Further, 19 (16.8%), 54 (47.8%) and 40 (35.4%) of the women were in first, second or third trimester of pregnancy, while 32 (28.3%), 32 (28.3%) and 49 (43.4%) were primigravida, secundigravida or multipara respectively. Though multiparous women were 1.11 likely to be positive for malaria parasites (OR=1.11, 95% CI: 0.44, 2.83), they were not likely to present with severe anemia (OR=0.85, 95% CI: 0.28, 2.58). Figure 3 explains that pregnant women may have some malaria parasitemia without developing anemia, may have some mild anemia without malaria parasitemia but that most cases of severe anemia in pregnancy are associated with a significant density of malaria parasitemia. Anemia was commonest (32/92, 28.3%) in the age range 26-30 years Table 3.

Figure 3 Distribution of various degrees of anemia among pregnant women with and without malaria parasitaemia.

Malaria commodities, herbal medication and anemia in pregnancy

The mean PCV of those (n=28) who possessed LLIN (30.0±5.8) but did not use it was not significantly different from that of women (n=15) who slept under LLIN night before survey (30.0±6.5) (Table 4). However, the mean PCV of pregnant women who slept under LLIN and still consumed herbal (26.0±5.1) tea was significantly lower (t=−2.43, P-value=0.02) than that of pregnant women who slept under LLIN but did not consume herbal tea (30.4±6.3). Regardless of whether the pregnant woman was parasitized or not, the mean PCV of those who consumed herbal tea (28.2±5.2) was significantly lower (t=−2.24, P-value=0.01) than those who did not consume herbal tea (30.8±6.5) in pregnancy Table 4.
Table 4: Mean Packed Cell Volume, prevalence of anemia and malaria parasitemia relative to possession and use of various anti-malaria commodities

| Variable           | Item                      | Yes Freq. | Yes % | No Freq. | No % | Malaria parasitemia Freq. | Malaria parasitemia % | PVC Mean (±sd) | P-value |
|--------------------|---------------------------|-----------|-------|----------|------|---------------------------|-----------------------|-----------------|---------|
| Possess LLIN       | Mean (±sd) PCV            | 28.1 (4.0)| 39.0 (4.0) | 26.5 (5.6) | 31.5 (5.4) | 20 | 22.0 | 30.0 (5.8) | 0.00 | 1.00 |
|                    | No                        | 69 (75.0)| 16 | 76.2 | 63.6 | 71 | 78.0 | 30.0 (6.5) | 0.28 | 0.39 |
| Slept under LLIN   | Mean (±sd) PCV            | 27.9 (5.0)| 39.1 (3.4) | 26.9 (7.3) | 30.6 (6.2) | 5 | 22.7 | 10 | 11.0 |
|                    | No                        | 12 (13.0)| 3 | 14.3 | 5 | 22.7 | 10 | 11.0 |
| Treated for malaria| Mean (±sd) PCV            | 28.2 (4.4)| 39.7 (5.5) | 25.2 (4.0) | 33.1 (5.9) | 30.5 | 6.5 |
|                    | No                        | 80 (87.0)| 18 | 85.7 | 17 | 77.3 | 81 | 89.0 | 0.81 | 0.39 |
| Used SP for IPTp   | Mean (±sd) PCV            | 27.7 (5.0)| 38.4 (2.9) | 26.8 (6.9) | 30.4 (5.7) | 29.4 | 6.2 |
|                    | No                        | 46 (50.0)| 9 | 42.9 | 15 | 68.2 | 40 | 44.0 |
| LLIN + Herbal tea  | Mean (±sd) PCV            | 28.3 (4.5)| 39.6 (3.9) | 26.7 (6.40) | 31.1 (6.2) | 30.6 | 6.4 |
|                    | No                        | 25 (27.2)| 7 | 33.3 | 6 | 27.3 | 26 | 28.6 |
| LLIN + Herbal tea  | Mean (±sd) PCV            | 27.9 (5.3)| 39.0 (3.3) | 26.5 (9.0) | 31.2 (6.0) | 30.3 | 6.7 |
|                    | No                        | 67 (72.8)| 14 | 66.7 | 16 | 72.7 | 65 | 71.4 |
| LLIN + Herbal tea  | Mean (±sd) PCV            | 30.0 (4.6)| 39.1 (3.7) | 26.9 (5.8) | 30.7 (6.0) | 29.9 | 6.1 |
|                    | No                        | 3 (3.3)| 1 | 4.8 | 1 | 4.6 | 3 | 3.3 |
| LLIN + Herbal tea  | Mean (±sd) PCV            | 31.0 (6.1)| 36.0 (0.0) | 24.0 (0.0) | 35.0 (1.0) | 32.3 | 5.6 |
|                    | No                        | 89 (96.7)| 20 | 95.2 | 21 | 95.4 | 88 | 96.7 |
| LLIN + Herbal tea  | Mean (±sd) PCV            | 27.9 (4.7)| 39.2 (3.5) | 26.9 (6.7) | 30.7 (6.0) | 29.9 | 6.3 |
|                    | No                        | 8 (8.7)| 1 | 4.8 | 3 | 13.6 | 6 | 6.6 |
| LLIN + Herbal tea  | Mean (±sd) PCV            | 24.7 (3.7)| 36.0 (0.0) | 21.0 (2.6) | 28.5 (4.1) | 26.0 | 5.1 |
|                    | No                        | 84 (91.3)| 20 | 95.2 | 19 | 86.4 | 85 | 93.4 |
| LLIN + Herbal tea  | Mean (±sd) PCV            | 28.3 (4.7)| 39.2 (3.5) | 27.7 (6.6) | 31.0 (6.1) | 30.4 | 6.3 |
|                    | No                        | 30 (32.6)| 3 | 14.3 | 6 | 27.3 | 27 | 29.1 |
| LLIN + Herbal tea  | Mean (±sd) PCV            | 27.3 (4.6)| 36.7 (1.1) | 23.3 (4.9) | 29.3 (4.7) | 28.2 | 5.2 |
|                    | No                        | 62 (67.4)| 18 | 85.7 | 16 | 72.7 | 64 | 70.9 |
| LLIN + Herbal tea  | Mean (±sd) PCV            | 28.3 (4.8)| 39.5 (3.6) | 28.1 (6.8) | 31.5 (6.4) | 30.8 | 6.5 |

*Fisher’s Exact Test

Table 5: Chi-square analysis of proportions with and without malaria parasitemia and anemia

| Variable | Malaria parasitemia | Total |
|----------|---------------------|-------|
|          | Yes Freq. | Yes % | No Freq. | No % |
| Anemia   | 19 | 86.4 | 73 | 80.2 | 92 | 81.4 |
|          | 3 | 13.6 | 18 | 19.8 | 21 | 18.6 |
| Total    | 22 | 19.5 | 91 | 80.5 | 113 | 100.0 |

χ² = -2.56, P-value = 0.01, r² = -1.83, P-value = 0.04, χ²=0.05, P-value=0.82, OR=1.15, 95% CI: 0.40, 3.12, r² = -1.82, P-value = 0.04

No malaria, No anemia

Overall, 18 (19.8%) of the pregnant women in the study had no malaria parasitemia and no anemia. The means (±sd) and range of age and PCV of these group of women were 30.4 (7.2), 21-45 years and 39.2 (3.7), 36-46 respectively. Women with no malaria parasitemia and no anemia were 1.56 more likely to present with no anemia than others with malaria parasitemia (χ²=0.13, P-value=0.72, OR=1.56, 95% CI: 0.42, 5.86) Table 5.

Discussion

This study aimed to highlight the degree of malaria-induced anemia in different age groups, different trimesters and in varying gravidity among pregnant women living in communities along the Lagoon coast in Lagos Nigeria. It should be appreciated with great concern that majority of the approximate 500,000 women who die annually in pregnancy occur most in the developing world, that are mostly malaria-endemic. Malaria and anemia in any stage of pregnancy are almost always devastating to

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the fetus, the mother, the family and the community. Based on the
guidelines of WHO, the Federal Ministry of Health have streamlined
current strategies controlling malaria in pregnancy to include trio of
Intermittent Preventive Therapy (IPTp) using Sulphadoxine-Pyrimethamine (SP), vector control and prompt treatment of acute
illness. There are some major key findings that this paper hopes
to deliberate upon. The first is the alarming prevalence of anemia
which was observed to be 81.4% among the study subjects. This
was higher than the 70% prevalence reported. and 61% stated by Shipala
et al.22 in Kenya, than the national prevalence of 56% in pregnant
women in Ghana;23–25 the 63% prevalence in India;26 and the 40.4%
reported elsewhere in Nigeria.27 Malaria may not be the only cause
of anemia in pregnancy. Anemia in pregnancy may also as be a result
of other sinister events such as placenta previa near the internalos of
the cervical canal, nutritional deficiency (Iron and Folate) and worm
infestation, especially in the developing world. These other forms of
anemia possibly compound malaria-induced anemia in pregnancy. For
example, it is known that Iron deficiency and malaria cause anemia
in pregnancy, which increase the risk of poor delivery and birth
outcomes. A survey with sustained anemia consequence of malaria
infection was of maternal death, still birth, low birth weight, and fetal impairment.30 Malaria parasites are known not only to destroy the red blood cells, 
posing danger to the pregnant woman, but also to cause fibrosis of the
placenta thus preventing adequate nutrients to be transported to the
fetus, leading to fetal distress, intrauterine growth retardation (IUGR),
low birth weight (LBW), abortion, stillbirth, fetal death or, in rare
cases, congenital malaria or possibly congenital malformation.

The mother’s immune system, in the presence of malaria, is such
that the system must accept the fetus but still guard against infections.
Regulatory T cells, a special type of T lymphocytes, play a crucial role
in maintaining this fetal tolerance by migrating from the blood towards
the placenta, where they secrete interleukin 10 (IL-10), an immune-
suppressing mediator.31 According to Fievet et al.,32 intrauterine
exposure to malarial antigens influence innate immune activation
with impaired co-stimulatory abilities of dendritic cells, and to modify
toll-like receptor-induced cytokine responses which may leave the
neonate more susceptible to other infections, as in the case of HIV.33,34
Others have reported a reduction in cell-mediated immune responses
to malaria parasite antigens during pregnancy.35,36 Another key finding
in this study is the low prevalence of 19.5% in malaria parasitemia,
comparable to a finding from Kenya37 but far below the 54.0% reported
by Amadi & Nwankwo38 in Southeast Nigeria. Unlike in other studies,
peak prevalence of malaria parasitemia in pregnancy was observed
in the third trimester (11, 27.5%) than in the first or second trimester.
The prevalence of malaria parasitemia was highest in the age group
of 26-30 years which also has the highest GDP. This was contrary
to what was reported from Gabon but may be due to more women
having their first child in this age group. Another surprising finding
is a 14-year-old pregnant girl (data not shown). Teenage pregnancy
may be due to unreported rape, peer-pressure or myth that primary
sex with a menstrual age can be alleviated by having sex. More studies
on factors contributing to teenage pregnancy in Nigeria are required.
Fourthly, the consumption of herbal teas commonly referred to as
Agbo Iba (Herbal tea for fever) among pregnant women in Nigeria.
The overall prevalence of malaria parasitemia among the study subject
was reported as 19.5% whereas the prevalence of anemia was 81.4%
indicating that malaria may not be the only cause of anemia. However, malaria
was associated with severe anemia. While higher prevalence of
malaria infection was associated with third trimester of pregnancy
and with primigravida, higher prevalence of anemia was associated
with second trimester of pregnancy and multigravida. The highest
Geometric mean parasite density was observed among those aged
26-30 years, the age group with the highest prevalence of anemia.
There was no significant difference in the mean Packaged Cell Volume (PCV)
of women who possessed LLIN but did not sleep under these
commodities and those who did. However, the mean PCV of women
who consumed herbal tea (Agbo Iba) in pregnancy was significantly
lower than the mean PCV of those who did not. A very low proportion
of pregnant women used Sulphadoxine-pyrimethamine for malaria prophylaxis
in pregnancy and fewer slept under LLIN night before survey. A success story is the 18 women who did not present with
anemia or malaria parasitemia in the study. A cohesive package of
interventions is desirable to avert malaria, iron deficiency, and anemia
during pregnancy. The Federal and State Ministries of Health should
regularly update their policies and guidelines to reflect World Health
Organization (WHO) recommendations for avoiding malaria and
anemia in pregnancy. There is also urgent need to continually train
and re-train health providers on application of WHO guidelines.
Government at all levels should also find out, through survey, and
address the reason(s) why women do not use malaria commodities in
pregnancy. Subsequent studies may be directed at determining immune
responses and role of white blood cells, especially, Neutrophils to
determine their specific role in placenta malaria. Studies are also
needed on folic acid, folates and other minerals that play a role in
improving the anemia status of pregnant women, especially in sub-
Saharan Africa.

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Conflicts of interest
The author declares there are no conflicts of interest.

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