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IMPACT OF MALARIA ON INFLAMMATORY PROTEINS, HAEMATOLOGICAL AND BIOCHEMICAL INDICES IN PREGNANCY

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ABSTRACT

Malaria morbidity and mortality has remained a major health burden in the developing countries especially in tropical Africa. Thus malaria association in pregnancy and its associated complication remains a major health problem to the expectant mothers. In this study a total of five hundred and fifty (550) blood specimens were obtained from both pregnant and non-pregnant mothers with and without malaria *parasitaemia* who consented to the study. Selected biochemical and haematological parameters were assessed using conventional methods. The result showed that the malaria parasite species isolated was *plasmodium falciparium*which accounted for about 80% of the total population; the age group of 26-35years had the highest malaria density for those classified as low (53.7%), average (55.7%) and high (70.4%). This accounted for 60.7% of the total malaria parasite density. Further analysis of the malaria parasite density on pregnancy according to their trimester showed that women on their second trimester of pregnancy had the highest percentage of malaria parasite density of 55.7% and this was statistically significant (P>0.05). The result also show that pregnancy with malaria *parasitaemia* had the highest mean ± standard deviation of 20.37± 15.55 while those grouped as having 'malaria *parasitaemia* without pregnancy' had the lowest (6.09± 3.76) level of C- reactive protein (CRP). This was also statistically significant (P<0.01).

Conclusively, the findings recorded in this study have now shown that malaria parasite infections during pregnancy have a significant impact on both the biochemical and haematological indices and the prevalent species of the parasite is *plasmodium faciparium.*

Keywords: *plasmodium faciparium,* pregnancy, malaria *parasitaemia,* morbidity, mortality.

IMPACT DU PALUDISME SUR PROTÉINES INFLAMMATOIRES, HÉMATOLOGIQUES ET BIOCHIMIQUES DANS AWHARENTOMAH KESTERA DIGBAN GROSSESSE

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RÉSUMÉ

L'auteurdelamorbidité et de la mortalité du paludismeestresté un important fardeau de la santé dans les pays endéveloppement, enparticulierenAfriquetropicale. Ainsi, le paludisme pendant la grossesseetl'associationsa complication associéedemeure un problème de santé majeur pour les futures mères. Danscetteétudeun total de cinq cent cinquante (550) échantillons de sang ontétéobtenus par les femmes enceintes et non enceintes et mèresd'uneparasitémie sans paludisme qui a consenti à l'étude. Certainsparamètreshématologiquesetbiochimiquesontétéévalués à l'aide de méthodesconventionnelles. Le résultat a montré que les espèces de parasites du paludisme a étéisoléfalciparium du plasmodium qui représentaient environ 80 % de la population totale ; le grouped'âge de 26-35ans avait la plus haute densité de paludisme pour ceuxclasséscommefaible (53,7 %), moyenne (55,7 %) et élevé (70,4 %). Celareprésentait 60,7 % de l'ensemble du parasite de la densité. Une analyse de la densité des parasites du paludisme sur la grossesseenfonction de leurtrimestreontmontré que les femmes sur leurdeuxièmetrimestre de grossesseavaient le pourcentage le plus élevé de paludisme la densitéparasitaire de 55,7 % et cen'étaitstatistiquementsignificative (P > 0,05).

Les résultatsmontrentégalement que la grossesse avec le paludisme la parasitémieavaient la plus haute moyenne ± écart-type de 20,37 ± 15,55 tandis que cellesclasséescommeayant le paludisme la parasitémie sans grossesse' avaient la plus faible (6,09 ± 3,76) niveau de la protéineréactive C (CRP). C'étaitaussistatistiquementsignificative (P < 0,01). D'unemanièreconcluante, les résultatsenregistrésdanscetteétudeontmontré que les infections parasites du paludisme pendant la grossesseontun impact significatif sur les indices biochimiques et hématologiques et les espècesdominantes du parasite Plasmodium estfaciparium.

Mots clés :grossesse, faciparium plasmodium, le paludisme la parasitémie, morbidité, mortalité.

INTRODUCTION

Malaria, a vector-borne disease is an ancient disease probably originating in Africa and is now regarded as a life threatening disease with nearly half of the world population being vulnerable to the infection(1-2). Malaria accounts for an estimated 2-3 million deaths annually and it is also responsible for untold morbidity in approximately 300-500 million people annually (3).

Malaria is caused by *plasmodium*, which is transmitted by mosquitoes and the four species of *plasmodium* cause malaria infection in humans. These are *Plasmodium falciparume*, *P. vivax, P malaria*e and *P. ovale. P. falciparum* (4)andis responsible for most deaths and most of the severe complications (5), including cerebral malaria, anemia and renal failure (6).

Malaria disease generally has severe devastating impact on man and it is commonly associated with poverty, or a cause of poverty (7), which can lead to a major hindrance in economic development. Malaria is one of the most common infectious diseases creating an enormous public health problem. The disease is caused by protozoan parasites of the genus Plasmodium. Most species of the *Plasmodium* parasites can infect humans. The most serious forms of the disease are caused by *Plasmodium falciparum* while those caused by *Plasmodium vivax,Plasmodiumovale* and *Plasmodium malariae* may cause milder disease in humans that is not generally fatal (8).

Plasmodium infection causes an acute febrile illness which is most notable for its periodic fever paroxysms occurring at either 48 or 72 hour intervals. The severity of the attack depends on the Plasmodium species as well as other circumstances such as the state of immunity and the general health and nutritional status of the infected individual. Malaria is a chronic disease which has a tendency to relapse or recrudesce over months or even years (9).

The most common way to obtain malaria is through the natural transmission by mosquitoes. Malaria can also be transmitted via blood transfusions or sharing syringes. Mechanical transmission of infected blood will result in a shorter incubation period since there will be no liver stage. There is also an increased risk of fatality with mechanically-transmitted *P.falciparum*. The lack of the liver stage infection also precludes relapses in *P.vivax*or *P.ovale* infections. Congenital transmission has also been documented, but is believed to be relatively rare despite the heavy infection of the placenta (10).

Symptoms of malaria include fever, shoveringarthralagia (Joint pains), vomiting, anemia caused by haemolysis, hemoglobinuria, retinal damage (11) and convulsion. The classic symptom of malaria is cyclical occurrence of sudden coldness followed by rigor and then fever and sweating lasting 4-6hrs, occurring every two days in P.vivax and P.ovale infections, while every three, for P. malariae (12). P. *flaciparum* can have recurrent fever every 36-48 hrs or a less pronounced and almost continuous fever for reasons that are poorly understood, but that may be related to high intracranial pressure, children with malaria frequently exhibit abnormal posturing, a sign indicating severe brain damage (13). Malaria has been found to cause cognitive impairments, especially in children as a result of wide spread of anemia during a period of rapid brain development. This direct brain and neurologic damage results from cerebral malaria to which children are more vulnerable (14).

Severe malaria is almost exclusively caused by *P.falciparam* infection and usually arises 6-14 days after infection consequences of severe malaria include coma and death if untreated, young children and pregnant women are especially fumble splenomegaly, severe headache, cerebral ischemia, hepatomegaly hypoglycemia and hemoglobiuria from lysed red blood cells leak into the urine. Severe malaria can progress extremely rapidly and cause death within hours or days (15).

In most severe cases of the disease fatality rates can exceed 20%, even with intensive care and treatment (16) in endemic areas because treatment is often less satisfactory and the overall fatality rate for all cases of malaria can be as high as one in ten over the longer term, developmental impairments have been documented in children who have suffered episodes of severe malaria (17). Chronic malaria is seen in both P.vivax and P.ovale, but not in *P.falciparum*. Here the disease can relapse months or years after exposure, due to the presence of latest parasites in the liver. Describing a case of malaria as cured by observing the disappearance of parasites from the blood stream can therefore be deceptive. The longest incubation period reported for P.vivax infection is 30 years (18).

The etiology of malaria in pregnancy is non-multifactorial of which its causes include poor nutrition and infection with other parasites which together contribute to increases maternal and neonatal morbidity and mortality (19).

In Nigeria, it's believed that in the malaria endemic area, pregnant women could remain asymptomatic despite *falciparum* infection (20). It is also clear that malaria parasites density differs in instances of asymptomatic and clinical malaria while the degree of *parasitaemia* may influence the pathologic and biochemical presentations of individuals presenting with either of these conditions.

Unfortunately not much has been done to establish the degree of renal involvement or other impaired function in malaria association with pregnancy cases in Nigeria and Anambra in particular. Hence, the present study was designed to assess *the influence of P. falciparum parasitaemia among pregnant mothers and its association on certain biochemical and haematological parameters* that could be evidence in apparently healthy pregnant women. Thus, the findings hope to serve as a tool in evidence based health education on the need to intensify efforts at malaria prevention during pregnancy through prompt access to effective treatment, intermittent preventive treatment and the consistent use of insecticide treated nets.

MATERIALS AND METHODS

A total of 550 women comprising of 300 pregnant women with malaria *parasitaemia*, 100 non pregnant women with malaria *parasitaemia* and 150 pregnant women without malaria *parasitaemia* who served as control, were recruited for this study. The control group were selected after data on their health status obtained from questionnaire containing relevant information responded to indicated healthy status before they were screened for the presence of *Plasmodium falciparum parasitaemia* and absence of pregnancy by testing negative to a blood pregnancy testing.

Sample Collection
Using a 10ml sterile syringe, about 8mls of venous blood was collected from each of the subjects and 4mls of the whole blood transferred into a sterile EDTA container while the remaining 4mls was dispense into a sterile plain blood bottle and allowed to clot. A drop of blood from the EDTA bottle was used in making thick and thin blood films. The thick films were stained using Giemsa stains (21) and examined microscopically using 100X objective after applying a small drop of immersion oil. The intensity of infection was also estimated based on the number of parasites counted per high power field of the microscope using the plus sign system. The remaining venous blood was then used in the estimation of some selected haematological and biochemical parameters as well as C - reactive protein.

Plasmodium falciparum malaria parasite screening: The *P. falciparum*malaria parasite was detected by Microscopic examination of giemsa stained thin and thick blood films. The *parasitaemia* was expressed as number of malaria parasites per microliter of blood (22).

Determination of Malaria parasite density
Parasite Density: The parasite density is the number of parasites counted in each microscopic field. The determination of number of parasites per micro-litre of blood is accomplished by counting the number of parasites in relation to a standard number of leukocytes per micro-litre (8000) (23).

Determination of packed cell volume The packed cell volume (PCV) was determined by micro-heamatocrit centrifugation of EDTA-whole blood collected into a capillary tube (24). The volume of the packed red cells was measured in a micro-haematocrit reader and expressed as relative mass of packed red cells present in a sample of whole blood in terms of percentage (%).

Creatinine estimation
The serum creatinine concentration was determined using the modified colourimetric method alkaline picrate-slot (25) in 1965 using the kit supplied Randox (24).

Urea estimation
Serum urea levels were determined using the DiacetyiMonoxine (DAM) (26), using the kit supplied by Randox (24).

Estimation of electrolyte levels (Sodium ion and potassium ion)
Sodium and potassium levels were estimated using flame photometry (27).

Estimation of electrolyte levels (BicarbonateHCO3 – and Chloride Cl-) The levels of bicarbonate and chloride ion were estimated using titrimetric method (27).

Quantitative Estimation of C - reactive protein (CRP)
The C- reactive protein (CRP) levels were assayed by the methodology for Enzyme Linked Immuno-sorbent Assay (ELISA) while the Colour was developed by Sigma-Fast o-phenylenediaminedihydrochloride tablets (supplied by Sigma, St. Louis, Minneapolis, USA). The limit of detection was place at 1µg/ml (CRP).

Determination of White Blood Cell Count (WBC)
0.95ml of WBC diluting fluid was put into bijou bottle and blood sample was mixed by inverting approximately 20 times and 50ml pipette was used

to draw blood up into the tip. The content of the pipette was then expelled into the diluting fluid and the content of the bottle was mixed by inversion. The dilution of blood contained in the bottle was 1:20.

Statistical Analysis

This was performed using Stac-pac Gold package. The mean (±SD) was determined for the variables in both groups while ANOVA was used to evaluate the levels of associations between the variables. The levels of significance was considered at p-value <0.05

RESULTS

The results obtained from this study are displayed in the tables and figures below. Table I showed that the malaria parasite species isolated was *P.falciparium* which accounted for about 80% the total population studied.

TABLE 1: PREVALENCE % OF THE DIFFERENT PLASMODIUM SPECIES ISOLATED AMONG PREGNANT WOMEN IN IHIALA, ANAMBRA STATE

Species	Pregnant women	Non-pregnant women	Total (%)
P. falciparum	300 (60%)	100 (20%)	80
P. ovale	0 (0%)	0 (0%)	0
P. vivax	0 (0%)	0 (0%)	0
P. malariae	0 (0%)	0 (0%)	0

TABLE 2: SHOWED THE AGE GROUP (IN YEARS) OF PERCENTAGE (%) PARITY AND PARASITE DENSITY IN PREGNANCY WITH MALARIA *PARASITAEMIA* ONLY

AGE (YEARS)	Low parasite density N (%)	Average density N (%)	High parasite density N (%)	Total N (%)
15-25 YRS	40 (37.73)	29 (36.70)	25 (21.73)	94 (31.34)
26 – 35 YRS	57 (53.77)	44 (55.69)	81 (70.43)	182 (60.66)
36YRS & ABOVE	9 (08.49)	6 (07.59)	9 (07.82)	**24 (08.00)**
Total	106 (35.3)	79 (26.3)	115 (38.3)	300 (100.0)

X2 = 8.507, DF =4, P- value = P > 0.05

Table 2 showed that the age group of 26-35years had the highest malaria parasite density for those classified as low (53.7%), Average (55.7%) and high (70.4%). This accounted for about 60.7% of the total malaria parasite density. Those above 36 years of age had the lowest malaria parasite density of 8.0%.

TABLE 3: SHOWED THE PERCENTAGE (%) PARITY AND PARASITE DENSITY IN THE DIFFERENT TRIMESTER OF PREGNANCY WITH MALARIA *PARASITAEMIA*

TRIMESTER	Low parasite density N (%)	Average parasite density N (%)	High parasite density N (%)	Total N (%)
First trimester	**20 (26.41)**	**22 (27.84)**	**24 (12.5)**	**74 (24.67)**
Second trimester	**53 (50.0)**	**38 (48.00)**	**76 (3.9)**	**167 (65.67)**
Third trimester	**25 (23.58)**	**19 (24.05)**	**15 (20)**	**59 (19.66)**
Total	**106 (35.3)**	**79 (26.3)**	**115 (38.3)**	**300 (100)**

X2 = 8.959, DF =4, P > 0.05

Further analysis of the malaria parasite density on pregnancy according to their trimester showed that women on their second trimester of pregnancy had the highest percentage of malaria parasite density of 55.7%. whereas those on their third trimester had the lowest (19.7%) as shown in table 3 above. This was statistically significant (P>0.05)

TABLE 4: SHOWED THE MEAN ± S.D OF C REACTIVE PROTEIN (CRP) FOR PREGNANCY WITH AND WITHOUT MALARIA PARASITE AND CONTROL GROUP

Pregnant women			Non Pregnant Women	
Parameter	**Without MP (n=150)**	**With MP (n=300)**	**With MP (n=100)**	**p-value**
CRP (ug/ml)	**14.17±6.09**	**20.37± 15.55**	**6.09± 3.76**	**P<0.01**

Table 4 showed that pregnancy with malaria *parastaemia* had the highest mean± standard deviation of CRP (20.37± 15.55) while those groups as malaria *parasitaemia* without pregnancy had the lowest (6.09± 3.76) level of CRP. This was found to be statistically significant (P<0.01).

TABLE 5: SHOWED THE MEAN ± S.D OF C REACTIVE PROTEIN (CRP) FOR PREGNANCY WITH AND WITHOUT MALARIA PARASITE ACCORDING TO TRIMESTER

	CRP at Different Trimesters of Pregnancy			
Subjects	**First**	**Second**	**Third**	**P value**
Pregnancy withMP(n=300)	21.19±11.81(74)	18.44± 10.46(167)	24.82± 16.94(59)	P<0.05
Pregnancy without MP(n=150)	11.80± 1.40 (19)	15.61± 4.30 (91)	19.93± 6.48 (40)	P<0.05

Further analysis on the CRP levels according to trimester should that the third trimester of the pregnancy with malaria *parasitaemia* group had the highest mean (24.82 ± 16.94) for CRP. While those group under second trimester had the lowest mean (18.44 ± 10.46) for CRP. Those on their third trimester of pregnancy for the pregnancy group without malaria *parasitaemia* had the lowest mean (19.93 ± 6.48). of CRP. This was statistical of pregnancy significant (P<0.01) as shown in table 5 above.

TABLE 6:SHOWED THE MEAN ± SD OF ELECTROLYTE, UREA AND CREATININE IN PREGNANCY WITH AND WITHOUT MALARIA PARASITE AND THEIR CONTROL GROUP (MALARIA PARASITE WITHOUT PREGNANCY).

Parameter	**Pregnant Women**		**Non Pregnant women**	**P value**
	with MP(n=300)	**without MP (n=150)**	**with MP (n=100)**	
Potassium (mmol/l)	**4.55± 4.11**	**5.38± 1.35**	**4.18± 0.64**	**p<0.05**
Soduim ion (mmol/l)	**142.75± 7.26**	**140.50± 1.41**	**141.37± 5.09**	**p>0.05**
Bicarbonate ion (mmol/l)	**24.76±4.30**	**26.13± 1.55**	**22.10± 9.74**	**p<0.05**
Chloride ion (mmol/l)	**101.51± 8.16**	**105.25± 9.28**	**89.66± 8.20**	**p<0.05**
Urea (mg/dl)	**20.66± 6.12**	**30.08±4.62**	**15. 39± 7.70**	**p<0.01**
Creatinine (mg/dl)	**2.75±1.24**	**3.23±1.37**	**0.75±0.24**	**p<0.05**

Table 6 showed that potassium, (5.38±1.35), chloride (105.25±9.28) and bicarbonate (26.13± 1.55) statically increase (P<0.05) for the pregnant women without malaria *parasitaemia* when compared to the non-pregnant women with malaria *parasitaemia* (potassium ion (4.18±0.64) chloride ion (89.66± 8.20) and bicarbonate (22.10±9.74). Similarly, urea (20.66± 6.12) and creatinine (2.75± 1.24), decrease significant (p<0.05) among the pregnant women with malaria *parasitaemia* when compare to those pregnant women without malaria *parasitaemia* (urea=30.08± 4.62 and creatinine =3.23± 1.37)

TABLE 7: SHOWED THE MEAN ± S.D OF ELECTROLYTE, UREA AND CREATININE PARAMETERS IN PREGNANCY WITH OR WITHOUT MALARIA *PARASITAEMIA*

	Pregnant Women		P value
Parameter	**with MP (n=300)**	**without MP (n=150)**	
Potassium (mmol/l)	**4.55± 4.11**	**5.38± 1.35**	**p<0.05**
Soduim ion (mmol/l)	**142.75± 7.26**	**140.50± 1.41**	**p<0.05**
Bicarbonate ion (mmol/l)	**24.76±4.30**	**26.13± 1.55**	**p<0.05**
Chloride ion (mmol/l)	**101.51± 8.16**	**105.25± 9.28**	**p<0.05**
Urea (mg/dl)	**20.66± 6.12**	**30.08±4.62**	**p<0.01**
Creatinine (mg/dl)	**2.75±1.24**	**3.23±1.37**	**p<0.05**

Table 7 showed that in pregnancy, sodium ion increases (142.75 ± 7.26) with malaria *parasitaemia* while potassium ion (4.55 ± 4.11) Bicarbonate ion (24.76 ± 4.30), choride ion (101.51± 8.16), urea (20.66± 6.12) and creatinine (2.75 ± 1.24) decreases respectively with malaria *parasitaemia* This was stastically significant (P<0.05).

TABLE 8: SHOWED THE MEAN ± SD OF ALKALINE PHOSPHATASE, AMINO-TRANSAMINASES & BILIRUBIN LEVELS IN PREGNANCY WITH AND WITHOUT MALARIA PARASITE AND THEIR CONTROL GROUP.

Parameter	**Pregnant Women**		**Non- Pregnant**	**P value**
	with MP (n=300)	**without MP (n=150)**	**women with MP (n=100)**	
Alkaline Phosphate (IU/L)	**42.96±8.12**	**66.88± 6.29**	**15.6± 5.09**	**p<0.01**
Alanine amino-transaminase (IU/L)	**8.27±3.27**	**14.75±2.34**	**7.79±4.32**	**p<0.05**
Asparate amino-transaminas (IU/L)	**10.27±3.70**	**12.72±2.34**	**8.19± 4.02**	**p<0.05**
Total Bilirubin (mg/dl)	**3.77± 1.01**	**2.31± 2.60**	**1.77± 1.01**	**p<0.05**
Conjugate Bilirubin (mg/dl)	**2.33± 1.02**	**1.77± 0.08**	**0.44± 0.20**	**p<0.05**
Unconjugate Bilirubin (mg/dl)	**1.20± 0.11**	**0.48± 0.5**	**0.36± 0.13**	**p<0.05**

Table 8 showed a statistically significant increase (P<0.05) in the pregnancy group without M.P for Alkaline phosphate (66.88± 6.29). Alanine aminotrasarminase (14.75± 2.34), Asparate aminotransminase when campare to their pregnancy with M.P (Alkaline phosphate, 42.96± 8.12 Alamineaminotransminase, 8.27± 3.27 and Asparate aminotransaminase, 10.27± 3.70) and their non-pregnant group with M.P (Alkaline phosphatase, 15.6±6.09, Alamine aminotransaruinase 7.79±4.32 and Asparate aminotransaminase 7.79± 4.32 and Asparate amino transaminase 8.19± 4

TABLE 9: SHOWED THE MEAN ± SD OF ALKALINE PHOSPHATASE, AMINO-TRANSAMINASES & BILIRUBIN LEVELS IN PREGNANCY WITH AND WITHOUT MALARIA PARASITE

Parameter	Pregnant Women		P value
	with MP.(n=300)	without MP.(n=150)	
Alkaline Phosphate(IU/L)	42.96±8.12	66.88± 6.29	p<0.01
Alanine Amino-transaminase(IU/L)	8.27±3.27	14.75±2.34	p<0.05
Asparate Amino-Transaminase(IU/L)	10.27±3.70	12.72±2.34	p<0.05
Total Bilirubin (mg/dl)	3.77± 1.01	2.31± 2.60	p<0.05
Conjugate Bilirubin (mg/dl)	2.33± 1.02	1.77± 0.08	p<0.05
Unconjugate Bilirubin (mg/dl)	1.20± 0.11	0.48± 0.5	p<0.05

Table 9 showed a statistically significant decrease (P<0.05) in akaline phosphate (42.96± 8.12) in pregnant women with malaria parasite when compare to those without malaria *parasitaemia* (66.88± 6.29). While total Bilirubin showed a significant (P<0.05) increase in those with malaria *parasitaemia* (3.77± 1.01) when compared to those without malaria *parasitaemia* (2.31± 2.60

TABLE 10: SHOWED THE MEAN ± S.D. % PCV, HAEMOGLOBIN & TOTAL WHITE BLOOD CELL COUNT LEVELS FOR PREGNANCY WITH AND WITHOUT MALARIA PARASITE AND CONTROL GROUP

Parameter	Pregnant Women	Non Pregnant Women		
	without MP (n=150)	with MP (n=300)	with MP (n=100)	P value
% PCV	4.22±4.22	37.13± 2.17	38.06± 3.76	P<0.01
Hb(g/dl)	11.38± 1.20	14.08± 11.40	12.05± 1.08	P<0.05
WBC-Total	5701.3± 2478.04	6937.50± 1988.49	3958.30± 2049.00	P<0.01

Table 10 showed a significant increase (P<0.01) in the % PCV for non- pregnancy women with malaria parasite (38.06± 3.76), when compare to the pregnant women with malaria parasite (37.13 ±2..17) and those without malaria parasite (34.22± 4.22) The Hb (14.08± 11.40) and total WBC /6937.5± 1988.49 of pregnant women with malaria parasite was increase when compare to both pregnant women without malaria parasite (Hb=11.38± 1.20 WBC-total =5701.3±2478.04) and non-pregnant women with malaria parasite (Hb=12.5±1.08 WBC-total = 3958.30± 2049.00

TABLE 11: SHOWED THE MEAN ± S.D. %PCV, HAEMOGLOBIN & TOTAL WHITE BLOOD CELL COUNT LEVELS FOR PREGNANCY WITH AND WITHOUT MALARIA PARASITE

Parameter	Pregnant Women		P value
	without MP.(n=150)	with MP.(n=300)	
PCV (%)	34.22±4.22	37.13± 2.17	P<0.01
Hb(g/dl)	11.38± 1.20	14.08± 11.40	P<0.05
WBC-Total	5701.3± 2478.04	6937.50± 1988.49	P<0.01

Table 11 showed that % PCV (34.22± 4.22), Hb (11.38±1.20) and total WBC (5701.3±2478.04) of pregnant women without malaria parasite significantly decrease (P<0.05) when compared to their pregnant women with malaria parasite (% PCV (37. 13± 2.17); Hb (14.08± 11.40) and total WBC (6937.50± 1988.49)

TABLE 12: THE MEAN ± S.D. % PCV, HAEMOGLOBIN & TOTAL WHITE BLOOD CELL COUNT LEVELS VERSUS PARITY FOR PREGNANCY WITH MALARIA PARASITE

PARITY	0	1	2	3	4	5	6	
PARAMETER	MEAN±SD	MEAN ± SD	MEAN ±SD	MEAN± SD	(MEAN ±SD)	MEAN± SD	MEAN± SD	P- VALUE
PCV	34.42±3.50	34.1±5.13	34.60±1.93	33.39±5.7	38.1±2.59	31.50±4	37.00±0.00	P<0.05
HB	11.40±1.16	11.33±1.71	11.52±0.63	11.12±1.90	12.70±0.82	10.49±0.82	12.30±0.00	P<0.05
WBC	57.75±38.6	59.63±21	56.19±15.84	52.80±12.81	57.00±10.51	62.00±19.33	68.00±0.00	P> 0.05

TABLE 13: SHOWED THE PERCENTAGE (%) PARITY AND PARASITE DENSITY IN PREGNANCY WITH MALARIA *PARASITAEMIA*

	PARASITE DENSITY							
PARITY	LOW DENSITY		AVERAGE DENSITY		HIGH DENSITY		TOTAL	
	N	(%)	N	(%)	N	(%)	N	(%)
0	31	(29.25)	12	(15.19)	37	(32.17)	80	(26.67)
1	29	(27.35)	37	(46.84)	32	(27.82)	98	(32.67)
2	22	(20.75)	18	(22.78)	23	(20.00)	63	(21.00)
3	17	(16.04)	9	(11.39)	12	(10.43)	38	(12.67)
4	0	0.0)	3	(03.80)	5	(04.35)	8	(2.67)
5	7	(06.60)	0	(0.0)	3	(02.61)	10	(3.33)
6	0	(0.0)	0	(0 .0)	3	(02.61)	3	(1.00)
	106	(35.3)	79	(26.3)	115	(38.3)	300	(100)

X2= 29.217, DF =12, P<0.01

Table 13: Showed that women who were on their first and second pregnancies had the highest percentage of malaria parasite density of 32.7% and 26.7%. While those who had above four pregnancies had the lowest amount of malaria parasite density of 2.7% for four (4), 3.3% for five (5) and 1.0% for six(6) pregnancies outcome.

DISCUSSION

Prevalence of malaria infection

Malaria infection during pregnancy is a major public health problem in tropical and sub-tropical regions around the globe. The result in this study confirms that plasmodium falciparum species of is the prevalent specie of plasmodium that was isolated among pregnant women with malaria *parasitaemia* in Ihiala, Anambra State, This specie accounted for a prevalence rate of 80% a shown on table 1. This finding can be compared to the report ofIsmail(28) who reported that over 90% of the global malaria burden occurs in the Southern parts of Africa. Although, *P.faciparuim* has been reported as the predominate species isolated among pregnant women in the tropics (29)but the presentation of asymptomatic malaria *parasitaemia* is different from that of severe or clinical malaria *parasitaemia* in during pregnancy. This may be due to the differences in malaria parasite density in the blood of the infected individual (30).had a higher percentage of parasite density (26.7% and 32.7%) when compared to those with more episodes of pregnancies (i.e. above four pregnancies outcome) The high parasite density reported may be due to immune suppression among those individuals on their first and second pregnancies which is a consequences of the effect of the *plasmodium faciparuim* infection among these individual and tends to improve as the pregnancies out-come exceed four (4), times. Thus, there is an acquired immunity against malaria (table 2). This can be compared to the report of**Dicko (31)**, who observed that the severity of malaria infection depends largely on the degree of malaria *parasitemia*, and pregnancy may increases the risk of malaria infection (32).

Similar analysis on the severity of high parasite density among the age group of pregnant women revealed that the number of the 2nd trimester pregnant women who visited the antenatal clinic was more than those in their 1st and 3rd trimester possibly because these groups of patient felt there was no clinical need. There was also significantly ($P<0.01$) increase in the parasite density among those with maternal age of 26 to 35 yrs. This finding can be compared to that of Olshake(33) who reported a lower parasite density among maternal age less than 20yrs.

Inflammatory proteins

C-reactive protein (CRP) is a protein found in the blood and whose levels increases in response to inflammation (34). The findings from this study confirms that during the episode of pregnancy there was an elevated CRP (14.17 ± 6.09) as seen among pregnant women without malaria *parasitaemia* and becomes severe when there is malaria *parastaemia* (20.37 ± 15.55) as shown in table 4. This elevated CRP levels were observed among the third trimester of pregnancy for those with malaria *parasitaemia* (table 5). This finding can be compared to the work done by (35) who have reported higher values for CRP during late pregnancy.

Biochemical Indices in Pregnancy with malaria parasitaemia

Alterations in biochemical parameters have been investigated and reported by several authors in malaria infections (1, 36). This has helped to intensify care for this group of patients and thus prevent death that may results from malaria complications. The result obtained from this study shows the impact of malaria and pregnancy on biochemical parameters, in Ihiala, Anambra State. Data presented in this study shows that urea and creatinine was significantly ($P<0.05$) decreased in pregnancy with malaria *partasiteamia* when compared with those without malaria *parasitaemia*. The concurrent decrease in the urea and creatinine reveals that there is a functional glomerular fitteration rate. This finding can be compared to the work done by Etim*et al*. (37) who reported an elevated urea and creatinine level.

In this study, there was a significant ($P<0.05$) increase in sodium ion and a significant ($P<0.05$) increase in sodium ion and a significant ($P<0.05$) decrease in Bicarbonate ion, and chloride ion. These changes may have resulted from the continuous haemolytic effect of the *plasmodium falciparium* parasite on the red cells which in-form will affect the ionic concentration of the whole blood uncosity.

Furthermore, this study also reveals that there is an alteration in the luier enzymes of pregnancy with malaria *parasitaemia* (table 9). There was a significant decrease infection. This can be compared to the work done by Adeosun *et al*.(38) who reported elevated or hyperbilirusinaemia in malaria which is a consequence of hamolysis and concluded that a severe infection can reflect luier damage. Thus, this study reveals a mild elevation in the bilirubin level of pregnant women with malaria *parasitaemia*.

Haematological indices in pregnancy

The impacts of malaria on haematological parameters during pregnancy have been with malaria parastaemia poorly studied in Anambra State. In this study the impact of malaria on haematological parameters, had a significant increase ($p<0.01$) in the %age packed cell volume of the multigravidae with an average mean value of

31.5% with a corresponding mean hemoglobin level of 10.5g/dl These findings can be compared to the work done by *Onyenekwe et al.* (39) who reported a low %age for PCV in the primigraviae. However in areas of stable transmission like Anambra State,

parasites density fifers in instances of asymptomatic and clinical malaria (Onyenekwe*et al* (39).The degree of parasite density and the parasite density threshold could explain the reason for the difference. Similarly there was also no significant difference ($p>0.05$) in the total white cell count (wbc). Thus anaemia as a presenting feature is more common in partially immune multigravida, living in hyper-endemic areas having malaria during pregnancy (40)

The pattern of % PCV among the study group was also observed. In the P.C.V. coded as low, and normal, the highest percentage of the low P.C.V was recorded in the mulliparous 44 (30.8%) and primigravidae 43 (30.1 %). Also the greater percentage of low pcv was recorded among those on 2nd trimester of pregnancy. This may be as the result of haemolysis causes by malaria parasites. This finding can be compared to the work done by (41) that malaria causes neutropemia and anaemia.

CONCLUSION

The findings recorded in this study have now shown that malaria parasite infection during pregnancy has a significant impact on both the most adult women have developed enough immunity that during pregnancy, *P.falciarum* infection does not usually result in fever or other clinical symptoms. It is also clear that malaria

biochemical and haematological indices. The prevalent species of the parasite is *plasmodium faciparium* and the degree of *parasitaemia* may result in inflammatory changes which are observed. Thus, the following contribution to knowledge was made:1. Prevalence rate of *P.faciparium* infection 80%.2. The maternal age of 26-35 years old had the highest degree of parasite density.3. There was significant changes in the liver enzymes especially, Alkaline phosphatase and the amino transaminase of pregnant women with malaria *parasitaemia*.4. There was a significant decrease in the urea and creatinie level of pregnant women with malaria *parasitaemia*. 5. There was a significant increase in the CRP, which serve as a pointer to the underlying inflammatory changes in the pregnant women with malaria *parasitaemia*.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper

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