International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 3 Number 1 (2014) pp. 104-111**
http://www.ijcmas.com

Original Research Article

Impact of *Plasmodium falciparum* malaria and hookworm infection on anaemia among pregnant women of ikwuano local government area, Abia state, Nigeria

Obeagu Emmanuel Ifeanyi[1*], Odo Matthew Chibunna[1], N.Anaebo Queen Braxton[2], Emelike Chinedum Uche[1]

[1]Diagnostic laboratory unit,university health services,michael okpara university of agriculture, Umudike, Abia State, Nigeria.
[2]Medical doctor,department of accident and emergency,lagos state University Teaching Hospital, Lagos, Nigeria
Corresponding author

K e y w o r d s

falciparum malaria; anaemia; pregnant women; PCV and Haemoglobin.

A B S T R A C T

The cases of ugly pregnancy outcomes have been on increase in this part of the world which led to this study to find the impact of falciparum malaria infection and hookworm infection on anaemia among pregnant women in Ikwuano L.G.A. 87 pregnant women with average age of 25.3 years ranging from 19-34 years who attended antenatal clinic in the health centres were recruited for the study. 51% of the subjects had falciparum malaria infection, hookworm infection(18%), co-infection(13%) and apparently healthy women (18%). The PCV and Haemoglobin of falciparum malaria and hookworm infection were significantly different ($P<0.05$) as well as PCV of those infected and non-infected subjects ($p<0.05$) 19.3% were anaemic (Hb<10g/dl).

Introduction

Malaria is one of the world's worst killer diseases recorded in human history. Despite attempts to eradicate it, it remains one of the worst diseases in terms of death annually. About 200-300 million cases occur each year with about 1.5 million death in Africa, South of Sahara. It is widespread throughout Asia and Latin America and has currently increased(Muller and Moser,1990).It is common in Europe and in North America (Doneyan *et al.*,1990).

Malaria is a serious parasitic disease characterized by fever, anaemia and is caused by a parasite of the genus Plasmodium and is transmitted from one human to another by the bite of infected female Anopheles mosquito. There are about forty five kinds of malaria parasite species that affect humans, four affect human directly, while the rest affect animals (monkey) and can be transferred to man (Zoonosis). Malaria is a serious public health problem. The parasite

plasmodium species infects the blood of an individual and parasitises it.

Malaria in pregnancy is a major contributor to adverse maternal and perinatal outcome. In hyperendemic areas like ours, it is a common cause of anaemia in pregnancy in both immune and non-immune individuals and is aggrevated by poor socio-economic circumstances. It has been shown that severe anaemia was found to be more than twice as common in women with peripheral parasitaemia as in those without parasitaemia (Shulman *et al.,* 1996). Indeed malaria can cause several perinatal and maternal complications including abortion,still birth, low birth weight and even death (Brabin,1983,McGregor,1987 and Nyirjesy *et al.*,1993). Incidentally,malaria infection is more rampant among the primigravidae and secundigravidae than the multigravidae (Nwagha *et al.*,2007).

The preferential susceptibility of those sets of pregnant women may be related to some evidence that immune-suppression associated with subsequent pregnancies(Riley *et al.*,1989 and Raheed *et al.*,1993).Previously, the depression of cell mediated immune response to *Plasmodium falciparum* antigens has been implicated as epidemiological studies have shown that malaria in pregnancy is prevalent in younger than older age group (Bouyou-Akotet *et al.*,2003 and Nwagha *et al.*,2 007). Currently, susceptibility to plasmodium parasitaemia has been linked to the level of anti-bodies to placental sequestered parasites (Elliot *et al.*,2005).Indeed these parasites preferentially adhere to chondroitin sulphate-A receptors (CSA) expressed by the syncytio trophoblasts in the placenta(Fried *et al.*,1998).Women in the first and second pregnancies are more susceptible as anti adhesion antibodies against CSA in binding parasites develop after successive pregnancies(Duffy and Fried,1999).

Malaria infection during pregnancy contributes significantly to anaemia in pregnancy and low birth weight babies(Deen *et al.,* 2001). Antenatal anaemia has shown positive correlation with low birth weight(LBW) and high Infant Mortality Rate(IMR).The use of effective anti-malaria drug during pregnancy has been found to lower the frequency of LBW and IMR(Steketee *et al.*,2005).

Malaria remains a major environmental factor focusing on serious pregnancy complications, whose incidence and severity depend on gestational age, parity and the level of malaria endemicity. Each year,50 million women living in malaria endemic areas become pregnant; oe-half of these women live in Afrca. It is estimated that 10,000 women and 200,000 infants die as a result of malaria infection during pregnancy. Severe maternal anaemia, prematurity and low birth weight contribute to more than half of those deaths (Egwang,2006).

In sub-sahara Africa,approximately,25 million pregnant women are at risk of *Plasmodium falciparum* infection every year and one in four women has evidence of *P.falciparum* infection during pregnancy in Africa rarely result in fever and therefore remains undetected and untreated. Meta-analysis of intervention trials suggest that successful prevention of these infections reduces the risk of severe maternal anaemia by 38%,Low birth weight by 43% and perinatal mortality by 27% among paucigravidae. Low birth weight associated with malaria in

pregnancy is estimated to result in 100,000 infants deaths in Africa each year.

Anaemia is the commonest symptom of malaria during pregnancy in both impoverished and developing women and that makes the women more susceptible to anaemia during pregnancy. It is one of the most visible symptoms of malaria and any pregnant women who is anaemia should be tested for the presence of malaria parasites. Anaemia due to malaria is most evident between 16-29 weeks of pregnancy. Fever is another symptom of malaria during pregnancy. Fever due to malaria can be of variable grades ranging from low grade to high grade fever. In the second trimester of pregnancy, fever symptoms can appear in form of paroxysms or sudden attacks and chills. Enlargement of the spleen is another symptom of malaria during pregnancy. However, it is again a variable symptom and it may or may not be present. Diarrhoea which include vomiting is another symptom of malaria during pregnancy. Pregnant women with malaria with malaria may exhibit symptoms of convulsions which can range from being mild to extreme. The other symptoms of malaria during pregnancy are jaundice, altered sensorium and coma. The malaria symptoms during pregnancy manifest only because the region that these pregnant women live in area endemic in nature. The symptoms of malaria during pregnancy can weaken the immune system of pregnant women and can also cause serious harm to their unborn babies. Moreover, women who develop malaria during the their first pregnancy are more likely to develop the disease in their subsequent pregnancies (Raheed *et al*.,1993).

Hookworm is a parasitic nematode that lives in the small intestine of its host, which may be a mammal such as a dog, cat or human. Two species of hookworms commonly infect humans, *Ancyclostoma duodenale* and *Necato americanus. A. duodenale* predominates in the Middle East ,North Africa, India and in Southeast Asia, China, and Indonesia. Hookworms are thought to infect more than 600 million people worldwide(Croese *et al*.,2012).

Hookworm is a leading cause of maternal and child morbidity in the developing countries of the tropics and subtropics. In susceptible children, hookworms cause intellectual cognitive and growth retardation, intrauterine growth retardation, prematurity and low birth weight among newborn to infected mothers.

There are no specific signs and symptoms of hookworm infection. They give rise to a combination of intestinal inflammation and progressive iron/protein-deficiency anaemia. Larval invasion of the skin might give rise to intense, local itching, usually on the footor lower leg, which can be followed by lesions that look like insect bites, can blister(ground itch),and lat for a week or more. Coughing, chest pain, wheezing, and fever will sometimes be experienced by people who have been exposed to very large numbers of larvae. Epigastric pains, indigestion, nausea, vomiting, constipation and diarrhoea can occur early or in later stages as well, although gastrointestinal symptoms tend to improve with time. Signs of advanced severe infection are those of anaemia and protein deficiency, including emaciation, cardiac failure and abdominal distension with ascites.

It is estimated that between 576-740 million individuals are infected with

hookworm today (Bethony *et al*.,2006),of these infected individuals about 80 million are severely affected(Gasser *et al*.,2009).The major etiology of hookworm infection is N. Americanus which is found in the Americans,sub-sahara Africa and Asia(Hotez *et al.*,.2005). A.duodenale is found in more scattered focal environments, namely Europe and the Mediterranean. Most infected individuals are concentrated in Sub-saharan Africa and East Asia/the Pacific Islands with each region having estimated of 198 million and 149 million infected individual respectively. Other affected regions include: South Asia(59 million),Latin America and the Caribbean(50 million) middle East/North Africa(10 million) (Betony *et al*.,2006).A majority of these infected individuals live in poverty – sticken areas with poor sanitation.

It is estimated that a third of all pregnant women in developing countries are infected with hookworm,56% of all pregnant women in developing countries suffer from anaemia,20% of all maternal deaths are either directly or indirectly related to anaemia. Numbers like this have led to an increased interest in the topic of hookworm-related anaemia during pregnancy(Gyorkos *et al*.,2006).With the understanding that chronic hookworm infection can often lead to anaemia, many people are now questionig if the treatment of hookworm could effect change in severe anaemia rates and thus also on maternal and child health as well. Most evidence suggest that the contribution of hookworm on maternal anaemia merits that all women of child-bearing age living in endemic areas be subject to periodic antihelmnthic treaement. The World Health Organisation even recommends that infected pregnant women be treated after their first trimester (Bethony *et al*., 2006)Regardless of these suggestions, only Madagascar, Nepal and Sri Lanka have added deworming to their antenatal careprogramme (Brooker *et al*.,2008).

.

This lack of deworming of pregnant women is explained by the fact that most individuals still fear that antihelmnthic treatment will result in adverse birth outcomes. But a 2006 study by Gyorkos *et al*., found that when comparing a group of pregnant women treated with mebendazole with a control placebo group, both ilustrated rather similar rates in adverse birth outcomes. The treated group demonstrated 5.6%adverse birth outcomes, while the control group had 6.25% adverse birth outcomes(Gyorkos *et al*.,2006).Furthermore, Larocque *et al*., illustrated that treatment for hookworm infection actually led to positive health results in the infants. It concluded that treatment with mebendazole plus iron supplements during antenatal care significantly reduced the proportion of very low birth weight infants when compared to a placebo control group (Larocque *et al*.,2006).Studies so far have validated recommendation to treat infected pregnant women for hookworm infection during pregnancy.

Co-infection with hookworm and *Plasmodium falciparum* is common in Africa (Brooker *et al*., 2007), but the exact number are unknown. *P.falciparum* and hookworm co-infection has been shown to have additive impact on anaemia resulting in adverse pregnancy outcomes(WHO,1991).There have few studies on the impact of *Plasmodium falciparum* and hookworm co-infection among pregnant women in rural communities where these parasites are endemic. This study was therefore aimed at ascertaining the impact of *Plasmodium*

falciparum and hookworm infection on the frequency of anaemia among pregnant women in Ikwuano Local Government Area, Abia State, Nigeria.

Materials and Methods

Study Area

The study was carried out in Ikwuano L.G.A.,Abia State,Nigeria.

Subjects and Methods

87 pregnant women who attended antenatal clinics at Amawom and Ndoro Health Centres in Ikwoano L.G.A; were selected for the study. Venous blood samples were collected from the women into EDTA anticoagulated containers for Packed Cell Volume Tests and other used directly on the glass slides to make thin blood films and thick blood films for detection of Malaria parasites and *Plasmodium falciparum* differentiation which were stained with Giemsa after beeing dry. Stool samples were also collected from those pregnant women and the samples analysed microscopically for the hookworm parasites detection.

Ethics

Oral consents were made to the subjects proir to sample collection.

Statistical Analysis

Data were presented in percentages and analysed by t-test with significant level at $P<0.05$.

Results and Discussion

Table 1 showed that 51% of the subjects were infected with falciparum malaria,18% infected with hookworm and 13% were infected with falciparum malaria and hookworm(co-infection) while 18% were the apparently healthy individuals. The high prevalence of malaria (51%) is close to the work of Ogboi *et al.,* (2012) 53%, 60% by Fuseni *et al* (2009) and higher than 42.6% by Ndomugyenyi *et al.*,(2008).The prevalence of hookworm is close to 20.7% reported by Fuseini *et al.,* (2008), lower than 23% (Ndomugyenyi *et al.*,2008), 30% by Ozumba *et al.*, (2005).

Table 2 showed that mean values of the subjects infected with malaria infection were significantly different($P<0.05$) both the mean values in falciparum malaria infection and hookworm and when co-infection were compared to the single infection. This showed that malaria has more suppressive effect on PCV and Haemoglobin than in hookworm and more serious in co-infection cases.

Table 3 showed highest prevalence of falciparum malaria in second trimester (45%),third trimester(32%) and first trimester(23%).

Table 4 showed significant decrease ($P<0.05$) in the mean values of PCV those infceted with falciparum malaria and hookworm compared to the non-infected subjects. Table 5 showed the same pattern of prevalence as Malaria in the subjects with the highest in second trimester(57%),followed by third(30%) and first(13%).This pattern of prevalence among the subjects could be traceable to the immunity in relation to the trimester and their hygienic level.

The study showed high level of falciparum malaria infection and hookworm infection among the pregnant women of Ikwuano L.G.A., which is a pointer to the level in

Table.1 Prevalence of falciparum malaria and hookworm infection

Infection	Number infected	Percentage of the Cases (%)
Malria	44	51
Hookworm	16	18
Co-infection	11	13
Apparently Healthy Women	16	18

Table. 2 Mean pcv values among the subjects

Infection	PCV+/-SD(%)	Hb+/-SD(g/dl)	P-VALUE
Malaria	25+/-2.4	8.2+/-1.2	
Hookworm	27+/-1.6	9.3+/-2.5	
Co-infection	22+/-2.7	7.4+/-2.0	

P<0.05

Table.3 Prevalence of Falciparum Malaria and Hookworm based on Trimester

Trimester	NO Infected	% Infected(%)
First	20	23
Second	39	45
Third	28	32

Table. 4 Mean pcv of the infected and non-infected

Subjects	PCV+/-SD(%)	P-Value
Infected(68)	31.5+/-1.2	
Non-infected(19)	38+/-2.6	P<0.05

Table. 5 Prevalence of hookworm based on trimester

Trimester	NO Infected	% Infected(%)
First	9	57
Second	5	30
Third	2	13

the entire population. Pregnant women in this area should be properly cared for by their husbands and the government. Adequate health education should be given to these women and other rural area to reduce the menace. The government should provide good drinking water and bushes should be cleared. Mosquito treated nets should be distributed to the women.

References

Albenese,G;Venturi,C. And Galbiati,G. 2001. Treatment of Larva Migrants Cutanea(Creeping Eruption):A Comparism Between Albendazole and Traditional Therapy. Inter. J. Dermatol. 40(1):67-71.

Bethony, J; Brooker,S. And Albonico,M; *et al*. 2006. Soil-transmited Helminth Infections: Ascariasis, Trichuriasis, and

Hookworm.Lancet 367(9521):1521-1532.

Bouyou-Akotet,M.K.,Lonete-Collard, D.E., Mabikia - Manfoumbi, M., Kendjo, E.,Matsiegui, P.B., Mavoungou,E. 2003. Prevalence of Plasmodium falciparum Infection in Pregnant Women in Gabon.Malaria J.2:18.

Brabin,B.J. 1983. An Analysis of Malaria in Pregnancy in Africa.Bull World Health Org.61:1005-1016.

Brooker,S; Akhwale,W; Pullan,R; *et al*. 2007. Epidemiology of Plasmodium-Helmnth Co-infection in Africa:Populations at Risk,Potential Impact on A naemia and Prospects for Combing Control.Am.J.Med.Hyg.77(6).:88-98.

Brooker, S;Clements,A.C. and Hotez,P.T; *et al*. 2006.The Co-distribution of *Plasmodium falciparum* and Hookworm Among African School Children.Mala.J.5:99.

Brooker,S;Hotez,P.J.and Bundy,D.A. 2008. Hookworm Related-Anaemia Among Pregnant Women:A Systematic Review.In Raso, Giovanna. Plos Negl.Trop.Dis.2(9):e291.

Croese,J;Loukas,A;Opdebeeck,J;Failey,S. And Prociv,P. 2012.Human Enteric Infection with Canine Hookworms. Annals of Internal Medicine 120(5):369-374.

Deen,J.L.,Von Seidlein,L.,Pinder,M.,Walraven,G.E. and Green Wood,B.M. 2001. The Safety of the Combination Artesunate and Pyrimethaimine-sulfadoxine Given During Pregnancy. Trans. Roy.Soc.Trop.Med.Hyg.95(4):424-428.

Donegan,E.,Stuart,M. And Niland,J.C. 1990. Infection with Human Immunodeficiency Virus type 1(HIV-1) Among Receipients of Antibody Positive Blood Donations. Annual International Medicine 113(10):733-739.

Duffy,P.E. and Fried,M. 1999. Malaria During Pregnancy; Parasites, Antibodies and Chondroctinsulphate-A.Biochem.Soc.Trans.,27:478-482.

Egwang,T. 2006. Malaria and HIV Interactions and Their Implications for Public Health Policy.International Journal of Epidermilogy.27(2):296-301.

Fried,M.,Noston,F.,Brockman,A,Brabin,B.J. and Duffy,P.E. 1998. Maternal Antibodies Block Malaria. Nature.395:851-852.

Fuseini,G., Edoh,D., Kalifa,B.G. *et al* ., 2009. Plasmodium and Intestinal Helminths Distribution Among Pregnant Women in the Kassen-Nankaria District of Nother Ghana. J. Epidemiol. Nematol. 1(2):019-024.

Gasser,R.B,Cantacessi,C. And Campell,B.E. 2009. Improved Molecular Diagnostic Tools for Human Hookworms. Expert Rev.Mol.Diagn.9(1):17-21.

Gyorkos, T.W; Larocque,R; Casapia,M. And Gotuzzo, E. 2006. Lack of Risk of Adverse Birth Outcomes After Deworming in Pregnant Women. Pediatr.Infect.Dis.J.25(9):791-794.

Hotez,P.J. and Pritchard,D.I. 1995. Hookworm Infection.Scientific American 272(6):68-74.

Hotez,P.J;Bethony,J;Bottazzi,M.E;Brooker, S. And Buss,P. 2005. Hookworm :The Great Infection of Mankind.Plo.s Med.2(3).:e67.

Kayenato,K.,Kodio,M.,New Man,R.D., Maiga,H.,Doumtabe,D.,Ongoiba, A. 2005. Comparison of Intermittent Preventive Treatments with Chemo prophylaxis for the Prevention of Malaria During Pregnancy in Mali.J.Infectious Diseases.19(10):109-116.

Larocque,R;Casapia,M;Gotuzzo,*et al*. 2006. A double-blind Randamized Controlled Trial of Antenatal Mebendazole in a Hookworm-endemic Area of Peru.Trop.Med.Int.Health 11(10):1485-1495.

Markell,E.K;John,D.C. and Petri,W.H. 2006. Markell and Voge's Medical Parasitology(9th ed.).St. Louis,M.O: Elservier Saunders.

McGregor, I.A.1987. Thoughts on Malaria in Pregnancy.Parasitologia,29:153-163.

Muller,O. And Moser,R. 1990.The Clinical and Parasitological Presentation of Plasmodium falciparum Malaria in Uganda Uninfected by HIV Infection. Tranasaction of the Royal Society of Tropical Medicine and Hygiene 3:36-38.

Ndamugyenyi,R.kabaterine,N,Oslen,A. and Magnussen P. 2008. Malaria and Hookworm Infections in Relation to Haemoglobin and Serum Feritin Level in Pregnancy in Masind District,West Uganda.Trans.R.Soc.Trop.Med.Hyg.102 (2):130-136.

Ndibazza,J.I.,Webb,E.L.,Lule,S.I.,Akello,M. ,Oduru,G.,Kizza,M.,Akuru,H.,Mahang,L .,Magnussen,P.,Vennervald,B.and Elliot,A. 2012. Asssociation Between Maternal Helminth and Malaria Infections in Pregnancy and Clinical Malaria in the Offspring: a Birth Cohort in Entebbe,Uganda.American Society of Tropical Medicine and Hygiene.

Nwagha,UI.,Ugwu,U.O.Nwagha,T.U.and Anyachie,U.S. 2007. Asymptomatic Plasmodium Parasitaemia in Pregnant Women Almost a Decade Aftre Rol Back Malria.Trans. Roy.Soc.Trop. Med.Hyp.103:16-20.

Nyirijesy,P.,Kavasya,T.,Axelead,P. And Fischer,P.R.1993. Malaria During Pregnancy:Neonatal Morbidity and Mortality and the Efficacy of Chloroquine Chemoprophylaxis. Clin.Infect.Dis.,16(1):127-132.

Ogboi,J.S.,Agu,P.U.,Akpoigbe,K.,Okeke,T. And Ezugwu,E. 2013. Impact of Plasmodium falciparum and Hookworm Infections on the Frequency of Anaemia in Pregnant Women of Rural Communities in Enugu,South East Nigeria.African Field Epidemiology Network.

Ozumba,U.C., Ozumba, N.A. and Anya,S. 2005.Helminthiasis in Pregnancy in Enugu,Nigeria. J. Health Sci. 51(3):291-293.

Raheed,F.N.,Bulmer,J.N.,Dunn,D.T.,Menen dex,C.,Jawla,M.F. and Jepson,A. 1993. Suppressed Peripheral Blood and Placental Blood Lympho proliferative Respones in First Pregnancies:Relevance to Malaria.Am. J.Trop.Med.Hyg.,48:154-160.

Riley, E.M. Scneider, G.,Sambou,I, and Greenwood,B.M. 1989.Suppression of Cell-mediated Immune Responses to alaria Antigens in Pregnant Gambia Women.Am.J.Trop.Med.Hyg.40:141-144.

Steketee,R.N. and Nahlen,B.L. 1996. The Burden of Malaria in Pregnancy in Malaria Epidemic Areas.American J. Trop. Med. Hygiene. 64(12):28-35.

Stoll,N.R., 1962. On Endemic Hookworm,Where Do We Stand Today?Exp.Parasitol.12(4)241-252.

Verhoeff,F.H., Brabin, B.J., Chimsuku,L., Kazember,P.,Russel,W.B. and Broad Head,R.L.1998.An Evaluation of the Effects on Intermittent Sulfdoxine-Pyrimethamine Treatment in Pregnancy on Parasite Clearance and Risk of Low Birth Weight in Rural Malawi.Am.J.Trop.Med.Parasitol.92 (2):141-150.