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Compliance to Malaria Treatment and Prevention Among Women Attending Antenatal Clinic at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital Amaku, Awka Anambra State Nigeria

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Abstract:

- ***Background:***

Malaria, a disease caused by infection with one or more of the Plasmodium species (P. falciparum, P. vivax, P. ovale, and P. malariae), remains a critical global health issue. Each year, it contributes to nearly 3 million deaths among mothers and children worldwide. Additionally, an estimated 25 million pregnant women are at risk of contracting malaria, with Africa bearing approximately 90% of the global disease burden.

- ***Methodology:***

This research utilized a cross-sectional descriptive approach to evaluate adherence to malaria prevention and treatment among women attending antenatal care at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital, Amaku, Awka, Nigeria. Although the planned sample size was 230 participants, only 120 women participated due to the limited timeframe of the study. Participants were selected through a simple random sampling technique.

- ***Results:***

The findings revealed a high level of awareness about malaria prevention and treatment among the participants, with 99 (96.12%) demonstrating strong knowledge and only 4 (3.88%) showing limited understanding. Compliance with malaria prevention and treatment measures was moderately high, as 75 (68.81%) adhered to recommended practices. The primary reason cited for low compliance was discomfort associated with using insecticide-treated nets (ITNs). No significant associations were observed between compliance and sociodemographic factors.

- ***Conclusion:***

Further studies with a larger sample size would be necessary to further assess the factors that affect compliance to malaria treatment and preventive measures. It is recommended that this research will inform doctors and the general public on the factors affecting compliance to malaria treatment and preventive measures among pregnant women. This will help be of invariable help in developing strategies and policies to reduce the incidence of malaria in pregnancy.

Keywords: *Malaria, Insecticide-Treated Nets, Compliance.*

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I. INTRODUCTION

A. Background of the Study

Malaria, caused by infection with any of the four *Plasmodium* species (P. falciparum, P. vivax, P. ovale, and P. malariae), remains a significant global health concern, with the highest impact in sub-Saharan Africa, although its prevalence is growing in Asia and Oceania [1]. The disease is transmitted mainly through the bite of an infected female *Anopheles* mosquito, but it can also spread via blood transfusions or from mother to child. It is estimated that nearly half of the world's population resides in malaria-prone areas, with over 500 million clinical episodes occurring annually [1]. The death rate is about 2.7 million, with 75% of these deaths occurring in children under five years old in Sub-Saharan Africa. In regions not typically affected by malaria, most cases are imported from endemic areas, though there are other rare sources, such as congenital transmission, blood transfusions, and in exceptional cases, mosquito bites locally.[2] The burden of malaria is especially high among young children and pregnant women in areas where the disease is endemic.

- *Malaria and Pregnancy*

While all four *Plasmodium* species can infect pregnant women, it is only the *P. vivax* and *P. falciparum* species that are known to have increased susceptibility during pregnancy. Approximately 50 million pregnant women live in malaria-endemic areas, with half residing in sub-Saharan Africa, where intense *P. falciparum* transmission occurs. Malaria during pregnancy presents significant risks for the mother, fetus, and neonate, contributing to severe maternal anemia, low birth weight (LBW) in 30–35% of cases, and 75,000–200,000 infant deaths annually [3]. Recent findings indicate that malaria's impact on maternal health in sub-Saharan Africa has been underestimated and may be a major factor in maternal mortality in the region. Pregnant women are particularly vulnerable to *Anopheles* mosquitoes, with a higher likelihood of infection [3]. During pregnancy, the chances of microscopic parasitemia increase, with this susceptibility being particularly pronounced in the second trimester and extending into the puerperium. Malaria during pregnancy is more likely to result in severe disease in non-immune women, with first-time pregnancies and HIV-positive pregnant women being at the highest risk. It is also noted that parasitemic pregnant women in sub-Saharan Africa often do not exhibit clinical signs, making early detection and treatment challenging.[3] Placental infection rates vary from 3.5% to 75%, depending on factors such as local malaria epidemiology and seasonal variations.[3] *P. falciparum* is the only species known to infect the human placenta, with no evidence suggesting that other species like *P. vivax* can do so. Maternal malaria infection can lead to adverse outcomes such as miscarriage, maternal anemia, LBW due to fetal growth restriction, premature delivery, intrauterine demise, and both maternal and infant mortality. The estimated annual death toll due to malaria-related LBW is 75,000–200,000. [3]

- *Pregnant Women and Malaria*

Pregnant women are more vulnerable to malaria due to factors such as pregnancy-related immunological changes that heighten their susceptibility to infection. Additionally, the placenta has specific adhesion receptors that promote the sequestration of malaria parasites, and pregnant women experience an increased attraction to *Anopheles* mosquitoes. [3]

While the signs and symptoms of malaria in pregnant women are similar to those in non-pregnant adults, pregnant women are at an elevated risk of developing complications like hypoglycemia, as well as severe issues such as pulmonary edema and cerebral malaria.

Malaria infection during pregnancy has been linked to several complications, including miscarriage, maternal anemia, premature birth, low birth weight (LBW) infants, intrauterine death, and both maternal and infant mortality. [4]

- *Pathology*

P. falciparum is often found in the intervillous spaces of the maternal placenta circulation, particularly in primigravid women. The inflammatory response and resulting maternal anemia may contribute to LBW through the production of inflammatory cytokines.[5] While *P. vivax* has also been associated with LBW, it does not appear to sequester in the placenta.[3] There is limited information available on other *Plasmodium* species and their interactions during pregnancy.

- *Malaria Treatment During Pregnancy*

Managing malaria during pregnancy requires addressing two main scenarios: (i) treating pregnant women already infected with malaria and (ii) preventing malaria in women who are exposed but uninfected. The choice of treatment should be guided by the severity of the maternal condition. Pregnant women with severe malaria, such as those experiencing coma or respiratory distress, should receive the most effective treatment available, regardless of the drug's reproductive safety profile. [6]

In cases where pregnant women present with symptomatic or asymptomatic parasitemia, there is an elevated risk of severe disease, particularly among non-immune women. Drugs that have been proven safe during pregnancy should be prioritized unless no other effective alternatives exist. [7] However, for many newer antimalarial drugs, or those currently under development, available safety data are limited or concerning. [6] Therefore, treatment decisions must involve a careful assessment of risks and benefits, given the significant impact of maternal malaria on both the mother and her baby.

- *Treatment of Uncomplicated Malaria in Pregnancy*

The selection of drugs or drug combinations for treating malaria during pregnancy depends on several factors, including the severity of maternal illness, drug efficacy, potential maternal and fetal toxicity, pregnancy-related pharmacokinetics, and the prevalence of drug resistance in the region. Unfortunately, despite the possibility of severe disease during pregnancy, data on drug toxicity and pharmacokinetics in this population are often scarce.

The frequent emergence of drug-resistant malaria strains worldwide, coupled with the necessity of using medications with either unknown fetal safety profiles or

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documented toxicity, presents a significant challenge for clinicians. Many older antimalarial drugs are no longer effective in certain regions, and limited information exists regarding the newer options. Ongoing studies aim to address these gaps, and data on maternal and fetal outcomes following drug exposure should be systematically collected for comprehensive follow-up.

Drug licensing varies by country, and as a result, first- and second-line treatment protocols differ based on factors such as resistance levels, costs, and drug availability. According to the World Health Organization (WHO), the current recommendation for treating uncomplicated malaria in pregnancy includes artemisinin-based combination therapies (ACTs) as the first choice during the second and third trimesters. For the first trimester, oral quinine for seven days remains the preferred treatment option. [8]

➢ *Sulfadoxine-Pyrimethamine (Sp):*

The two components of SP work by targeting distinct enzymes in the parasite's folic acid synthesis pathway. In recent years, SP, either alone or in combination with other drugs, served as the first-line treatment for uncomplicated malaria in many African nations. Currently, more than 20 African countries recommend its use for malaria treatment. However, several genetic mutations have recently been identified that could render SP therapeutically ineffective. Repeated use of SP is associated with adverse effects, including the risk of Stevens-Johnson syndrome, although pregnancy does not appear to increase this risk. [3]

Animal studies have shown that SP can be embryotoxic in rats, and its use during the first trimester of pregnancy is discouraged due to the theoretical risk of neural tube defects caused by maternal folate deficiency. Despite this, no evidence of an increased risk of spontaneous abortion or congenital malformations has been reported in humans. [9] Unfortunately, there is limited information regarding SP's pharmacodynamics in pregnancy.

- *Chloroquine:*

Chloroquine remains effective against most malaria species, but resistance to the drug is widespread, particularly for *P. falciparum*. As a result, it is now rarely indicated for treating *P. falciparum* infections. Resistance is also emerging in various parts of the world. Despite this, chloroquine has been extensively used for both the treatment and prevention of malaria during pregnancy and is considered safe for use during pregnancy and breastfeeding.

Overdose of chloroquine is, however, a common concern and can result in serious complications. The potential for resistant strains limits the drug's use, but this issue requires careful evaluation before its exclusion from treatment protocols.

- *Mefloquine:*

Mefloquine is highly effective in treating malaria and has also proven to be an excellent prophylactic option for travelers during the second and third trimesters of pregnancy. Due to its long half-life, it can be administered on a weekly basis and has the potential to replace SP as a preventive measure against malaria. Current evidence suggests that mefloquine is safe to use during pregnancy, including in the first trimester. [10]

- *Amodiaquine:*

Amodiaquine, an aminoquinoline structurally similar to chloroquine, is increasingly being utilized as part of first-line therapy in regions where chloroquine is no longer effective. Although amodiaquine chemoprophylaxis has been linked to rare but severe toxicities, such as agranulocytosis and hepatic failure, these complications are infrequent when the drug is used for treatment. There is no published data on animal toxicity, and information on the safety and tolerability of amodiaquine during pregnancy remains limited. [11]

- *Artesunate, Artemether, and Artemisinins:*

Artemisinins are typically used in combination with other antimalarial drugs, as prolonged use beyond seven days is required when administered as monotherapy. Artemisinin-based combination therapies (ACTs) are rapidly becoming the standard treatment and are recommended by the WHO for use in malaria-endemic regions. [8] No resistance to artemisinins has been reported so far. Data, particularly from East Asia, indicate that artemisinins are at least as effective as alternative treatments and, in some cases, superior.

All drugs in this class may produce similar adverse effects. Animal studies in rats and rabbits have shown fetal resorption and skeletal abnormalities, even at low doses. However, data from over 600 pregnancies treated with artesunate during the second and third trimesters have not revealed maternal or fetal toxicity. Artesunate also appears safe for breastfeeding mothers.

Despite these findings, caution is advised, and artemisinins should only be used during pregnancy when no other treatment options are available. Studies on their use in pregnancy are ongoing. As for artemether-lumefantrine, data on its safety in pregnancy is not yet available, though a trial is underway in Thailand. Additionally, reproductive toxicity and pharmacokinetics studies on dihydroartemisinin and piperaquine are yet to be conducted. Reports from China have documented their use in pregnancy without any reported adverse events. [12]

- *Chlorproguanil/Dapsone (LapDap):*

Ongoing research in Tanzania and Mali aims to provide data on the pharmacokinetics, safety, tolerability, and efficacy of LapDap in treating malaria in pregnant women. Existing animal studies indicate that LapDap does not exhibit reproductive toxicity. [13]

- *Chlorproguanil-Dapsone-Artesunate (CDA):*

Research involving pregnant women is currently being conducted to evaluate this combination therapy. Its low cost is a significant advantage for use as intermittent preventive treatment. However, CDA shares the same reproductive toxicity concerns as other artemisinin-based combination therapies.

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- *Atovaquone-Proguanil (Malarone):*

This drug is increasingly used for malaria treatment and prophylaxis in travelers, particularly among non-pregnant individuals. It is known for its low incidence of adverse effects and the convenience of requiring only seven days of treatment post-exposure. However, its high cost limits its accessibility in endemic countries. When tested in a small group of pregnant women in combination with artesunate, atovaquone-proguanil demonstrated safety and high efficacy against multi-drug-resistant malaria. [14]

➢ *Treatment of Severe or Complicated Malaria in Pregnancy*

- *Quinine:*

Quinine remains the preferred treatment for severe malaria during pregnancy when administered parenterally. However, its use is often associated with poor compliance due to the need for prolonged treatment (seven days), low tolerability caused by gastrointestinal and ear-related side effects, and its extremely bitter taste.

Quinine is classified as a Category C drug by the US Food and Drug Administration. The increased risk of miscarriage or stillbirth observed in cases of severe malaria is attributed to the disease itself rather than to quinine treatment. Pregnant women are at a higher risk of developing quinine-induced hypoglycemia, which necessitates careful monitoring of blood glucose levels and, when needed, the administration of parenteral dextrose supplementation. [15]

- *Artesunate:*

Recent studies suggest that parenteral artesunate is more effective than quinine for the treatment of severe malaria. [3] As a result, it is likely to become the treatment of choice for severe malaria in pregnant women, particularly in Asia, where quinine shows reduced efficacy. However, concerns regarding reproductive safety remain. Further studies involving African pregnant women are essential to confirm whether artemisinin derivatives are superior to quinine before making broad recommendations for their use during pregnancy.

An international consortium of experts specializing in malaria during pregnancy is being established to address key questions related to malaria control in pregnant women. This initiative will include a thorough evaluation of alternative drug options in various endemic settings.

➢ *Malaria Prevention In Pregnancy*

- *Drug-Based Prevention*

✓ *Chemoprophylaxis:*

Chemoprophylaxis during pregnancy has been shown to reduce maternal anemia and low birth weight, particularly in first and second pregnancies. [3] Previously, chloroquine chemoprophylaxis was widely recommended for malaria prevention in pregnant women in Africa due to its low cost, widespread availability, and safety across all trimesters. However, the emergence of chloroquine-resistant parasites has rendered its use impractical in many parts of the world. Poor compliance with weekly dosing regimens further limited its effectiveness. Currently, chloroquine is only used in some countries in West Africa, Latin America, and India. Its use is now almost exclusively limited to P. vivax infections, which are often resistant to SP.

In Latin America, no chemoprophylaxis is currently in widespread use, though it remains part of official policy in certain countries.

✓ *Intermittent Preventive Treatment in Pregnancy (IPTp):*

To address poor compliance with weekly chemoprophylaxis, a new strategy, Intermittent Preventive Treatment in Pregnancy (IPTp), was developed. The mechanism of action of IPTp is not fully understood, but it may reduce parasitemia, clear placental infections, or provide prophylactic protection against new infections. [16]

IPTp is the recommended malaria prevention strategy for pregnant women in areas of stable malaria transmission, such as most of sub-Saharan Africa. It involves administering a full course of antimalarial treatment at specific time points to at-risk populations, regardless of their infection status. Although IPT is also being explored as a potential malaria prevention method for infants, its effectiveness in this subgroup has not yet been conclusively demonstrated. Trials are ongoing to evaluate its role in malaria control programs for children.

✓ *Sulfadoxine-Pyrimethamine (SP):*

An African study showed that administering two doses of SP during pregnancy was more effective than chloroquine for treatment or prophylaxis.[3] Additional studies have demonstrated increased birth weight and maternal hemoglobin levels with low morbidity rates comparable to treatment outcomes.

In areas with stable malaria transmission, WHO recommends IPTp using SP in at least two doses, administered one month apart from the second trimester onwards. HIV-infected women may require more frequent dosing. SP is currently the only option for IPTp; however, due to the emergence of resistant parasites, alternative drugs should urgently be investigated. [17]

Although promising, this strategy has not overcome the compliance challenges associated with chemoprophylaxis. Poor adherence to the second dose remains a significant issue. Monthly administration of SP may offer advantages over the two-dose regimen, though further studies are needed to assess its safety and cost-effectiveness before widespread adoption.

✓ *Alternatives to SP for IPTp:*

To date, no IPTp studies using alternative drugs have been completed, and further research is needed to evaluate the role of these alternatives in prophylaxis and pregnancy outcomes.

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Mefloquine, despite some side effects, showed promise in a single study where a treatment dose (750 mg) followed by weekly prophylaxis (250 mg) improved birth weights by reducing placental malaria. [18] IPTp studies with chlorproguanil-dapsone (LapDap) are currently underway, with additional research on drug combinations expected to follow.

The combination of SP and artesunate is a potentially promising option for regions like West Africa, where SP resistance is still uncommon. SP combined with azithromycin is also being investigated. Azithromycin is safe for use during pregnancy, has broad-spectrum antibacterial and antimalarial activity, and may be particularly beneficial for HIV-infected pregnant women.

Dapsone, which has been widely used to treat leprosy, was recently reviewed for its role in pregnancy and has not been associated with adverse effects. [19]

➢ *Non-Pharmacological Interventions*

- *Long-Lasting Insecticide-Treated Nets (LLITNs):*

Long-lasting insecticide-treated nets (LLITNs) are replacing traditional insecticide-treated nets (ITNs) in many countries. ITNs, which are mosquito nets treated with insecticides, are estimated to be twice as effective as untreated nets and offer more than 70% protection compared to no net use. They provide dual benefits: protecting individuals sleeping under them and killing mosquitoes that come into contact with the nets. Additionally, ITNs offer some level of protection to others in the vicinity, such as people sleeping in the same room but not directly under the net.

The distribution and use of ITNs are recognized as essential malaria prevention methods and are integral to the World Health Organization's (WHO) Millennium Development Goals (MDGs). Between 2010 and 2015, there was an 80% increase in ITN usage among populations at risk of malaria in sub-Saharan Africa.

Preventing malaria during pregnancy is a critical intervention to improve maternal and fetal health worldwide. Since mosquito bites are the primary mode of malaria transmission, the use of insecticide-treated nets remains an effective strategy for reducing transmission and associated risks.

- *Use of Insecticide Sprays and Coils:*

In terms of knowledge about malaria prevention in pregnancy, respondents demonstrated greater familiarity with the use of indoor aerosol insecticide sprays than with LLITNs or IPTp. This observation aligns with studies conducted in Malawi and southwestern Nigeria, where most people reported using screens and sprays as their primary malaria prevention methods.

In Nigeria, the use of aerosol insecticide sprays is particularly common, possibly to address the nuisance caused by mosquito noise. However, the growing resistance of mosquito populations to these insecticides poses a significant threat to their long-term efficacy. [33]

B. Problem Statement

Malaria contributes to nearly 3 million maternal and child deaths annually worldwide, with 25 million pregnant women at risk. In Africa, the continent bears 90% of the global malaria burden, incurring costs of up to $12 billion and a 1.3% loss in GDP each year [20]. In Nigeria, malaria represents a significant health crisis, costing around 132 billion naira annually and causing approximately 300,000 deaths each year. This is the highest number of malaria-related deaths globally, with 97% of the population at risk. According to the World Health Organization (WHO), malaria leads to over 10,000 maternal deaths and 200,000 neonatal deaths annually in Nigeria. It is a primary cause of abortion, stillbirth, anemia during pregnancy, preterm births, and low birth weight[22]. Despite considerable efforts to combat the disease, malaria continues to severely affect the health of pregnant women and children in Nigeria, with no significant reduction in transmission rates.

C. Justification

Intermittent Preventive Treatment in Pregnancy (IPTP) and the use of Long-Lasting Insecticidal Nets (LLITN) have been shown to decrease malaria transmission by 70% to 80%. However, despite these effective interventions and the availability of various antimalarial treatments, malaria remains a significant cause of maternal and neonatal morbidity and mortality in Nigeria[23]. Although health authorities have promoted the use of LLITNs among pregnant women, actual usage and ownership remain limited[24]. This study aims to evaluate the level of compliance with malaria treatment and prevention practices among pregnant women at the Chukwuemeka Odumegwu Ojukwu University Teaching Hospital in Awka, Anambra State, Southeast Nigeria, and identify factors hindering effective prevention and treatment.

D. General Objectives

To assess pregnant women's knowledge of malaria, as well as their compliance with malaria treatment and prevention practices, at the Chukwuemeka Odumegwu Ojukwu University Teaching Hospital.

E. Specific Objectives

- To evaluate the level of knowledge about malaria among pregnant women attending antenatal clinics at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital.
- To assess the use of LLITNs and other malaria prevention measures among pregnant women attending antenatal clinics at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital.
- To examine the compliance of pregnant women with malaria treatment during pregnancy.
- To identify factors that hinder adequate compliance with malaria prevention and treatment.

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II. LITERATURE REVIEW

A. Knowledge of Malaria:

A cross-sectional study conducted in Adis-Zemen, Ethiopia, included 235 pregnant women, yielding a response rate of 99.6%. Of these, 172 women (73.2%) demonstrated good knowledge of malaria. Women from urban areas, with higher family incomes, and those with formal education showed greater knowledge[25].

Another cross-sectional study in a pre-urban setting in southwestern Uganda involved 800 women. The study found that 96.1% of the women were aware that malaria is dangerous during pregnancy; 60.3% knew it could cause anemia, and 71.3% associated malaria with general weakness. However, fewer women (44.9%) were aware that malaria could cause abortion, and 14.9% thought it could lead to stillbirth[26].

A study conducted by the Department of Community Health and Primary Care at the University of Lagos, Nigeria, interviewed 422 respondents. Nearly all respondents (96.2%) knew that malaria is caused by mosquito bites. However, there was limited awareness about malaria's complications during pregnancy, with 27% unaware of any complications. Over half (51.6%) did not know the risks of malaria to the fetus, and only 39.8% recognized that malaria could lead to fetal death[27].

At Adeleke University, Ede, Osun State, Nigeria, a study of 165 respondents found that 157 (95.2%) had heard of malaria in pregnancy, 155 (92.7%) believed it was transmitted by mosquitoes, and 141 (85.5%) agreed that untreated malaria could be fatal. Additionally, 63.3% had experienced malaria during pregnancy, and 83.0% believed malaria could result in low birth weight[28].

A recent study at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital in Awka assessed the knowledge, attitudes, and use of insecticide-treated nets among pregnant women attending antenatal clinics. The study showed that the majority (98.3%) were aware of malaria in pregnancy[32].

B. Compliance of Women to Treatment and Prevention Ofmalaria in Pregnancy

A study conducted at the Department of Obstetrics and Gynecology, Federal Teaching Hospital, Abakaliki, Nigeria, involved 516 parturients. It found that 72.1% (367/516) received at least one dose of prescribed IPTp. Among those who took the first dose, 59.7% (219/367) adhered to the second dose, and only 4.9% (18/367) took a third dose. Clinical malaria occurred in 85% (127/149) of women who did not receive IPTp, compared to just 20.5% of those who received at least one dose. The study highlighted that over half of the parturients did not adhere to the prescribed malaria prevention treatment during pregnancy[30].

A recent study at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital, Awka, assessing the knowledge, attitudes, and use of insecticide-treated nets among pregnant women attending antenatal clinics found that 60.4% of the respondents slept under LLITNs[32].

C. The Use of Llitn and Other Preventive Measures

A cross-sectional study in a pre-urban setting in South-Western Uganda found that less than half (48.8%) of the women received two doses of sulfadoxine-pyrimethamine (SP) for malaria prevention during pregnancy, while 16.3% received at least three doses, as recommended by the current policy[26].

A study at the Department of Community Health and Primary Care, College of Medicine, University of Lagos, Nigeria, revealed that of the 422 respondents interviewed, 41.9% used insecticide sprays and coils for malaria prevention during pregnancy, while 36.9% used intermittent preventive treatment. Only 24.1% utilized insecticide-treated nets, and almost 20% did not use any form of prevention.[27]

Similarly, a study at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital, Awka, found that 60.4% of pregnant women attending antenatal clinics slept under LLITNs[32].

D. Factorsaffecting Compliance to Treatment and Prevention of Malaria in Pregnancy

A cross-sectional study in Adis Zemen, Ethiopia, revealed that pregnant women's understanding of malaria is influenced by various socio-demographic factors, including education level, occupation, place of residence, access to media (such as radio or television), religion, ethnicity, age, and household income[25].

In a study conducted in Senegal, involving 4,616 women aged 15–49 who had recently been pregnant, it was found that women aged 35 to 49 were more likely to adopt optimal malaria prevention practices during pregnancy compared to those under 20. This difference was attributed to younger women's limited exposure to pregnancy-related experiences and insufficient knowledge about malaria prevention. Older women, with greater life experience and awareness of pregnancy risks, were more prepared to utilize preventive measures. Age was identified as a key factor in compliance with malaria prevention practices[31].

Research from the Department of Community Health and Primary Care in Lagos showed a significant relationship between educational level, marital status, and knowledge of malaria during pregnancy. Respondents with at least a secondary education were more aware of malaria's effects during pregnancy, and married women demonstrated a higher level of knowledge compared to those who were unmarried[27].

A study at the Department of Obstetrics and Gynecology, Federal Teaching Hospital, Abakaliki, Nigeria, involved 516 parturients. Among those who took at least one dose of intermittent preventive treatment for malaria in pregnancy (IPTp), 35.4% (130/367) only took the first dose. Of these, 68.8% (89/130) did not follow up with additional doses due to personal reasons such as lack of funds (31.5%), perceiving the medication as unnecessary (16.9%),

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forgetfulness (12.3%), and side effects like weakness after the first dose (7.7%). Other challenges included patient-related factors like lack of information about directly observed treatment (26%), financial constraints for purchasing drugs (15%), long waiting times (18%), and unawareness of the importance of additional doses (3%). Facility-related challenges included unavailability of clean drinking water (20%), inadequate staff to supervise treatment (10%), and overcrowded healthcare facilities (6%)[30].

A recent study at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital, Awka, assessed pregnant women's knowledge, attitudes, and use of insecticide-treated nets (LLITN) during antenatal visits. Although there was widespread awareness of LLITNs, actual usage was lower, primarily due to discomfort from increased heat while sleeping under the nets and challenges related to accessibility and availability.[32]

METHODOLOGY

A. Study Area

The Chukwuemeka Odumegwu Ojukwu University Teaching Hospital (COOUTH), previously known as Anambra State University Teaching Hospital (ANSUTH), is a tertiary medical facility located in Awka, Anambra State, Nigeria. Operated by the Anambra State Government, it serves as a training ground for healthcare professionals in partnership with Chukwuemeka Odumegwu Ojukwu University. COOUTH provides comprehensive healthcare services, including diagnostic and treatment options typical of a teaching hospital, and is particularly recognized for delivering quality antenatal care (ANC) services.

B. Study Design

This research utilized a cross-sectional survey approach.

C. Study Population

The study focused on pregnant women attending antenatal booking appointments, held weekly on Wednesdays, at the Chukwuemeka Odumegwu Ojukwu University Teaching Hospital.

D. Sample Size Determination

Using the formula for calculating minimum sample size for cross sectional studies[32].

$$n = \frac{Z^2 pq}{d^2}$$

Where
n = minimum sample size
z = standard normal deviate usually 1.96
p = proportion of respondents in Oshogbo, who had knowledge of LLITNs = 0.41
d =degree of precision taken as 5% = 0.05
q= 1- p = (1-0.41)

Therefore,

$$n = \frac{1.96^2 \times 0.41 \times (1-0.41)}{0.05^2} = 372$$

The sample size was approximated to 370

Since the population size is < 10,000, final sample estimate will be:

$$nf = \frac{n}{1+\frac{(n)}{(N)}}$$

When
nf =the desired sample size when population Is <10,000
n= the desired sample size when population is < 10,000
N= the estimate of the population size = 600 as evidenced by the number of pregnant women who registered for ANC over the
past three months.

Therefore,

$$nf = \frac{370}{1+\frac{370}{600}}$$

$$= \frac{370}{1+0.6}$$

$$= \frac{370}{1.6}$$

= 231, approximated to 230

The sample size was approximated to230.

E. Sampling Technique

A systematic random sampling method was employed for this study. The antenatal clinic booking register indicated an average of 456 clients per three-month period, which was the expected duration of the study. The sampling interval was calculated as 2, derived by dividing 456 by the sample size of 230. The first participant was selected using simple random sampling, and then every other client who booked was chosen for the study until the required sample size was met.

F. Inclusion Criteria

- Clients attending the antenatal clinic at COOUTH.
- Clients who were stable enough to answer the questions.
- Clients who provided consent.

G. Exclusion Criteria

Pregnant women who were admitted to the hospital.

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H. Instruments for Data Collection

Data were collected using a semi-structured, interviewer-administered questionnaire.

I. Data Analysis

The questionnaires were reviewed for errors and omissions at the end of each day. Data were entered into the computer and analyzed using SPSS version 26.0. Errors in the data were identified and corrected. The results were presented in tables and bar charts.

J. Ethical Consideration

Ethical approval for the study was sought and granted by the ethical review committee of Chukwuemeka Odumegwu Ojukwu University Teaching Hospital, through the Department of Community Medicine. Informed verbal consent was obtained from participants before administering the questionnaires. Participation was voluntary, and all collected data were kept strictly confidential.

III. RESULTS

A. Data Analysis

The study had a desired sample size of 230 but because of time constraint and short interval of sample collection only 120 sample were collected with a response rate of 100%, however some variables were not filled by respondents explaining why the total frequency of such variables was not up to 120.

Table 1: Socio-Demographic Characteristics of Respondents

Variables	Frequency (n)	Percentage %
Age (at last birthday)		
26-35	80	68.38%
15-25	29	24.79%
36-45	8	6.84%
Mean = 28.91, SD = 5.54		
Marital Status		
Single	7	5.93%
Married	97	82.20%
Divorced	14	11.86%
Widowed	0	0.00%
Occupation		
Civil servant	38	32.48%
House wife	17	14.53%
Artisan	3	2.56%
Business/trader	59	50.43%
Highest educational qualification		
Primary school	2	1.68%
Secondary school	25	21.01%
Tertiary institution	92	77.31%
Number of child/children		
None	36	30.25%
1-2	57	47.90%
3-4	25	21.01%
5 and above	1	0.84%

The study involved 120 women with the mean age of 28.91 (SD = 5.54). Majority of the women were married 97 (82.20%), 14 (11.86%) divorced and 7 (5.93) single as at the time of this study. There were 92 (77.31%) who attained tertiary level of education, 24 (21.01%) stopped at secondary level while 2 (1.68%) had only primary education. Other socio-demographic characteristics are stated in the table.

Table 2: Knowledge of Malaria among Women Attending Antenatal Clinic at COOUTH

Variables	Yes	No
Knowledge on causes of malaria		
Bites from infected mosquitoes	115 (95.83%)*	5 (4.17%)
Dirty environment	91 (75.21%)*	30 (24.79%)
Too much exposure to sunlight	28 (23.93%)	89 (76.07%)*
Knowledge on risks		
Malaria in pregnancy causes a serious health risk	116 (95.87%)*	5 (4.13%)
Malaria in pregnancy causes maternal illness	105 (89.74%)*	12 (10.26%)
Malaria in pregnancy causes maternal anemia	104 (87.39%)*	15 (12.61%)
Malaria in pregnancy causes abortion	48 (40.68%)*	70 (59.32%)
Malaria in pregnancy causes low birth weight	81 (68.64%)*	37 (31.36%)

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Malaria in pregnancy causes jaundice	105 (88.24%)*	14 (11.76%)
Knowledge on prevention and treatment of malaria in pregnancy		
Prevention of malaria pregnancy is possible	118 (97.52%)*	3 (2.48%)
I know about long lasting insecticide treated nets	111 (92.50%)*	9 (7.50%)
Regular use of long lasting insectide treated nets can prevent malaria	114 (95.00%)*	6 (5.00%)
Drugs can be taken to prevent malaria in pregnancy	114 (94.21%)*	7 (5.79%)
Malaria in pregnancy can be treated	118 (97.52%)*	3 (2.48%)
Any antimalarial drug can be used to treat malaria in pregnancy	45 (37.50%)	75 (62.50%)*

Table 3: Illustrating the Sources of Information on the Knowledge of Prevention and Treatment of Malaria

Source(s) of information on the knowledge of prevention and treatment of malaria	**Frequency (%)**
Friends and relatives	40 (33.90%)
Hospital	97 (82.20%)
Newspaper/Articles	28 (23.73%)
Mass media	56 (47.46%)
Health seminars	55 (46.61%)
School	41 (34.75%)

Note: The starred * responses indicate the correct answers to the questions on knowledge

The majority of participants, 115 (95.83%), understood that malaria is caused by bites from infected mosquitoes. Awareness of the risks associated with malaria during pregnancy was also high, with 116 (95.87%) recognizing it as a significant health threat. Furthermore, 104 (87.49%) knew that malaria causes maternal anemia, 81 (68.64%) correctly identified it as a cause of low birth weight, and 70 (59.32%) were aware that malaria in pregnancy could result in abortion. Knowledge of prevention and treatment was also high, with 114 (95%) acknowledging that the regular use of long-acting insecticide-treated nets can prevent malaria.

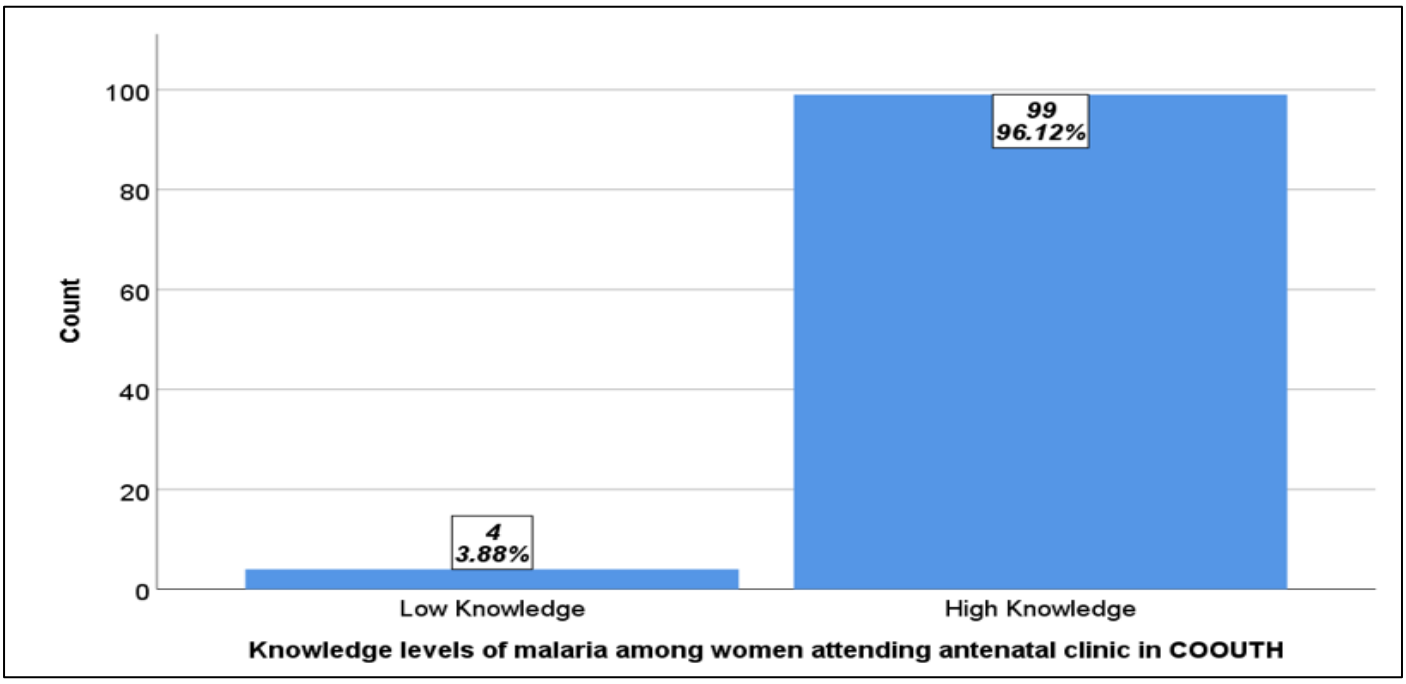

Fig 1: Knowledge Level of Malaria Among Women Attending Antenatal Clinic in COOUTH

- *A Simple Bar Chart Representing the Knowledge Level of Malaria Among Women Attending Antenatal Clinic in Coouth*

A total of 14 questions were designed to assess the participants' knowledge of malaria. The questions were grouped into three sets: the first focused on the causes of malaria, the second on the risks associated with malaria, and the third on the prevention and treatment of malaria during pregnancy. A point was awarded for each correct answer, and 0 points were given for incorrect answers. The total score was calculated for each respondent. Those with scores between 0 and 7 were classified as having Low Knowledge, while those with scores above 7 were categorized as having High Knowledge. The knowledge of malaria prevention and treatment was generally high among the participants, with 99 (96.12%) demonstrating High Knowledge and 4 (3.88%) showing Low Knowledge.

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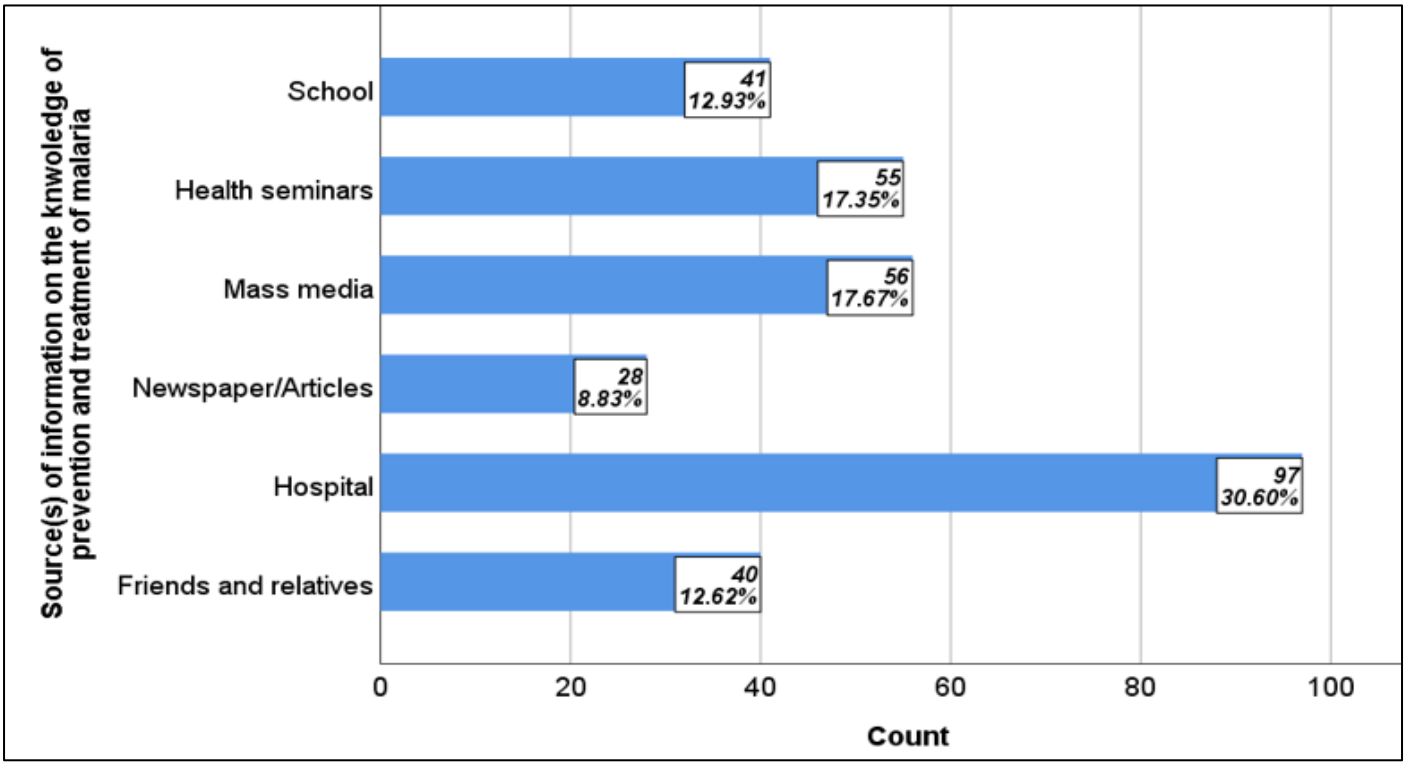

Fig 2: A Simple Bar Chart Representing the Sources of Information on the Knowledge of Malaria

Majority of the respondents got their knowledge from hospitals 97 (30.60%), 56 (17.67%) from mass media, 55 (17.35%) from health seminars, 41 (12.93%) from schools, 40 (12.62%) from friends and relatives while 28 (8.83%) from Newspapers/articles.

Table 3: Compliance to Prevention and Treatment of Malaria

	Yes	No
I have at least one ITN	98 (83.05%)	20 (16.95%)
I sleep under ITN every night	76 (63.87%)	43 (36.13%)
There are nets in my doors and windows	100 (83.33%)	20 (16.67%)
I frequently check my ITN for holes	79 (67.52%)	38 (32.48%)
After long usage, I re-treat my ITN	45 (40.54%)	66 (59.46%)
I do not engage in self-medication for the treatment of malaria (or any fever) during pregnancy	97 (81.51%)	22 (18.49%)

Among the pregnant women that participated in the study, 98 (83.05%) had at least one ITN while 76 (63.87%) sleep under ITN every night.

Table 4: Factors Affecting Compliance to Preventive and Treatment of Malaria

Factors affecting compliance to preventive and treatment measures of malaria*	Frequency (%)
High cost of drugs	26 (21.85%)
Unavailability of ITN in local markets	22 (18.49%)
I'm not comfortable sleeping under ITN	45 (37.82%)
Absence of handling stands for the nets	9 (7.56%)
None	53 (44.54%)

* This is a multiple response question set hence was analyzed as such.

The most reported reason for low compliance to preventive and treatment measures against malaria among the study participants was lack of comfortability sleeping under ITN. Other reasons include high cost of drugs 26 (21.85%), unavailability of ITN in local markets 22 (18.49%). Some participants 63 (44.54%) however, had no reason for not being compliant to preventive and treatment measures against malaria.

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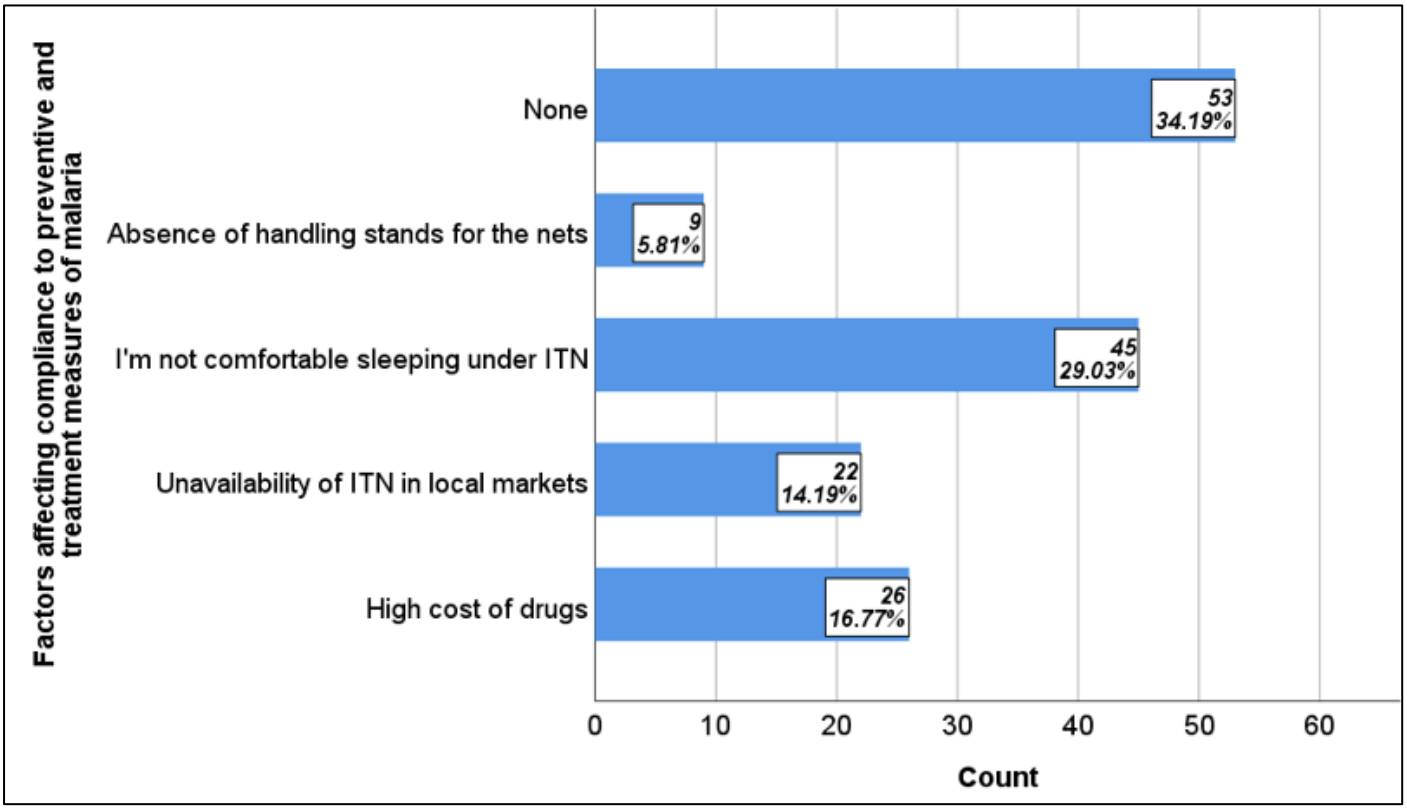

Fig 3: A simple bar chart showing factors affecting compliance to malaria prevention and treatment.

The most reported reason for low compliance to preventive and treatment measures against malaria among the study participants was lack of comfortability sleeping under ITN. Other reasons include high cost of drugs 26 (21.85%), unavailability of ITN in local markets 22 (18.49%). Some participants 63 (44.54%) however, had no reason for not being compliant to preventive and treatment measures against malaria.

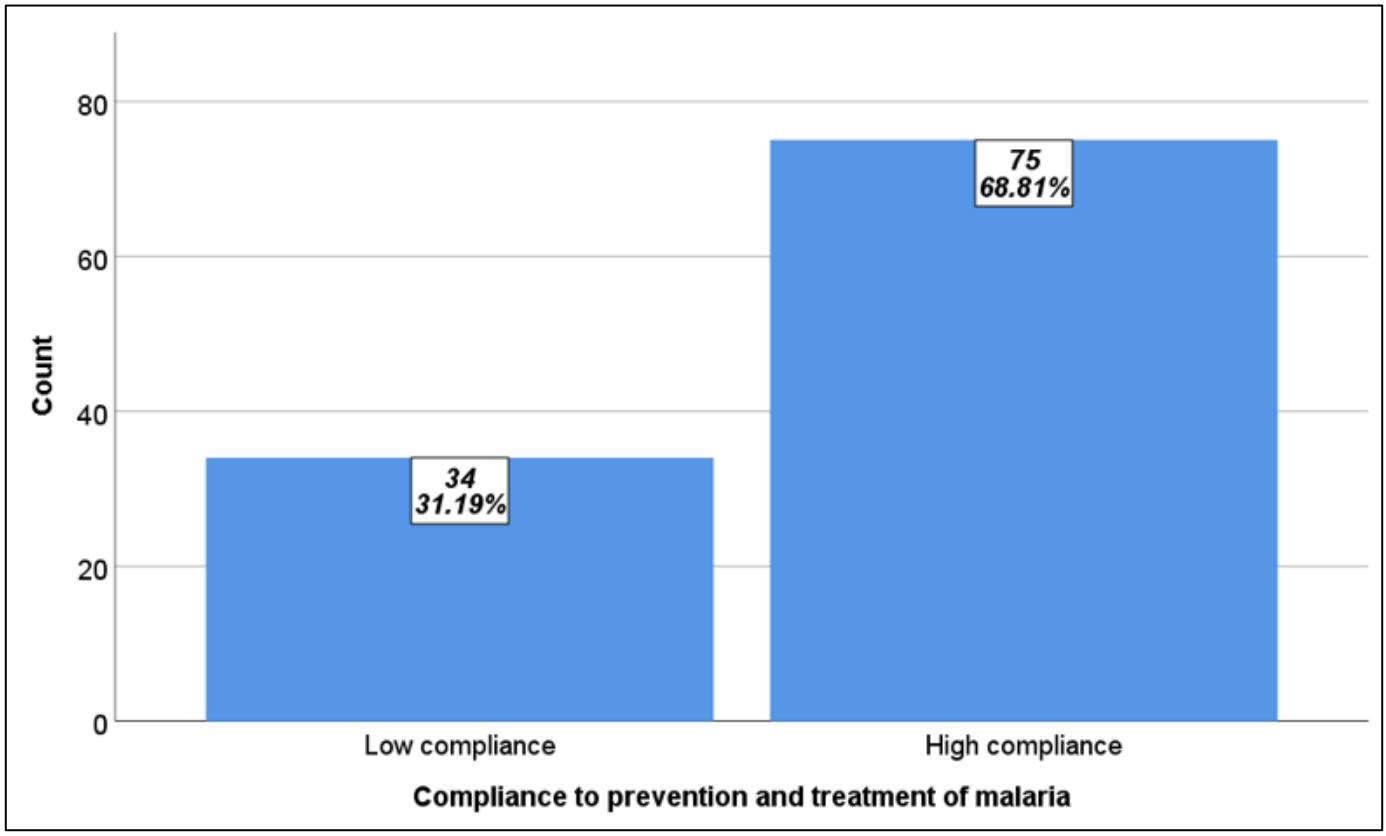

Fig 4: A Simple Bar Chart Representing the Compliance Level of Participants to Treatment and Preventive Measures of Malaria

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A total of 6 questions were used to assess the level of compliance to the preventive and treatment measures of malaria among women attending antenatal clinic in COOUTH. A score of 1 was awarded to responses indicating compliance and 0 score to responses indicating non compliance. Participants with score 0 -3 were graded as having Low Compliance while those with scores >3 as having High Compliance. The study reported a high compliance 75 (68.81%) to the preventive and treatment measures of malaria.

Table 5: Relationship between Socio-Demographic Characteristics Knowledge and Compliance to Prevention and Treatment of Malaria using Chi Square Test of Independence

Variables	*Compliance to prevention and treatment of malaria*		*Chi-square (X^2)*	*P-value*
	Low compliance	*High compliance*		
Age (at last birthday)				
15-25	8 (30.77%)	18 (69.23%)	0.58	0.972
26-35	23 (32.39%)	48 (67.61%)		
36-45	2 (28.57%)	5 (71.43%)		
Marital Status				
Single	2 (28.57%)	5 (71.43%)		0.369
Married	28 (32.94%)	57 (67.06%)	1.994	
Divorced	2 (14.29%)	12 (85.71%)		
Occupation				
Civil servant	6 (17.65%)	28 (82.35%)	4.513	0.211
House wife	7 (43.75%)	9 (56.25%)		
Artisan	1 (33.33%)	2 (66.67%)		
Business/trader	18 (35.29%)	33 (64.71%)		
Highest educational qualification				
Primary school	1 (50.00%)	1 (50.00%)		0.278
Secondary school	10 (43.48%)	13 (56.52%)	2.563	
Tertiary institution	22 (27.16%)	59 (72.84%)		
Number of child/children				
None	12 (38.71%)	19 (61.29%)	2.612	0.455
1-2	14 (25.93%)	40 (74.07%)		
3-4	8 (40.00%)	12 (60.00%)		
5 and above	0 (0.00%)	1 (100.00%)		
Knowledge level				
Low	2 (50.00%)	2 (50.00%)		0.460
High	30 (32.26%)	63 (67.74%)	0.546	

A Chi square test of independence was used to assess the relationship between the different socio-demographic characteristics and compliance to preventive and treatment measures against malaria. No significant relationship was seen between compliance and any of the socio demographic variables. There was also no significant relationship between the knowledge of malaria and compliance to malaria treatment and prevention ($X^2 = 0.546$, p-value = 0.46)

IV. DISCUSSION AND RECOMMENDATION

A. Preamble

Malaria is caused by infection with one or more of the four species of *Plasmodium* and remains a severe health challenge, particularly in sub-Saharan Africa. This study is a cross-sectional descriptive investigation that examines compliance with malaria treatment and prevention among women attending the antenatal clinic at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital, Amaku, Awka, Nigeria.

B. Discussion

The study involved 120 women with the mean age of 28.91 (SD = 5.54). Majority of the women were married 97 (82.20%), 14 (11.86%) divorced and 7 (5.93) single as at the time of this study. There were 92 (77.31%) who attained tertiary level of education, 24 (21.01%) stopped at secondary level while 2 (1.68%) had only primary education.

The knowledge of prevention and treatment of malaria was high among study participants with 99 (96.12%) having High knowledge and 4 (3.88%) low knowledge. Majority of the participant 115 (95.83%) knew that malaria is caused by bites from infected mosquitoes. Knowledge on the risks of malaria in pregnancy was also high, 116 (95.87%) were aware that it poses a serious health risk, 104 (87.49%) knew it causes maternal anaemia, 81 (68.64%) correctly agreed that it causes low birth weight but only 70 (59.32%) were aware that malaria in pregnancy can cause abortion. Also knowledge on prevention and treatment of malaria in pregnancy was equally high, 114 (95%) knew that regular use of long acting insecticide treated nets can prevent malaria.

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The major source of knowledge was from hospitals 97 (30.60%), 56 (17.67%) from mass media, 55 (17.35%) from health seminars, 41 (12.93%) from schools, 40 (12.62%) from friends and relatives while 28 (8.83%) from Newspapers/articles. Similar studies done in Ethiopia [25] and Uganda [26] showed a good knowledge level of 73.2% and 96.1% respectively similar to our study. This high knowledge level could be attributed to proper health education during antenatal visits.

The study reported a high compliance 75 (68.81%) to the preventive and treatment measures of malaria. Among the pregnant women that participated in the study, 98 (83.05%) had at least one ITN while 76 (63.87%) sleep under ITN every night. The most reported reason for low compliance to preventive and treatment measures against malaria among the study participants was lack of comfortability sleeping under ITN. Other reasons include high cost of drugs 26 (21.85%), unavailability of ITN in local markets 22 (18.49%). Some participants 63 (44.54%) however, had no reason for not being compliant to preventive and treatment measures against malaria. A Chi-square test of independence was conducted to assess the relationship between various socio-demographic characteristics and compliance with malaria treatment and prevention. No significant relationship was found between compliance and any of the socio-demographic variables. Additionally, there was no significant association between knowledge of malaria and compliance with malaria treatment and prevention (X^2 = 0.546, p-value = 0.46). This finding contrasts with a cross-sectional study conducted in Senegal, which found that older women (aged 35-49) were more likely to adopt optimal malaria prevention methods during pregnancy compared to younger women under 20 years.

C. Recommendations

➢ *Based on the findings from this study, the following recommendations are made:*

- Government should conduct studies to improve the comfortability of long lasting insecticide treated nets.
- Strategies and funding should be put in place to subsidize the cost of drugs.
- LLITN should be made available in the local markets to improve its usage and availability.

V. CONCLUSION

The knowledge of malaria prevention and treatment was high among the study participants, with 99 (96.12%) demonstrating High Knowledge and 4 (3.88%) exhibiting Low Knowledge. There was also a relatively high level of compliance (75, 68.81%) with preventive and treatment measures for malaria. The most common reason for low compliance was discomfort while sleeping under insecticide-treated nets (ITN).

No significant relationship was seen between compliance, knowledge level and any of the socio demographic variables.

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