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# COMPARATIVE STUDY AND PREVALENCE OF PLASMODIUM FALCIPARUM AMONG CHILDREN AND PREGNANT WOMEN ATTENDING GENERAL HOSPITAL, LAPAI, NIGERIA

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**ABSTRACT**
Malaria is a life threatening disease caused by *Plasmodium* sp that is transmitted to people through the bite of infected mosquitoes. The *Plasmodium falciparum* specie have been confirmed to affects the lives of almost 40% of the world's population with pregnant women and children under-five years of age being the most affected. Malaria infection during pregnancy is an important public health problem with substantial risks to both the mother and foetus. This study was undertaken to determine malarial infection among children and pregnant women attending General Hospital Lapai, Niger state, Nigeria with the intent to compare two methods of Rapid diagnostic test (RDTs) and microscopy in the diagnosis of malaria. A cross-sectional and Hospital-based surveillance study was conducted on 150 patients by collecting blood samples from children and pregnant women attending General Hospital Lapai, Niger state. Blood samples were collected and examined for the presence of *Plasmodium* sp by rapid diagnostic test (RDT), and mp microscopy. A total of 75 pregnant women and 75 children were sampled for malaria parasites infection. Out of the 75 samples collected from children under the age of 5 years, a total of 58 (77.3%) participants were found positive using Microscopy and 26 (34.7%) positive using RDTs technique. The findings demonstrated that Mp microscopy for detection of malaria *P. falciparum* was highly sensitive (80.7%) as compared to RDT (44.7%). And out of the 75 samples collected from pregnant women, a total of 63 (84.0%) participants were found positive using Microscopy and 41 (54.7%) positive using RDTs technique. The results obtained suggested that microscopy remains the gold standard method for diagnosis of malarial infection, although the HRP-2 pf RDTs can be used where microscopy is not available and in cases where urgent malaria diagnosis is needed. The sensitivity and specificity of the RDT kit used (Care start™ malaria Pf (HRP2) Ag RDT) were 98% and 97.5% respectively. This study recorded high prevalence of malaria parasitaemia among pregnant women and children (63 (84.0%) Microscopy and 41 (54.7%) RDTs technique and 58 (77.3%) Microscopy and 26 (34.7%) RDTs technique respectively), attending General Hospital Lapai, Niger State. Regular environmental sanitation to dislodge mosquitoes from their breeding places will go a long way to reduce prevalence of malaria, and early antenatal booking for effective monitoring and prompt treatment of malaria in pregnancy will contribute significantly in reducing maternal morbidity and mortality, and its perinatal mortality. Routine intermittent preventive treatment of malaria is recommended for pregnant women in this area.

**Keywords:** Malaria, *Plasmodium falciparum,* Rapid Diagnostic Test, Microscopy, Children, Pregnant women.

**INTRODUCTION**
Globally, malaria remains one of the most important infectious diseases affecting human kind in terms of morbidity and mortality (WHO, 2020), and is the second most common cause of infectious disease-related death in the world, after tuberculosis (Kochar *et al.,* 2010). There are five species of human malaria parasite: *Plasmodium falciparum, P. vivax, P.ovale, P. knowlesi* and *P. malariae* which have different world distributions thought overlapping exists (Omang *et al.*, 2020; WHO, 2012). *Plasmodium falciparum*, the deadliest one, is common in West and East Africa, Haiti, the Dominican Republic, part of Amazon (South America), and South East Asia (Menard *et al.*, 2016) including Indonesia. In Africa *Plasmodium falciparum* malaria is a common infectious disease, and arguably the most important parasitic disease in the world, posing a significant public health burden as compared to other World Health Organization (WHO) disease-endemic regions. For instance, Africa contributed to about 93% (213 million of 228 million) and 94% (380,000 of 405,000) of global cases and deaths, respectively in 2018, the majority in children under the age of five years (WHO, 2019; 2020). Of the five parasite species that infect humans, *Plasmodium falciparum*, highly prevalent in Africa, is the most common cause of severe illness (WHO, 2019; 2020). Pregnant women and children under 5 years old are the most affected (WHO, 2013; Anaemene, 2018). In sub-Saharan Africa, it is estimated that 25 to 30 million women are at risk of contracting *Plasmodium falciparum* during pregnancy (Dellicour *et al*., 2016). Falciparum malaria is a multifactorial disease that involves the complex interplay between the host, vector, and the pathogen (Clayton *et al*., 2014; Acharya *et al*., 2017). The host–pathogen interactions have been a driving selective force influencing the genetic architecture of both species, particularly, on how their genes are involved in drug and/or genetic resistance, disease susceptibility, and the infection processes (Luckhart *et al*., 2015; Su *et al.*, 2020). Nigeria suffers the world's greatest malaria burden, with approximately 51 million cases and 207,000 deaths reported annually (approximately 30 % of the total malaria burden in Africa), while 97 % of the total population (approximately 173 million) is at risk of infection (WHO, 2014). Malaria in pregnancy is caused mainly by the specie *P. falciparum,* which is the most common species in Africa (WHO, 2019; 2020). Most cases of malaria in pregnancy in areas of stable malaria transmission are asymptomatic (Skeketee *et al*., 2001). Depending on the endemicity of malaria in an area, it can be expected that 1–50% of pregnant women may carry malaria parasitaemia, especially in the

placenta, without noticing it, which causes maternal anaemia and low birth weight (Staalsoe *et al.,* 2004). This is attributed to anti-disease immunity acquired during previous exposure that protects against clinical malaria (Rogerson *et al.,* 2007). Mosquito (the vector that transmits the malaria parasite) has affinity for pregnant women because pregnancy causes women to release a greater than normal amount of Carbon Dioxide ($CO_2$) which adds to the odoriferous secretions during pregnancy, which attracts mosquitoes, coupled with the increased body surface and increased blood flow in the skin, exposing the pregnant woman to mosquito bite (Tegegne *et al.,* 2019). Also, the accumulation of parasitized red blood cells in the placental vessels triggers an inflammatory process which has been known to cause an immune activation in the placental tissue which would not have occurred in a non-pregnant woman (Omer *et al*., 2017; Goshu *et al.,* 2019). Pregnant women are three times more likely to suffer from severe diseases as a result of malarial infection compared with their non-pregnant counterparts because a woman's immune system is affected during pregnancy making them becomes much more susceptible to developing malaria and have a mortality rate that approaches 50% (WHO, 2006), which at times even lead to the death of the child or right after delivery (Kochar *et al.,* 2010; Muhammad *et al*., 2016). Severe malaria is mainly a disease of the children from the first few months of life to the age of about 5 years, becoming less common in older children and adults (Omang *et al*., 2020). Complicated malaria is more common in children under age 5 with high mortality, and sometimes in pregnant women (a condition specifically called pregnancy-associated malaria) (Okpua and Uduituma, 2018). Children and pregnant women are particularly vulnerable to *Plasmodium falciparum* infection and disease, which translates into significant negative consequences for the health of mothers and infants (Ataide *et al.,* 2014). Clinical diagnosis is based on the patient's signs and symptoms, and the earliest symptoms of malaria are very nonspecific and variable, and include fever, headache, weakness, chills, dizziness, abdominal pain, diarrhoea, nausea, vomiting, anorexia, and pruritus (Looareesuwan *et al.,* 1999; Djabanor *et al.,* 2017). In Nigeria, malaria in pregnant women is a major public health concern because it is the major cause of maternal mortality (Omang *et al*., 2020). Disease is caused by the direct effects of red cell parasitisation and destruction by the asexual parasites and the host reaction to this process resulting into anaemia (Omang *et al*., 2020). Malarial anaemia (reduction in haemoglobulin level) can also become chronic through pathways of persistent inflammation and bone marrow suppression leading to reduced production of erythrocytes (White, 2018; Starck et al., 2021). Since anaemic children have lower oxygen-capacity, they are more susceptible to opportunistic infections, more tired, and less resilient than healthy children (Tusting *et al.,* 2013). These symptoms ultimately add up to a higher risk of cognitive and physical development deficits in anaemic young children (Balarajan et al., 2011; Plessow *et al*., 2015; Yang *et al*. 2018). Malaria is also responsible for 20% of still births and 11% of all maternal deaths by way of spontaneous abortion; placental pathologies, infant mortality and morbidity, intrauterine growth retardation and low birth weight due to premature delivery. Mothers that had febrile malaria in the third trimester are also found to be at increased risk from all infections that threaten children during infancy (Nwonwu *et al.,* 2009; Tegegne *et al.,* 2019). In the laboratory, malaria is diagnosed using different techniques, e.g. conventional microscopic examination of thick and thin peripheral blood smears blood film which is the gold standard and the most widely used method for the diagnosis of malaria and identification of the *Plasmodium* species (WHO, 2019). However, microscopic examination may be combined with other diagnostic methods, such as an immunochromatographic test (ICT) - rapid diagnostic tests, Quantitative Buffy Coat (QBC) examination and nucleic acid detection methods (e.g. loop-mediated isothermal amplification (LAMP) or real-time polymerase chain reaction (rtPCR) (Boonstra *et al.,* 2021). Since the World Health Organization (WHO) recognized the urgent need for new, simple, quick, accurate, and cost-effective diagnostic tests for determining the presence of malaria parasites, to overcome the deficiencies of light microscopy, numerous new malaria-diagnostic techniques have been developed (WHO, 2010). This, in turn, has led to an increase in the use of RDTs for malaria, which are fast and easy to perform, and do not require electricity or specific equipment (Bell *et al.,* 2001). Currently, 86 malaria RDTs are available from 28 different manufacturers (WHO, 2014). Unlike conventional microscopic diagnosis RDTs detect malaria antigen in blood flowing along a membrane containing specific anti-malaria antibodies; they do not require laboratory equipment. Most products target a *P. falciparum*-specific protein, e.g. histidine-rich protein II (HRP-II) or lactate dehydrogenase (LDH). Some tests detect *P. falciparum* specific and pan-specific antigens (aldolase or panmalaria pLDH), and distinguish non- *P. falciparum* infections from mixed malaria infections **(**Cunningham *et al.,* 2019). Although most RDT products are suitable for *P. falciparum* malaria diagnosis, some also claim that they can effectively and rapidly diagnose *P. vivax* malaria (Park *et al.,* 2006). RDTs are not quantitative and elaborate. They thus fail to provide information of possible prognostic importance and are not suitable for detailed investigations on the therapeutic efficacy of antimalarial drugs **(**Incardona *et al*., 2017**).** Epidemiological studies of malaria will provide additional understanding of its disease course, and, eventually, lead to improved management. Therefore this study attempts to diagnose malaria parasite and the prevalence status (*Plasmodium falciparum)* causing *falciparum* malaria among children and pregnant women attending General Hospital Lapai, using mp microscopy technique and RDT method in order to correlate and enhance the precision of malaria diagnosis and to make recommendation that could assist in the reduction or eradication of *falciparum* malaria. The techniques (mp microscopy and RDT) were employed so as to make comparative results after the analysis, comparing the effectiveness of both techniques in the detection of malaria parasite.

## MATERIALS AND METHODS

**Study area:** A cross-sectional hospital-based study was carried out at General Hospital Lapai, Niger state, Nigeria. Lapai local government area is one of the local government areas in Niger state, Nigeria with its administrative headquarters situated in the town of Lapai (Fig. 1), **within longitude 9.0453$^0$N and latitude 6.5703$^0$E.**

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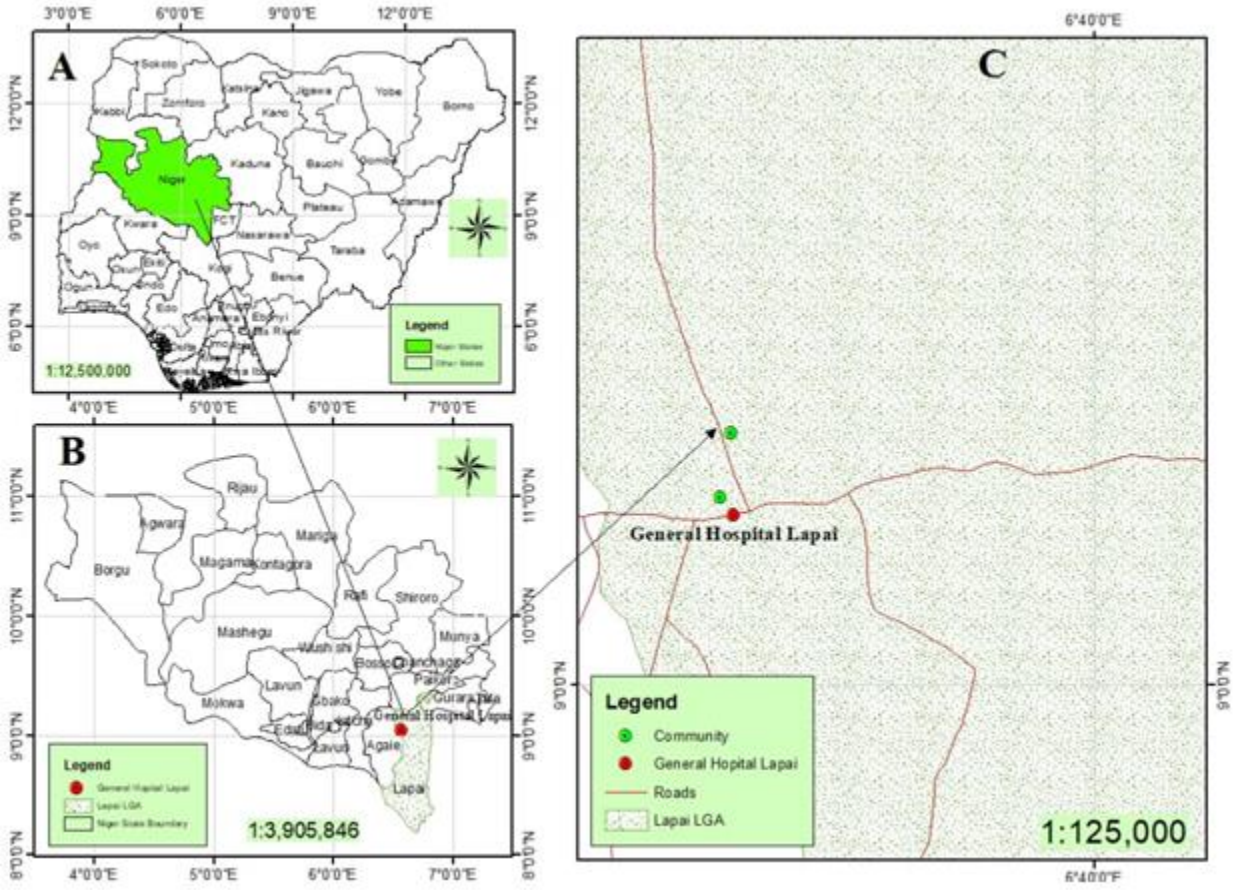


**Figure 1:** Map of Nigeria showing Niger state (A) and Lapai Local government (B) indicating General Hospital Lapai Niger state (C).
**Source:** Adapted from Minna Street Map, 2014

**Study population:** A total of 150 human blood samples (75 pregnant women and 75 children) were investigated for malaria parasites infection. Samples were collected from children of age ranging from 0 to <5 years of age and pregnant women who are clinically diagnosed for malaria so as to determine the prevalence status of *falciparum* malaria among children and pregnant women attending General Hospital Lapai, Niger state.

**Administration of Questionnaire:** Prior to the collection of blood samples, a self-administered questionnaire was prepared and given to each participant. The participation was voluntary. The participants were interviewed using a well-structured and pre-test questionnaire so as to obtain a basic socio-demographic information about the study population, and the information or data about young children of age between 0 to <5years were collected from their guardians or family members such as parents or siblings. The questionnaire contains information such as patient's sample number, gender, age, place of domicile, educational status etc.

**Ethical approval:** Ethical approval was obtained from the General Hospital Management Board Lapai, and the consent of patient's participation was obtained through the consent of the patient's guardian or the patient's themselves.

**Inclusion criteria**
1. All children and pregnant women who are clinically diagnosed for MP test.
2. Patients who are willing to participate in the research study.
3. Patients attending General Hospital Lapai only were included.

**Exclusion criteria**
1. Patients who refuse to participate in the research study.
2. Patients attending outside General Hospital Lapai were excluded.

## METHODOLOGY

**Collection of sample**
Two to five millilitres of blood samples were aseptically collected by venipuncture into EDTA bottle to prevent the clotting of the blood sample. The samples were collected adhering to the standard method of using sterile syringe, tourniquet, and EDTA bottle container during the blood sample collection.

**Sample processing and Test procedures**

**Microscopy method (Gold Standard)**
For each of the samples collected, a thick and a thin film were made. A thin film was prepared by placing a drop of blood in the centre of a microscope glass slide and using the corner of a clean

slide to spread the blood to cover an area of about 10 $mm^2$ (Cheesbrough *et al.,* 2000). The slides were labeled using the respective patient numbers assigned at the laboratory. The slides were air dried and stained with 5% Giemsa's solution for 20 minutes; this was carried out for identification and Quantitation of asexual *P. falciparum* species. The slides were then rinsed under mild running tap water and allowed to air-dry. For the Thick film, a small drop of blood was placed at the centre of the grease free slide and spread with the edge of another slide in a repeated coil shaped to a diameter approximately 2 cm. The slides were labeled and left horizontally while drying and were kept well to prevent them from dust and damage. It was stained using 5% Giemsa stain for 20 minutes. Both thin and thick films were observed microscopically under x100 oil objective lens and results were recorded (Cheesbrough *et al.,* 2000)

**MP Rapid Diagnostic Test (RDT)**

A rapid lateral flow immune-chromatographic *in vitro* antigen detection test kit (Care start™ Access Bio Inc, USA) for detecting malaria *P. falciparum* infection was used to detect malaria HRP2 Pf (Histidine rich protein 2 *Plasmodium falciparum*) in patient's blood samples according to the manufacturer's instructions. About 5 µl of blood sample was collected using a micro-pipette provided, the whole blood was added into the "S" well and 60 µl assay buffer solution added to the "A" well and result was read after 20 minutes. The diagnostic sensitivity and specificity were determined according to World Health Organization standard, positive and negative predictive values were performed according to Manufacturer's recommendation. Sensitivity refers to the test's ability to correctly detect patients who have malaria and specificity relates to the test's ability to correctly detect patients without malaria (WHO, 1998).

**Test interpretation**

1. The presence of one coloured band (control line ''C'') within the result window indicates a **negative result.**
2. The presence of two coloured band (test line ''P.F and control line ''C'') within the result window, regardless of which band appears first, indicates a **positive result**.
3. If both lines fail to appear, it indicates an **invalid test** and the test were repeated using a new test kit.

**Statistical analysis**

Statistical analysis was performed using SPSS software (SPSS Inc., Chicago, IL, USA, version 16.0) and double checked before analysis. Data were checked for normality, and the Student t-test and analysis of variance were used for normally distributed data to compare between two or more than two groups, respectively. Proportions were compared by $\chi^2$-test. P-values <0.05 were considered significant.

**RESULTS**

Comparative analysis of all the samples collected between the two different methods used was made. Out of the 75 samples collected from children under the age of 5 years, microscopic examination resulted in 58 (77.3%) malaria positive cases while RDT kit techniques reported 26 (34.7%) malaria positive cases. And out of the 75 samples collected from pregnant women of age range from 16-45 years, microscopic examination resulted in 63 (84.0%) malaria positive cases while RDT kit techniques reported 52 (54.7%) malaria positive cases. All previously diagnosed malaria cases were confirmed and species determined by the modified staining technique. Traditionally, the stained thick blood films allow only the screening of films for the presence or absence of parasite in the specimen.

**Table 4.1** and **4.2** gives a tabular socio-demographic prevalence interpretation of children under the age of five years that were subjected to both Diagnostic methods (Microscopic and RDTs). For microscopy; children under the age ranges gives a P. value of 0.576 (no significance difference), while RDTs gives a P. value of 0.129 (no significance difference).

**Table 4.3** and **4.4** gives a tabular socio-demographic prevalence interpretation of pregnant women between the age of 16-40, that were subjected to both Diagnostic methods (Microscopic and RDTs). For microscopy; pregnant women in age ranges gives a P. value of 0.01 (there is significance difference), while RDTs gives a P. value of 0.02 (there is significance difference)

**Table 4.1**: Prevalence and socio-demographic distributions of malaria infection among children according to age, sex, and use of ITNs, using Microscopic technique

| Socio-demographic Features | No. Examined | No. positive using Microscopy | Prevalence (%) | Chi-square ($X^2$) | Df (n-1) | P. value |
|---|---|---|---|---|---|---|
| • **Age in years** | | | | | | |
| ≤1 | 32 | 23 | 71.9 | | | |
| 2-3 | 24 | 19 | 79.2 | **1.103** | **2** | **0.576** |
| 4-<5 | 19 | 16 | 84.2 | | | |
| **Total** | **75** | **58** | **77.3** | | | |
| • **Sex** | | | | | | |
| Male | 29 | 23 | 79.3 | | | |
| Female | 46 | 35 | 76.1 | **0.105** | **1** | **0.105** |
| **Total** | **75** | **58** | **77.3** | | | |
| • **Usage of ITNs** | | | | | | |
| Yes | 53 | 39 | 73.6 | | | |
| No | 22 | 19 | 86.4 | **0.377** | **1** | **0.539** |
| **Total** | **75** | **58** | **77.3** | | | |

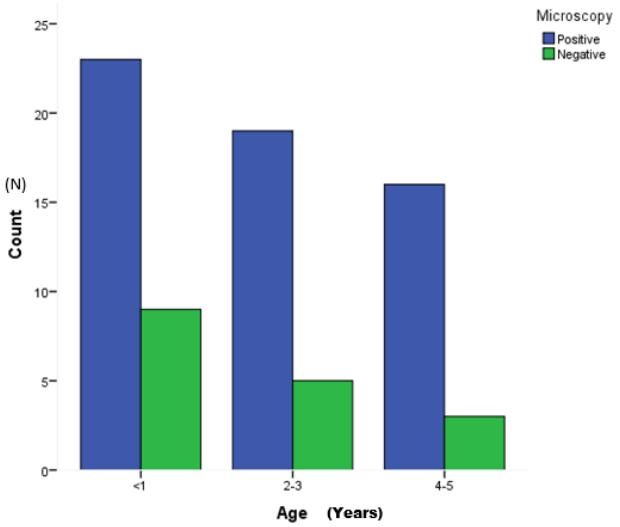


**Figure 2**: prevalence of malaria infection by age among children using Microscopic technique

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**Table 4.2**: Prevalence and socio-demographic distributions of malaria among children according to age, sex, and use of ITNs, using RDTs

| Socio-demographic Features | Number Examined | No. positive using RDT | Prevalence (%) | Chi-square ($X^2$) | Df (n-1) | P. Value |
|---|---|---|---|---|---|---|
| • **Age in years** | | | | | | |
| ≤1 | 32 | 7 | 21.9 | | | |
| 2-3 | 24 | 11 | 45.8 | **4.097** | **2** | **0.129** |
| 4-<5 | 19 | 8 | 42.1 | | | |
| **Total** | **75** | **26** | **34.7** | | | |
| • **Sex** | | | | | | |
| Male | 29 | 12 | 41.4 | | | |
| Female | 46 | 17 | 30.4 | **2.314** | **1** | **0.128** |
| **Total** | **75** | **26** | **34.7** | | | |
| • **Usage of ITNs** | | | | | | |
| Yes | 53 | 16 | 30.2 | | | |
| No | 22 | 10 | 45.5 | **0.040** | **1** | **0.842** |
| **Total** | **75** | **26** | **34.7** | | | |

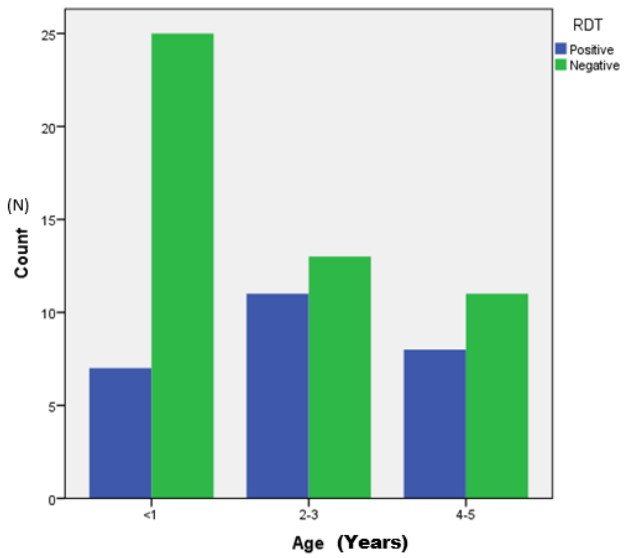


**Figure 3**: prevalence of malaria infection by age among children using RDTs technique

**Table 4.3**: Prevalence and socio-demographic distributions of malaria infection among pregnant women according to age, sex, educational status, and use of ITNs, using Microscopic technique

| Socio-demographic Features | No. Examined | No. positive using Microscopy | Prevalence (%) | Chi-square ($X^2$) | Df (n-1) | P. value |
|---|---|---|---|---|---|---|
| • **Age in years** | | | | | | |
| 16-20 | 5 | 3 | 60.0 | | | |
| 21-25 | 24 | 23 | 95.8 | | | |
| 26-30 | 16 | 14 | 87.5 | | | |
| 31-35 | 19 | 17 | 89.5 | **14.979** | **5** | **0.010** |
| 36-40 | 7 | 4 | 57.1 | | | |
| 41-45 | 4 | 2 | 50.0 | | | |
| **Total** | **75** | **63** | **84.0** | | | |
| • **Sex** | | | | | | |
| Female | 75 | 63 | 84.0 | | **0** | |
| **Total** | **75** | **63** | **84.0** | | | |
| • **Educational status** | | | | | | |
| None | 11 | 9 | 81.8 | | | |
| Primary | 38 | 35 | 92.1 | | | |
| Secondary | 14 | 11 | 78.6 | **13.859** | **3** | **0.003** |
| Tertiary | 12 | 8 | 66.7 | | | |
| **Total** | **75** | **63** | **84.0** | | | |
| • **Usage of ITNs** | | | | | | |
| Yes | 12 | 10 | 83.3 | | | |
| No | 63 | 53 | 84.1 | **0.586** | **1** | **0.444** |
| **Total** | **75** | **63** | **84.0** | | | |

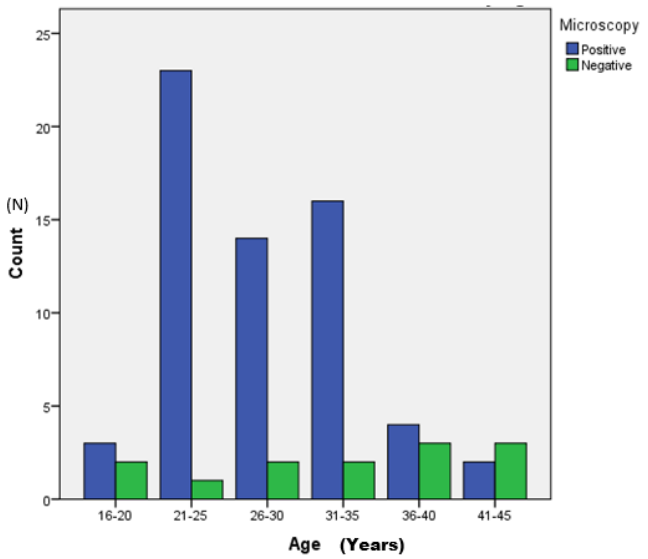


**Figure 4**: prevalence of malaria infection by age among pregnant women using Microscopic technique

**Table 4.4**: Prevalence and socio-demographic distributions of malaria among pregnant women according to age, sex, education status, and use of ITNs, using RDTs technique

| Socio-demographic Features | Number examined | No. positive using RDT | Prevalence (%) | Chi-square ($X^2$) | Df (n-1) | P. Value |
|---|---|---|---|---|---|---|
| • **Age in years** | | | | | | |
| 16-20 | 5 | 1 | 20.0 | | | |
| 21-25 | 24 | 16 | 66.7 | | | |
| 26-30 | 16 | 10 | 62.5 | | | |
| 31-35 | 19 | 12 | 63.2 | **13.214** | **5** | **0.021** |
| 36-40 | 7 | 2 | 28.6 | | | |
| 41-45 | 4 | 0 | 0.0 | | | |
| **Total** | **75** | **41** | **54.7** | | | |
| • **Sex** | | | | | | |
| Female | 75 | 41 | 54.7 | | **0** | |
| **Total** | **75** | **41** | **54.7** | | | |
| • **Educational status** | | | | | | |
| None | 11 | 9 | 81.8 | | | |
| Primary | 38 | 17 | 44.7 | | | |
| Secondary | 14 | 6 | 42.9 | **8.489** | **3** | **0.037** |
| Tertiary | 12 | 9 | 75.0 | | | |
| **Total** | **75** | **41** | **54.7** | | | |
| • **Usage of ITNs** | | | | | | |
| Yes | 12 | 3 | 25.0 | | | |
| No | 63 | 38 | 60.3 | **0.830** | **1** | **0.362** |
| **Total** | **75** | **41** | **54.7** | | | |

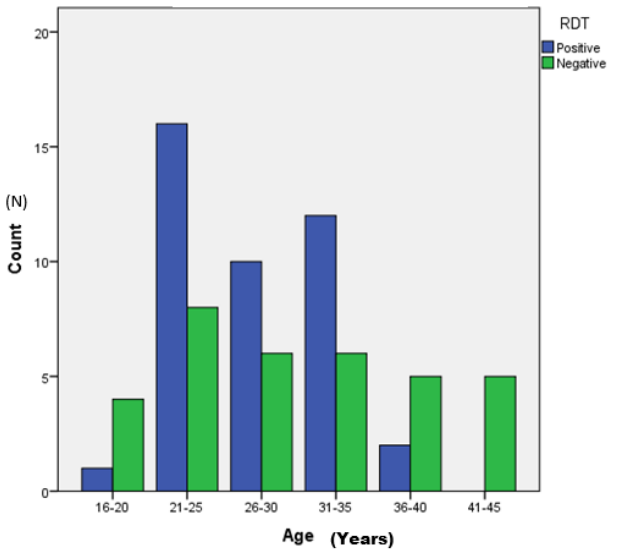


**Figure 5**: prevalence of malaria infection by age among pregnant women using RDTs technique

**DISCUSSION**

There are two basic diagnostic methods for malaria; these are microscopy, and antigen testing methods (RDT). In this study, the prevalence of *Plasmodium falciparum* employing Microscopy and Rapid Diagnosis Test (RDT) (Histidine Rich Protein-2; HRP) was evaluated. Prevalence of (77.3% -mp microscopy; 34.7% -RDT) malaria was observed among all the age groups for children and (84.0% -mp microscopy; 54.7% -RDT) prevalence for pregnant women in this study; this could be as a result of holo-endemic malaria among Nigerians. However, children of lower age group (< 1) had a prevalence of 71.9% by microscopy and 21.9% by RDT out of the total 75 subjects screened. The sensitivity and specificity of the RDT kit used (Care start™ malaria Pf (HRP2) Ag RDT) were 98% and 97.5% respectively. This might be attributed to their low/no immunity to infections at that age. The high prevalence of *Plasmodium falciparum* among children in this study is similar to the studies conducted by Ofovwe and Eregie (2001) in Benin city in Nigeria, where high prevalence of severe falciparum malaria in children aged 6 month to 5 years were discovered and Coldiron *et al.* (2021) where parasite density was highest among children aged 3–59 months, whose parasite densities were significantly higher than those aged 5–9 years in Niger Republic. Children are known to be parasitaemic than adults and that younger children who are infected are more likely to have higher parasite burdens and there were no differences in the prevalence of parasitaemia between males and females. Nwonwu *et al*. (2009) asserted another reason for the high prevalence that, there is slow acquisition of active immunity to malaria; this could be the reason why subjects of lower age groups were more susceptible to malaria in this study. Female subjects showed a lower prevalence compared to males in this study. The reason for these differences cannot be empirically traced to any reason in particular, it may have occurred by chance. Gilles and Warell (1993) however reported that there is no scientific evidence that susceptibility to malaria is gender based. The socio-economic status might have also played a role in the observed prevalence common to the different occupation. All occupational groups were observed to be predisposed to malaria infections and had a prevalence of (56.3% by microscopy and 36.9% by RDT). Onah and Omudu (2016) reported that there is no relationship between occupation and prevalence of malaria; this is in contrast to other studies conducted in Akure and Ogun states, Nigeria (Olasehinde *et al.,* 2010), where the parasite species were determined by examination of thin blood films only. However, in the mp microscopy technique, distinct staining of malaria parasite and malarial pigment and clear background allowed determination of parasite species even in the thick blood films. Pregnancies in women living in malaria endemic regions, particularly in sub–Saharan Africa are associated with a high frequency and density of *Plasmodium falciparum* parasitaemia, with high rates of maternal morbidity (Mkandala, 2003). *P. falciparum* being the only species found in this study is in line with study of Barboza *et al.* (2017) which showed that *P. falciparum* is the most dominant species in pregnancy. In highly endemic malarious area where semi-immune adults usually have substantially acquired resistance to local strains of Plasmodia, the prevalence of clinical malaria is higher and its severity greater in pregnant women than in non-pregnant women (Okwa, 2003). Younger women appeared to be susceptible to malaria in this study as prevalence was highest among age group 21-25 (95.8%) for microscopy and (66.7%) for RDTs. This contradicted the findings of Adefioye *et al.* (2007) that found 36-39 year old group to be more susceptible, but agreed with the findings of Dicko *et al.* (2003) who opined that adolescents and young adult pregnant women were more susceptible to malaria than older pregnant women, because of continuous development of malaria immunity in older women. Community knowledge and attitudes to diagnosis demonstrate the importance of providing patients with a reliable explanation for their illness. This improves treatment-seeking behaviour and compliance. It was impressive to discover that knowledge about signs and symptoms of malaria is relatively high in this study with most respondents indicating awareness of key symptoms including fever, headache, chills, weakness, and joint/body pains. This is in line with the observations of most studies in endemic settings (Oreagba *et al.,* 2004; Adedotun *et al.,* 2010).

Federal Ministry of Health (FMOH) survey assumed that the households had good knowledge of the symptoms of malaria if they mentioned at least fever plus headache or other pain but poor knowledge if they mentioned fever plus general weaknesses or dizziness. In this study, majority of the patients had good knowledge of the symptoms of malaria. This was also seen in study of Oreagba *et al.,* (2004) at urban Ado-Odo in Ogun-State, Nigeria, where majority of households were considered to have good knowledge of the symptoms of malaria. Nevertheless according to Bell *et al.* (2001), observation of fever alone, and of fever in combination with chills and or headache, achieved quite high sensitivities, but both criteria resulted in high rates of overtreatment and, any narrower combination of symptoms resulted in sensitivities unacceptable in relation to the detection of a life-threatening illness. Malaria Rapid Diagnostic Tests (RDTs) have been recommended to improve diagnostic efficiency, which is important for preventing indiscriminate use of Artemisinin-Based Combination Therapy (ACT), thereby preventing or delaying the development of parasite resistance to this new first-line drug (Msellem *et al.,* 2009). RDTs can be used as a stop-gap when microscopy services are not operating or as a primary diagnostic tool for rural/remote areas without microscopy services however, RDTs result can be sometimes misleading because RDTs occasionally give false negative results if symptoms consistent with severe malaria are present (Ibeneme *et al*., 2017; Incardona *et al*., 2017). Microscopy is considered the standard gold test for malaria diagnosis because it differentiate between the species as many RDTs cannot do, it can equally provide detailed information about stages present which RDTs cannot do.

**Conclusion and Recommendation**

This study revealed high prevalence of malaria parasitaemia among pregnant women and children attending General Hospital Lapai, Niger State. Regular environmental sanitation to dislodge mosquitoes from their breeding places will go a long way to reduce prevalence of malaria in villages and towns commonly seen in the tropics. Also, early antenatal booking for effective monitoring and prompt treatment of malaria in pregnancy will contribute significantly in reducing maternal morbidity and mortality, and its perinatal mortality. Routine intermittent preventive treatment of malaria is recommended for pregnant women in this area, and regular use of insecticide treated nets. The comparative analysis of RDTs and Microscopy techniques in the determination of prevalence and diagnosis of malaria (*P. falciparum*) among children and pregnant women in this study clearly showed that Malaria microscopy is still a part of good clinical practices; it should always be a part of malaria case management because species identification and confirmation were demonstrated and this will help in improving surveillance in public health practices. Whereas the sensitivity of RDTs at level of parasitaemia compared to stained blood film microscopy was inadequate/poor. Therefore negative RDTs should always be microscopically confirmed. New technologies should be improved on in order to develop new tools that are comparable to Microscopy (gold standard). Malaria microscopy has a limitations of been laborious, overwhelming in poor power setting, time consuming requiring a lot of expertise and training. Many other diseases have symptoms similar to malaria, and symptomatic diagnosis alone may be misleading and even harmful to patient management. Therefore, symptomatic disease should be monitored using both methods.

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