**Prevalence of Malaria Among Pregnant Women Attending Antenatal Clinic in Primary Health Care Center Rumuodumanya, Rivers State, Nigeria**

**Abstract**

This study investigated the prevalence of malaria infection among pregnant women attending antenatal clinics at Primary Health Care Center Rumuodumanya in Port Harcourt, Nigeria. Using standard parasitological methods, blood samples from 302 participants were analyzed through microscopic examination of Giemsa-stained thick and thin blood films. Results revealed an overall malaria prevalence of 26.49% (80/302), with significant variations across trimesters and age groups. First-trimester pregnancies showed the highest infection rate (32.03%), followed by third (27.45%) and second trimesters (15.28%). Age-specific analysis demonstrated striking differences, with the highest prevalence among women ≥40 years (100%, 3/3) and those <20 years (81.82%, 9/11), compared to 21.05% (40/190) in 20-30-year-olds and 28.57% (28/98) in 31-40-year-olds. The relatively low overall prevalence suggests that participants' knowledge of malaria prevention measures, including proper use of insecticide-treated nets and environmental management, may be contributing to reduced transmission. These findings underscore the importance of maintaining and strengthening malaria education programs alongside routine antenatal care services to further mitigate infection risks in this vulnerable population.

**Keywords**: Malaria Parasite, *Plasmodium,* Pregnancy, Antenatal clinic, Gestational age.

1. **Introduction**

 Malaria is a parasitic disease caused by protozoans of the genus Plasmodium, transmitted through the bite of infected female Anopheles mosquitoes. The clinical severity of malaria varies depending on the infecting Plasmodium species. Following inoculation, the parasites undergo hepatic replication before invading and subsequently lysing erythrocytes. Malaria in pregnancy constitutes a major public health challenge, particularly in tropical and subtropical regions, where transmission rates remain high (WHO, 2010). In sub-Saharan Africa, Plasmodium falciparum is the predominant etiological agent of malaria in pregnant women (WHO, 2010). The clinical manifestations of malaria during pregnancy are influenced by both parasite load and the host’s acquired immunity (Perlmann & Troye-Blomberg, 2000).

 Pregnant women and their fetuses are particularly vulnerable to malaria-associated complications, including maternal anemia, intrauterine growth restriction, low birth weight, and increased prenatal mortality. This heightened susceptibility is partly attributed to pregnancy-induced immunological modulation, which diminishes anti-malarial defenses (Fievet et al., 1997). The burden of malaria varies across different regions of the world and even within a country (O'Meara et al., 2010). Nigeria bears a substantial burden of malaria, accounting for approximately 25% of all cases reported in the World Health Organization (WHO) African Region (WHO, 2010). According to the Nigerian National Malaria Control Programme (NMCP), suspected malaria cases surged from 3.0 million in 2000 to 4.3 million in 2009, reflecting a 42% increase (WHO, 2010).

 This study aims to determine the prevalence of malaria infection among pregnant women attending the antenatal clinic at the Primary Health Care Center in Rumuodumanya, Obio-Akpor Local Government Area (LGA), Rivers State, Nigeria. The findings will provide critical epidemiological data to inform targeted malaria control strategies within the region.

Previous studies have documented varying malaria prevalence rates among pregnant women in Nigeria. Umeh et al. (2017) conducted a comparative analysis of malaria parasitemia in pregnant and non-pregnant women attending antenatal clinics in Owerri, Southeastern Nigeria. Peripheral blood samples from 292 pregnant women and 58 non-pregnant controls were examined via microscopy. The results revealed a significantly higher prevalence of P. falciparum infection in pregnant women (69.5%) compared to non-pregnant women (20.7%) (P < 0.05), underscoring the increased susceptibility during gestation.

 Similarly, Nzeako et al. (2013) investigated malaria prevalence among pregnant women in Aluu, Obio-Akpor LGA, Rivers State. Of the 80 participants screened, 72.5% tested positive for malaria, with P. falciparum (63.5%) being the predominant species, followed by P. vivax (18.9%), P. malariae (15.5%), and P. ovale (1.7%). No statistically significant difference (\*p\* > 0.05) was observed between primigravid (58.6%) and multigravid (41.3%) women, suggesting that pregnancy-associated immune suppression, rather than gravidity alone, influences infection rates. The study further highlighted the role of health education in malaria prevention during pregnancy.

 A comparative study by Amala et al. (2017) assessed malaria prevalence in urban and rural settings in Rivers State, involving 400 pregnant women (200 from each setting) and 100 non-pregnant controls. The prevalence was significantly higher in the rural cohort (Bori General Hospital: 35%) than in the urban cohort (Braithwaite Memorial Specialist Hospital, now Rivers State University Teaching Hospital: 27.5%), with non-pregnant women exhibiting a 15% prevalence rate. These findings suggest that geographical and socioeconomic factors may influence malaria transmission dynamics.

 Shaibu et al. (2019) evaluated malaria prevalence and awareness among pregnant women attending Ahmadu Bello University Medical Centre (ABUMC) in Zaria, Kaduna State. Among 100 participants, the overall prevalence was 60%, with the highest infection rates observed in adolescents (<15 years; 100%), women with hemoglobin genotype AA (65.7%), unemployed individuals (60.5%), those with secondary education (68.4%), and first-trimester pregnancies (70%). No significant age-dependent variation was detected (χ² = 6.403, \*p\* = 0.380), indicating uniform exposure risk across age groups.

 Over 200 million cases of malaria occur each year, 90% of which occur in Africa, and 655,000 people died from the disease in 2010, making it one of the world's most important health problems (Mawson, 2013).

1. **Materials and Methods**
	1. **Study Area**

 This research was carried out at the Primary Health Care Center in Rumuodumanya, located in Obio-Akpor Local Government Area of Rivers State, Nigeria. The exact geographical coordinates of the study location are Latitude 4.8340° N and Longitude 7.0334° E (see Figure 1 for reference). Obio-Akpor LGA forms part of Port Harcourt, the bustling capital city of Rivers State, with the local population primarily belonging to the Ikwerre ethnic group. The area experiences typical tropical weather conditions, maintaining consistently warm temperatures throughout the year that typically range between 25°C and 28°C. The climate remains relatively stable with high humidity levels, characteristic of the Niger Delta region. This urban setting, combined with its dense population and numerous water bodies in the surrounding environment, creates ideal breeding grounds for mosquitoes, particularly the Anopheles species known to transmit malaria. These environmental and demographic factors contribute to making malaria transmission a persistent public health concern in the area.



**Fig 1.** Map of Obio-Akpor LGA, Rivers State, Nigeria. **Source:** Rivers State ministry of land survey.

**2.2 Study Population**

 The study included 302 pregnant women attending antenatal care at the Primary Health Center in Rumuodumanya. Participants were randomly selected without screening for pre-existing medical conditions to ensure a representative sample of the clinic population. The age range of participants spanned from 18 to 45 years, encompassing women of reproductive age across different stages of pregnancy.

**2.3 Sample Collection:**

 Venous blood samples (2 mL each) were aseptically collected from 302 randomly selected pregnant women attending the antenatal clinic at Primary Health Center Rumuodumanya. Using standard phlebotomy procedures, blood was drawn and immediately transferred into EDTA (ethylene diamine tetraacetic acid) anticoagulant tubes. Each sample was gently inverted several times to ensure proper mixing with the anticoagulant and prevent coagulation. Following collection, the samples were promptly transported in a cool box to the Parasitology Laboratory in the Department of Animal and Environmental Biology at the University of Port Harcourt for diagnostic analysis. Strict cold chain maintenance was observed during transportation to preserve sample integrity. All procedures were performed under sterile conditions to minimize contamination risks and ensure reliable test results.

**2.4 Preparation of Thick and Thin Film**:

 Blood films were prepared according to standard parasitological techniques (Cheesbrough, 2010) with modifications following WHO (2002) guidelines. For thick film preparation, two drops of blood were carefully placed on a clean, grease-free slide using a sterile rubber pipette. Using the corner of a second slide, the blood was gently mixed in a circular motion for 20 seconds to achieve both defibrination and an even, round smear approximately 1 cm in diameter. The prepared thick films were air-dried completely before staining. For thin films, a single drop of blood was placed near one end of a clean slide, and a spreader slide held at a 45° angle was used to create a monolayer smear. The thin films were immediately fixed with absolute methanol for 10 seconds to preserve cellular morphology.

 Both film types were stained using Giemsa solution (pH 7.2) prepared in phosphate-buffered water at different concentrations: thick films at 1:20 dilution for 30-40 minutes and thin films at 1:10 dilution for 30 minutes. Following staining, slides were rinsed gently with buffered water and air-dried vertically. Microscopic examination was performed using a light microscope with 100× oil immersion objective. Thick films were used for parasite density quantification, while thin films enabled species identification through morphological characterization of parasites within erythrocytes. Quality control measures included examination of at least 100 high-power fields before declaring a slide negative and cross-checking species identification between two experienced microscopists for discordant results.

 **2.5 Data Analysis**:

 The collected data were analyzed using appropriate statistical methods. Descriptive statistics, including measures of central tendency (mean, median, and mode) and dispersion (standard deviation), were calculated to summarize the data distribution. For comparative analysis between categorical variables, the Chi-square (χ²) test was employed to determine statistical significance, with a p-value threshold of <0.05 considered significant. All statistical computations were performed using SPSS version 25 (IBM Corp., Armonk, NY, USA), ensuring robust and reliable analysis of the malaria prevalence data among the study population

1. **Result**

 The study screened a total of 302 pregnant women for malaria parasite infection through microscopic examination of blood films. Laboratory analysis revealed that 80 participants tested positive for Plasmodium parasites, yielding an overall prevalence rate of 26.49% (80/302). The detailed distribution of malaria-positive cases is presented in Table 1, which includes breakdowns by demographic and clinical characteristics.

 **Table 1:** Prevalence of Malaria Amongst the Pregnant Women

|  |  |  |  |
| --- | --- | --- | --- |
| **Variables** | **Total Population** | **Positive Cases** | **Prevalence** |
| **Total** | 302 | 80 | 26.49 |

 Table 2 presents the age distribution of malaria infection among study participants. The results demonstrate a distinct age-related pattern, with the highest infection rate (100%) observed in women aged ≥41 years. Adolescents (<20 years) showed the second highest prevalence at 81.82%. In contrast, women aged 20-30 years exhibited the lowest infection rate at 21.05%. These findings suggest a U-shaped relationship between maternal age and malaria susceptibility in our study population.

**Table 2:** Prevalence of Malaria Amongst the Study Participants According to Their Ages

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Age** | **Total No** | **Total Negative** | **Total Positive** | **Prevalence (%)** |
| < 20 | 11 | 2 | 9 | 81.82 |
|  20-30 | 190 | 150 | 40 | 21.05 |
| 31-40 | 98 | 70 | 28 | 28.57 |
|  > 41 | 3 | 0 | 3 | 100 |
| **Total** | 302 | 222 | 80 | 26.49 |

 The analysis revealed significant variations in malaria prevalence according to gestational age (Table 3). Pregnant women in their first trimester demonstrated the highest infection rate (32.03%), while those in the second trimester showed the lowest prevalence (15.28%). These findings suggest that malaria susceptibility may vary across different stages of pregnancy, with the first trimester appearing particularly vulnerable to Plasmodium infection.

**Table 3.** Prevalence of Malaria Amongst the Study Participants According to Gestational Ages

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Gestational Age** | **Total Number** | **Total Negative** | **No Positive** | **Prevalence** |
| 1st Trimester | 128 | 87 | 41 | 32.03 |
| 2nd Trimester | 72 | 61 | 11 | 15.28 |
| 3rd Trimester | 102 | 74 | 28 | 27.45 |
| **Total** | 302 | 222 | 80 | 26.49 |

 The chi-square test of association revealed a statistically significant relationship between maternal age groups and malaria infection status (χ² = 28.741, df = 3, p < 0.001). This strong association (p < 0.0001) indicates that the observed age-specific prevalence differences were highly unlikely to have occurred by chance alone. The complete contingency table and test details are provided in Appendix I.

1. **Discussion**

 The prevalence of malaria among pregnant women in this study was 26.49% (80/302), consistent with patterns observed in malaria-endemic regions of sub-Saharan Africa, where pregnancy increases susceptibility to Plasmodium falciparum infection and associated complications. The exclusive detection of P.falciparum aligns with previous studies in similar settings, confirming its dominance as the primary causative agent of malaria in pregnancy. This finding reflects the stable transmission dynamics in endemic areas, where partial immunity in adults is often compromised during pregnancy due to immunological changes, the observed prevalence, though significant, was relatively lower than expected, which may be attributed to several factors, including increased utilization of preventive measures such as long-lasting insecticide-treated nets (LLINs) and intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP). Additionally, this study was conducted during the dry season, when mosquito activity and malaria transmission are typically reduced compared to the rainy season.

            Age-specific analysis revealed that women aged 40 years and above had the highest infection rate (100%), a finding partially consistent with some previous studies but contrary to others, peak prevalence in younger or older age groups. These discrepancies may stem from variations in study populations, regional transmission intensity, or differences in sampling methodologies. Regarding gestational age, women in their first trimester exhibited the highest malaria prevalence (32.03%), followed by those in the third (27.45%) and second trimesters (15.28%). While physiological factors explain higher first-trimester susceptibility, the inconsistent patterns across studies underscore how programmatic variables, including ANC attendance rates and ITN distribution timelines, can significantly modify malaria risk trajectories in pregnancy.

            The findings underscore the persistent burden of malaria in pregnancy, despite ongoing control efforts. The variations in prevalence across age groups and trimesters highlight the need for targeted interventions, particularly for high-risk subgroups such as first-trimester pregnancies and younger women. While the moderate prevalence in this study suggests some success of existing prevention programs, the significant infection rate indicates room for improvement, possibly through enhanced health education, distributing LLIN, and stricter adherence to IPTp-SP guidelines. Further research is warranted to investigate the factors driving the observed epidemiological patterns and to optimize intervention strategies in similar settings.

1. **Conclusion**

 This study demonstrates a relatively low malaria prevalence (26.49%) among pregnant women in Rivers State, showing partial effectiveness of current control measures, likely due to participants' good knowledge of prevention methods, including insecticide-treated net (ITN) use and environmental sanitation. The findings highlight the dual importance of early antenatal care enrollment for prompt malaria management and consistent implementation of WHO-recommended intermittent preventive treatment in pregnancy (IPTp-SP), which together can significantly reduce maternal morbidity, perinatal mortality, and adverse fetal outcomes by minimizing placental malaria. To sustain and improve these results, targeted health education should reinforce proper ITN usage and IPTp adherence. At the same time, community-based programs could expand prevention through indoor residual spraying and behavioral change communication, ultimately contributing to malaria elimination goals in Nigeria's endemic regions, as a result of enhanced health service integration.

**Ethical Approval and Consent**

 Prior to study commencement, ethical approval was obtained through official channels from the Department of Animal and Environmental Biology at the University of Port Harcourt. The research team conducted preliminary visits to the health center, presenting the identification letter and study proposal to hospital administration, antenatal care staff, and laboratory personnel. During these engagements, comprehensive explanations were provided regarding the study's objectives, methodology, and potential benefits, with all queries from healthcare providers addressed. The health center management subsequently facilitated awareness sessions to inform pregnant women about the study, ensuring proper understanding before participation. Written informed consent was obtained through a dual-approval system, securing both institutional permission from hospital authorities and individual voluntary consent from each participant. This multilayered ethical review and permission process adhered to established research standards while maintaining transparency with all stakeholders involved in the study.

**COMPETING INTERESTS DISCLAIMER:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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