# Prevalence of Malaria among Prison Inmates in Owerri Municipality, Imo State, Nigeria: Addressing Surveillance Gaps and Proposing Contextual Solutions

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## Abstract

**Background**
Malaria remains a significant public health concern in Nigeria, with incarcerated populations facing heightened vulnerability due to overcrowding, inadequate sanitation, and restricted access to preventive interventions. While malaria prevalence has been investigated in correctional facilities in other regions, data from the Owerri Municipality Correctional Centre, Imo State, are lacking.

**Objective**
This study aimed to determine the prevalence and intensity of malaria infection among inmates of the Owerri Correctional Centre, Imo State, Nigeria.

**Methods**
A cross-sectional survey was conducted from May to October 2024, enrolling 600 inmates. Capillary blood samples were obtained via finger prick, and both thick and thin blood smears were prepared on clean, grease-free glass slides. Microscopic examination was performed to detect and quantify Plasmodium species. Prevalence was calculated overall and by demographic subgroup, and infection intensity was classified as light, moderate, or heavy based on parasite density.

**Results**
The overall malaria prevalence was 92.3% (554/600). By sex, prevalence was 92.5% (370/400) in males and 92.0% (184/200) in females, with no statistically significant association ($\chi^2 = 0.046$, $p = 0.83$; $OR \approx 1.06$). Age-specific prevalence was highest among inmates aged 28–38 years (95.3%), followed by 17–27 years (94.0%), and lowest in those aged 61–71 years (79.5%). Infection intensity distribution showed 39.2% light, 45.8% moderate, and 15.0% heavy infections.

**Conclusion**
The markedly high malaria prevalence among inmates underscores the combined effects of structural neglect and environmental risk factors within correctional facilities. Targeted interventions—including improved sanitation, consistent provision of preventive tools, regular vector control measures, and urgent prison decongestion are critical to reducing malaria transmission and safeguarding the health of incarcerated populations.

## 1. Introduction

Malaria remains one of the most significant public health challenges in tropical and subtropical regions, with sub-Saharan Africa bearing the heaviest burden. In 2022, there were an estimated 249 million cases and >608,000 deaths globally; Nigeria alone contributed ~27% of cases and ~31% of deaths Malaria No More, 2023; *The Lancet Microbe*, 2024. The disease, caused by *Plasmodium parasites*, is transmitted to humans through bites of infected female *Anopheles* mosquitoes; less common routes include blood transfusion, organ transplantation, needle sharing,

and congenital transmission [1]. Symptoms typically occur 10–15 days after infection and include fever, chills, headache, myalgias/arthralgias, vomiting, and malaise ECDC, 2023; World Vision, 2024. Severe disease can lead to cerebral malaria, anemia, organ failure, and death—especially in young children and pregnant women [1].

Despite gains from artemisinin-based combination therapies (ACTs), long-lasting insecticidal nets (LLINs), intermittent preventive treatment in pregnancy (IPTp), indoor residual spraying (IRS), and expanded financing, malaria remains entrenched in Nigeria (NMEP, 2021–2025; WHO, 2023) [1]. Structural inequities, inconsistent access to care, vector/insecticide resistance, and socio-environmental vulnerabilities complicate control WHO, 2023 [1]. Prison populations often overcrowded poorly ventilated, and with inadequate sanitation and health services are at disproportionate risk PRI, 2025; U.S. Department of State, 2019; WHO Regional Office for Europe, 2014. These conditions foster vector proliferation and amplify transmission of malaria and other communicable diseases. Nigerian correctional facilities are regularly documented as over capacity with unsafe conditions Asylum Research Centre, 2019; PRI, 2025. Yet prison health is routinely excluded from routine surveillance frameworks (WHO Regional Office for Europe, 2014).

Evidence from Nigerian prisons confirms malaria as a leading morbidity (e.g., 73–81% in three South-East federal prisons; Abah et al., 2018), but Owerri Municipality lacks epidemiologic estimates despite qualitative documentation of the Owerri Correctional Centre in prior research Uche et al., 2023[2]. This study therefore assesses malaria prevalence and intensity among inmates in the Owerri Correctional Centre, Imo State, Nigeria, and proposes contextual solutions aligned with national strategy (NMEP, 2021–2025) and WHO guidance (WHO, 2023) [1].

## 2. Materials and Methods
### 2.1 Study Area
This study was conducted at the Owerri Correctional Centre, located along the Okigwe–Owerri Road in Owerri Municipality, Imo State, Nigeria. The facility is centrally positioned within the urban center and surrounded by significant landmarks: it is bounded to the north by Shell Camp Police Barracks, to the south by a Catholic church that provides spiritual support to inmates, to the east by the Imo State Fire Service Headquarters, and to the west by Rockview Hotel, a major hospitality establishment. Established in 1905, the correctional centre was originally designed to accommodate 500 inmates. However, as of the time of study, it housed over 4,500 individuals nine times its intended capacity. This level of overcrowding, combined with poor ventilation, limited sanitation, and inadequate medical services, creates a conducive environment for the transmission of communicable diseases such as malaria.

### 2.2 Study Design
This was a descriptive cross-sectional study carried out between May and October 2024 tdetermine the prevalence and intensity of malaria infection among inmates. The study involved both

laboratory diagnosis and socio-demographic data collection through structured interviews.

### 2.3 Study Population and Sampling Technique
A total of 600 consenting inmates were selected using stratified random sampling to ensure representation across age groups, gender, and duration of incarceration. Inclusion criteria comprised inmates who had resided in the prison for more than two weeks and provided informed consent. Inmates under anti-malarial treatment or with serious medical conditions were excluded to minimize bias.

### 2.4 Sample Collection and Laboratory Analysis
Capillary blood samples were obtained through finger-prick using sterile lancets under aseptic conditions. For each participant, both thick and thin blood smears were prepared on clean, grease-free glass slides. The slides were air-dried and labeled before being transported to the Diagnostic Laboratory of the Department of Microbiology, Imo State University, Owerri. Microscopic examination of the smears was performed after Giemsa staining following WHO standard protocols. The thick smear was used for parasite detection and density estimation, while the thin smear was used for species identification. Parasitemia levels were categorized as light, moderate, or heavy based on the number of parasites per micro liter of blood.

### 2.5 Data Collection Tools
In addition to laboratory data, socio-demographic and environmental data were collected using a pre-tested, interviewer-administered questionnaire. The tool captured information on age, sex, duration of incarceration, use of malaria preventive measures (e.g., insecticide-treated nets), and prior malaria episodes.

### 2.6 Data Analysis
Collected data were coded and analyzed using SPSS version 25.0. Descriptive statistics (frequencies, means, Percentages) were used to summarize socio-demographic variables and malaria prevalence. Associations between variables such as age, sex, and parasitemia levels were assessed using Chi-square test, with significance set at $p < 0.05$.

### 2.7 Ethical Considerations
Ethical approval for the study was obtained from the Imo State Ministry of Health Ethical Review Committee. Permission to conduct the research was also granted by the Nigerian Correctional Service, Imo State Command. Participation was voluntary, and informed consent was obtained from all participants. Confidentiality and anonymity were strictly maintained throughout the study.

## 3. Results
### 3.1 Overall Malaria Prevalence
A total of 600 inmates (400 males, 200 females) were examined for malaria infection (Table 1). The overall prevalence was 80.00% (n = 480). Both males (80.00%, 320/400) and females (80.00%, 160/200) exhibited identical prevalence rates, with 20.00% of each

sex testing negative for malaria as shown in table 1. Microscopic examination revealed varying levels of parasitemia, indicating both moderate and heavy infection intensities among the affected inmates.

A chi-square test showed no statistically significant association between gender and malaria prevalence ($\chi^2 = 0.000$, $p = 1.000$). The odds ratio (OR = 1.00) confirmed equal odds of infection for males and females.

$\chi^2 = 0.000$, $p = 1.000$; Odds ratio = 1.00 (males vs. females) This uniformity in prevalence across sexes suggests that malaria risk within the prison environment is driven primarily by shared environmental and structural factors—such as vector exposure, overcrowding, and inadequate mosquito control—rather than sex-specific differences.

**Table 1: Gender-related prevalence of malaria among prison inmates in Owerri, Nigeria**

| Sex | Number Examined | Number Infected, n (%) | Number Uninfected, n (%) |
|---|---|---|---|
| Male | 400 | 320 (80.00) | 80 (20.00) |
| Female | 200 | 160 (80.00) | 40 (20.00) |
| Total | 600 | 480 (80.00) | 120 (20.00) |

### 3.2 Gender-Specific Prevalence

The gender-stratified analysis of malaria prevalence among the prison population shows a slightly higher burden among male inmates compared with their female counterparts. Males accounted for 47.5% of the total population as infected, while females contributed 21.7%. The proportion of uninfected individuals was correspondingly higher among females (11.7%) than among males (19.2%) as illustrated in figure 1. This pattern aligns with previous research suggesting that behavioral and occupational exposures such as outdoor activities, participation in prison labor or increased mobility within the facility may contribute to heightened malaria transmission risk among men.

Although the observed difference in infection prevalence between males (71.3%) and females (65.0%) was not statistically significant (p > 0.05), the distribution hints at a gender-based differential in exposure or susceptibility. The slightly lower prevalence in females could be influenced by differences in daily routines, potential variations in cell block ventilation or crowding, or even immune modulation related to hormonal factors.
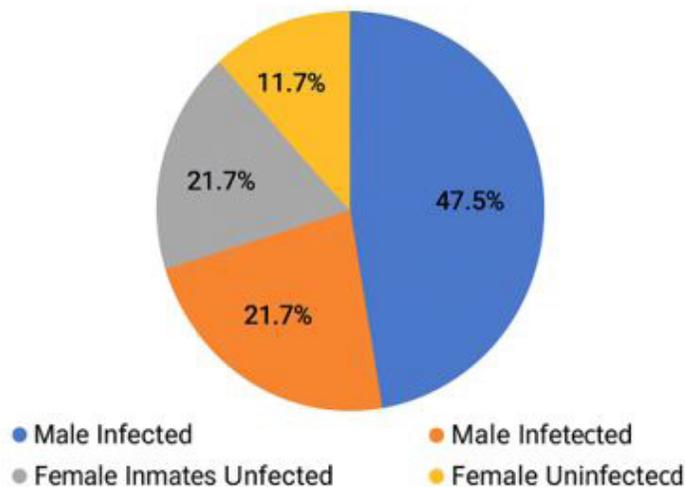


### 3.3 Age-Specific Prevalence

A total of 600 participants were examined, of whom 554 were infected, yielding an overall prevalence of 92.3%. The prevalence was highest among individuals aged 28–38 years (95.3%), followed closely by those aged 17–27 years (93.98%). Infection rates remained high in the 39–49 years (90.12%) and 50–60 years (92.33%) groups. The lowest prevalence occurred in the 61–71-year group (79.5%), which also had the highest proportion of uninfected individuals (20.45%). As shown in table 3.2 below

**Table 2: Age-specific Prevalence of Malaria among Prison Inmates**

| Variables Age group (Years) | Number Examined | Frequency Number infected | Number uninfected | Percentages Infected % | Uninfected % |
|---|---|---|---|---|---|
| 17-27 | 166 | 156 | 10 | 93.98 | 6.02 |
| 28-38 | 191 | 182 | 9 | 95.30 | 4.71 |
| 39-49 | 121 | 109 | 12 | 90.12 | 9.91 |
| 50-60 | 78 | 72 | 6 | 92.33 | 7.69 |
| 61-71 | 44 | 35 | 9 | 79.50 | 20.45 |
| **Total** | **600** | **554** | **46** | | |

### 3.4 Parasitemia Distribution and Implications

The bar chart figure 2, shows that moderate parasitemia was most prevalent (45.8%), followed by light infections (39.2%) and heavy parasitemia (15.0%). The dominance of moderate and light infections suggests partial immunity in this population, likely from repeated exposure, while the smaller proportion with heavy parasitemia represents the most clinically significant risk. These patterns underscore the need for targeted interventions focusing on both reducing severe cases and interrupting transmission from individuals with lower parasite densities.



Distribution of Parasitemia Levels among Infected Individuals
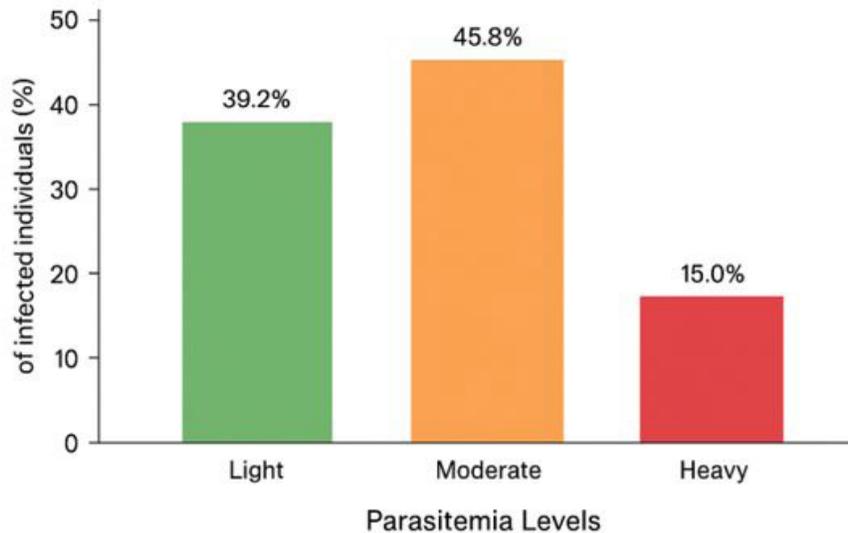
### 4. Discussion

This study reveals a strikingly high malaria prevalence of 80.0% among inmates in Owerri Correctional Centre, reflecting a substantial public health concern within Nigeria's prison system Abah et al., 2018; Otuu & Shu, 2025 [2]. The uniform prevalence observed in both males and females underscores the dominant role of shared environmental and structural risk factors such as overcrowding, poor ventilation, inadequate sanitation, and ineffective vector control rather than sex-specific biological susceptibility (Asylum Research Centre, 2019; PRI, 2025; U.S. Department of State, 2019). While gender differences were statistically insignificant, the slightly higher proportion of infected males may be linked to increased exposure through prison labor, greater mobility within the facility, or behavioral differences, aligning with observations from other correctional settings in sub-Saharan Africa [2].

Age-specific analysis demonstrated near-universal infection among the most socioeconomically active cohorts (17–38 years), with prevalence exceeding 93%. These groups may experience higher exposure due to greater participation in communal activities and labor-intensive duties. Conversely, the reduced prevalence in older inmates (61–71 years) could reflect lower exposure due to restricted mobility, prior development of partial immunity, or survivor bias in which only healthier individuals reach older ages within prison populations. These findings are consistent with studies indicating that younger adult males in endemic settings often bear the heaviest malaria burden due to a combination of behavioral and biological factors CDC, 2024; WHO, 2023; NMEP, 2021–2025; PRI, 2025 [1].

Parasitemia distribution patterns offer further insight into disease dynamics in this population. The predominance of moderate

(45.8%) and light (39.2%) infections suggests a degree of acquired immunity from repeated exposure, which may partially suppress parasite densities without eliminating infection. However, the 15.0% of inmates with heavy parasitemia represents a clinically critical subgroup at heightened risk for severe disease outcomes such as cerebral malaria and anemia. This subgroup likely sustains transmission cycles, underscoring the need for targeted case management alongside population-wide prevention strategies. The extremely high infection rates reported here far exceed national averages and reinforce the characterization of prisons as high-transmission microenvironments. Overcrowding Owerri facility currently houses nine times its intended capacity creates optimal conditions for vector–host contact, while structural neglect limits the feasibility of standard prevention measures such as insecticide-treated net use or indoor residual spraying. These findings align with WHO's recognition of prisons as neglected epidemiological foci for vector-borne diseases and echo calls for integrating correctional facilities into national malaria surveillance frameworks WHO Regional Office for Europe, 2014; NMEP, 2021–2025.

From a public health perspective, the implications are twofold. First, malaria control in prisons cannot rely solely on facility-based interventions; it requires structural reforms addressing overcrowding, infrastructure, and sustained access to preventive tools. Second, inclusion of prison health data into state and national malaria reporting systems is essential for accurate disease burden estimation and equitable resource allocation. Failure to address prison malaria prevalence risks maintaining a persistent reservoir of infection capable of undermining broader elimination efforts.

## 5. Conclusion

In conclusion, the high prevalence, significant proportion of moderate-to-heavy parasitemia, and the socio-environmental conditions identified in this study highlight the urgent need for targeted, context-specific malaria control strategies within correctional facilities. Interventions should prioritize environmental vector control, routine screening, prompt treatment, and infrastructural improvements, with a particular focus on reducing overcrowding. Integrating prison health into national malaria elimination strategies will not only improve inmate health outcomes but also contribute meaningfully to community-level malaria control [3-14].

## Recommendations

1. Integration into National Malaria Control Programs: Correctional facilities should be incorporated into state and federal malaria surveillance systems to ensure early detection and prompt treatment of cases.
2. Vector Control Measures: Implement sustained environmental management strategies, such as eliminating mosquito breeding sites, using insecticide-treated bed nets, and conducting periodic indoor residual spraying.
3. Infrastructure Improvement: Address severe overcrowding through prison decongestion policies and improve ventilation to reduce mosquito–human contact.

4. Routine Screening and Case Management: Establish regular malaria screening for inmates and prison staff, coupled with timely access to effective antimalarial drugs.
5. Health Education: Conduct targeted health education programs to improve awareness of malaria prevention among inmates and prison personnel.
6. Research Expansion: Encourage further epidemiological and entomological studies within prison settings to better understand transmission dynamics and evaluate intervention effectiveness.

## Limitations

This study had several limitations. First, its cross-sectional design provides only a snapshot of malaria prevalence and parasitemia patterns, limiting causal inference. Second, microscopy though a gold standard may under-detect very low parasitemia, potentially underestimating prevalence. Third, the study was restricted to a single correctional facility, which may limit the generalizability of findings to other prisons in Nigeria with different environmental and management conditions. Lastly, behavioral and environmental exposure data were self-reported and subject to recall bias.

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