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Prevalence and Determinants of Malaria among Inmates of Afokang Prison, Calabar, Nigeria

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Abstract

Malaria remains a public health challenge in Nigeria, driven by poor conditions, overcrowding, vector-control gaps, and limited healthcare access. Correctional facilities are vulnerable yet under-researched transmission settings, where inmates face prolonged exposure to these risks. This study assessed malaria prevalence and identified associated demographic, environmental, behavioural, and healthcare-related factors among inmates at Afokang Prison in Calabar, Cross River State. A cross-sectional design enrolled 240 inmates selected from 16 cells between August and October 2025. Malaria infection was confirmed via rapid diagnostic tests on finger-prick blood, while a structured questionnaire captured socio-demographics, knowledge, preventive practices, environmental conditions, and healthcare-seeking behaviours. Data were analysed using descriptive statistics and chi-square tests ($p < 0.05$), supplemented by a review of prison health records from 2023–2024. Overall, 176 of 240 inmates (73.3%) tested positive. Prevalence was comparable between males (73.1%) and females (75.0%, $\chi^2 = 0.38$, $p = 0.846$) and did not differ significantly across age groups, peaking at 79.62% among those aged 30–34 years and lowest at 68.08% among those aged 35–39 years ($p = 0.514$). Although prevalence varied by incarceration duration, from 65.51% (six months) to 80.64% (one year), this association was non-significant ($p = 0.743$). Environmental deficiencies were pervasive: 84.2% reported stagnant water, 74.2% cited nearby bushes, 80.0% noted irregular cleaning or fumigation, 76.7% lacked window screens, and 72.9% were not provided with mosquito nets. While 90.8% acknowledged malaria's preventability and 87.9% correctly identified mosquito transmission, only 30.0% consistently used nets. Historical records revealed an upward trajectory, from 56.77% in 2023 to 65.45% in 2024, culminating in 73.3%. These findings confirm a high malaria burden within Afokang Prison, driven by substandard sanitation, insufficient vector control, delayed healthcare access, and a pronounced knowledge-practice gap. Urgent, multi-pronged interventions are required, including intensified environmental sanitation, indoor residual spraying, universal provision and enforced use of insecticide-treated nets, prompt diagnosis and treatment, and health education tailored to the prison population.

Keywords: malaria; prison inmates; prevalence; determinants; environmental factors; mosquito nets.

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Introduction

Malaria is a mosquito-borne parasitic disease caused by *Plasmodium* species and transmitted principally through the bites of infected female *Anopheles* mosquitoes. It remains one of the most important infectious diseases affecting populations in tropical and subtropical regions, particularly sub-Saharan Africa. Clinical manifestations range from uncomplicated fever, headache, chills and weakness to severe disease, neurological complications and death (Bartoloni & Zammarchi, 2012; World Health Organisation [WHO], 2022). Nigeria carries a substantial proportion of the global malaria burden. The disease continues to affect individuals and communities through recurrent illness, healthcare expenditure, loss of productivity and mortality. Cross River State, located in the South-South region of Nigeria, remains an important malaria-endemic setting. Previous reports cited in the study have indicated considerable malaria burden in the state and nationally (National Demographic and Health Survey [NDHS], 2018). Malaria transmission is influenced by interactions between parasite, mosquito vector, human host and the surrounding environment. Important environmental determinants include stagnant water, poor drainage, vegetation, inadequate waste management and other conditions that provide breeding habitats for mosquitoes. Human behaviours, including inconsistent use of insecticide-treated nets, delayed treatment-seeking and self-medication, can further sustain transmission (Oladepo et al., 2010; Mpimbaza et al., 2022). Correctional institutions represent a particularly important setting for investigating malaria. Inmates are confined within a relatively restricted environment, often with limited control over ventilation, sleeping arrangements, sanitation, mosquito exposure and healthcare access. Overcrowding and poor environmental conditions can facilitate

mosquito-human contact and consequently increase the risk of transmission. Studies conducted in Nigerian prisons have reported substantial malaria burdens among inmates. Mamman et al. (2014), for example, reported a prevalence of 53.67% among inmates in Jos Prison, while Otuu and Shu (2018) reported malaria as the most prevalent disease among inmates in three federal prisons in South-Eastern Nigeria.

The burden of malaria in correctional facilities is also important because inmates are not isolated permanently from the wider population. Prison staff, visitors and discharged inmates may create pathways for transmission between correctional institutions and surrounding communities. Consequently, malaria control in prisons should be regarded as an integral component of broader public-health and malaria-elimination strategies. Afokang Prison in Calabar is a maximum-security correctional facility accommodating inmates of different categories. The thesis on which the present article is based reports a prison population of approximately 600 inmates at the time of the study and describes the facility as one of the older correctional institutions in Nigeria. The study selected 240 inmates from 16 cells for parasitological examination and questionnaire assessment. Despite malaria-control programmes in Nigeria, limited information is available concerning the disease burden and determinants within correctional institutions, particularly Afokang Prison. The present study therefore assessed malaria prevalence among inmates and examined demographic, environmental, behavioural and healthcare-related factors that may contribute to continued transmission

Materials and Methods

2.1 Study area and design

A cross-sectional study design was employed. The study was conducted at Afokang Prison in Calabar South, Cross River State, Nigeria. The study was conducted between August and

October 2025 among inmates of Afokang Prison. Out of 600 inmates, a total of 240 inmates participated in the study. Afokang Prison is a maximum-security prison and harbours offenders of all categories of crimes, including those awaiting trial, convicts, and

condemned criminals of both sexes. It is one of the earliest remand institutions in Nigeria. It was established by the British colonialists in 1890. The institution has a holding capacity of about 500 inmates. However, it is confirmed by an earlier observation that “Nigerian prisons have less than 4% of total prison admissions being females, about 80% serve short-term imprisonment of less than two years, and more than 50% are between the ages of 28 and 50 years”. (Cross River National Park, 2021). Presently, the Afokang prison contains a total of six hundred (600) inmates, with five hundred and seventy-five (575) males and twenty-five (25) females.

2.2 Study Population and Sampling Techniques

A simple random sampling procedure was used to select participants from 16 cells. According to the study protocol, eligible inmates were identified from available cell lists, and every second individual was selected. Twenty inmates were selected from each cell, resulting in a total sample of 240 participants. Inmates who had stayed in the prison for at least three months were eligible for inclusion.

The sample size was calculated using Taro Yamane's formula because the population is known.

- Use a formula such as:

$$\text{Sample Size (n)} = \frac{N}{1 + N(e)^2}$$
(Chinedu et al., 2024)

With an error margin of 0.5

This was conducted from August to October 2025. A total of 240 inmates were involved in the study.

2.3 Data collection method

Malaria infection was assessed using rapid diagnostic test (RDT) kits. For each participant, the fingertip was cleaned with an alcohol swab, punctured using a sterile lancet and capillary blood was collected and applied to the test strip. Results were read according to the manufacturer's instructions. Only inmates who consented to participate were examined. A structured, pre-tested questionnaire was administered to participants whose blood samples had been examined. Information was collected on socio-demographic characteristics, malaria experience, healthcare-seeking behaviour, environmental conditions, preventive practices and knowledge of malaria. Focus-group discussions and interviews with inmates and health personnel were also used to explore perceptions concerning malaria prevention and treatment. Malaria records from the Afokang Prison Health Centre for 2023 and 2024 were reviewed to examine temporal trends in malaria positivity. The records contained monthly numbers of inmates tested and malaria-positive results.

2.4 Data Analysis

Malaria prevalence was calculated as the proportion of participants who tested positive among those examined. Descriptive statistics were used to summarize the data, while chi-square tests were used to examine associations between malaria infection and selected socio-demographic variables. Statistical significance was assessed at $p < 0.05$.

2.5 Ethical Considerations

Permission was obtained from the Research Management Committee of the University of Cross River State, while approval was obtained from the State Comptroller of Prisons and clearance from the Prison Health Care Unit. Individual consent was obtained from participating inmates, and confidentiality of information was maintained.

Results

Overall Prevalence of Malaria: Of the 240 inmates examined, 176 tested positive for malaria, giving an overall prevalence of **73.3%**, while 64 (26.7%) tested negative. The result indicates a very high malaria burden among inmates during the study period. The Prevalence rate across all genders is 73.33%. By gender, males recorded a 73.1% positivity rate, while females had a slightly higher prevalence of 75 %; however, the male population is larger, though the difference was not significant ($\chi^2 = 0.38$, $p = 0.846$). This is shown in Table 1. Across age groups, there was a total prevalence of 73.3%, with the highest prevalence (79.62%) observed among those aged 30-34 years, signifying the peak exposure by age, and the lowest (69.76%) in the 20-24 age group ($\chi^2 = 3.268$, $p = 0.514$). Based on duration of stay in prison, a total of 176 (73.3%) tested positive for malaria infection, higher rate was among those incarcerated for two years or more 52 (75.67%), followed by those who were incarcerated for 1 year 50 (80.64%), 6 months with 38 (65.51%), and 3 months 36(78.26%). However, these differences were not statistically significant ($\chi^2 = 1.241$, $p = 0.743$). This showed increasing prevalence with time spent, confirming that prolonged residence enhances risk through sustained exposure to mosquito breeding zones.

Percentages are presented as reported/derived from the study table.

Source: Study data, 2025. The original thesis reports the corresponding figures and statistical tests.

3.1.1 Malaria by Sex

Malaria prevalence was 73.1% among males and 75.0% among females. Although females recorded a slightly higher positivity rate, the difference was not statistically significant ($\chi^2=0.380$, $p=0.846$).

3.1.2 Malaria by Age

The highest prevalence was observed among inmates aged 30–34 years (79.62%), followed by those aged 40–45 years (77.5%). The lowest prevalence was observed among inmates aged 35 –39 years (68.08%). The relationship between age and malaria infection was not statistically significant ($\chi^2=3.268$, $p=0.514$).

3.1.3 Malaria by Duration of Incarceration

Malaria prevalence varied according to duration of incarceration. The highest prevalence occurred among inmates incarcerated for one year (80.64%), followed by those incarcerated for three months (78.26%) and two years or more (75.67%). The lowest prevalence occurred among inmates incarcerated for six months (65.51%). The relationship was not statistically significant ($\chi^2=1.241$, $p=0.743$), as shown in Table 1.

3.2 Socio-Demographic Characteristics

Of the 240 participants, 216 (90.0%) were males, and 24 (10.0%) were females. Participants aged 25–34 years constituted 45.8% of the sample. Regarding duration of incarceration, 30.8% had stayed for at least two years. Half of the participants (50.4%) had no formal education, while 30.0% had primary education, 17.1% had secondary education, and 2.5% had tertiary education, see Table 2.

Table 1. Prevalence of malaria according to sex, age and duration of incarceration

Variable	Category	Examined (n)	Positive n (%)	Negative n (%)	χ^2	p-value
Sex	Male	216	158 (73.1)	58 (26.9)	0.380	0.846
	Female	24	18 (75.0)	6 (25.0)		
Age (years)	20–24	43	30 (69.76)	13 (30.23)	3.268	0.514
	25–29	56	40 (71.42)	16 (28.57)		
	30–34	54	43 (79.62)	11 (20.37)		
	35–39	47	32 (68.08)	15 (31.92) *		
	40–45	40	31 (77.50)	9 (22.50)		
Duration of stay	3 months	46	36 (78.26)	10 (21.73)	1.241	0.743
	6 months	58	38 (65.51)	20 (34.48)		
	1 year	62	50 (80.64)	12 (19.35)		
	≥2 years	74	52 (75.67)	24 (24.32)		

3.3 Malaria Case-Management Practices

The study identified substantial gaps in malaria diagnosis and treatment. Only 62.9% of inmates reported that they had previously been examined for malaria, while 37.1% had never been examined. Only 45.8% reported receiving treatment within the prison. More than half (52.5%) reported delays in receiving treatment after developing symptoms, see Table 3.

Table 2. Socio-demographic characteristics of study participants (N=240)

Variable	Category	Frequency	Percentage (%)
Sex	Male	216	90.0
	Female	24	10.0
Age (years)	20–24	43	17.9
	25–29	56	23.3
	30–34	54	22.5
	35–39	47	19.6
	40–45	40	16.7
Duration of stay	3 months	46	19.2
	6 months	58	24.2
	1 year	62	25.8
	≥2 years	74	30.8
Education	None	121	50.4
	Primary	72	30.0
	Secondary	41	17.1
	Tertiary	6	2.5

Table 3. Malaria case-management practices among inmates

Indicator	Response	Frequency	Percentage (%)
Ever examined for malaria	Yes	151	62.9
	No	89	37.1
Received treatment in prison	Yes	110	45.8
	No	130	54.2
Treatment provided by clinic staff	Yes	168	70.0
	No	72	30.0
Time to receive treatment	Immediate	114	47.5
	Delayed	126	52.5
Witnessed malaria-related death	Yes	44	18.3
	No	196	81.7

3.4 Environmental and Structural Determinants

In Table 4, environmental conditions potentially favourable for malaria transmission were widespread. Stagnant water around the prison was reported by 84.2% of respondents, while 74.2% reported bushes or grasses near the cells. Only 20.0% reported regular cleaning or fumigation. Furthermore, 76.7% reported that windows or ventilation openings lacked screens, while 72.9% indicated that mosquito nets were not provided.

Table 4. Environmental and structural conditions associated with malaria transmission

Environmental factor	Response	Frequency	Percentage (%)
Stagnant water present	Yes	202	84.2
	No	38	15.8
Bushes/grass near cells	Yes	178	74.2
	No	62	25.8
Regular cleaning/fumigation	Yes	48	20.0
	No	192	80.0
Window/ventilation screens installed	Yes	56	23.3
	No	184	76.7
Mosquito nets provided	Yes	65	27.1
	No	175	72.9

Table 5. Knowledge and preventive practices concerning malaria

Indicator	Yes, n	Percentage (%)
Believe malaria is preventable	218	90.8
Know mosquitoes cause malaria	211	87.9
Can recognize malaria symptoms	195	81.3
Report illness early	138	57.5
Complete medication course	126	52.5
Engage in self-medication	94	39.2
Received malaria health education	88	36.7
Use mosquito nets consistently	72	30.0
Believe malaria can be cured	229	95.4

3.5 Knowledge, Attitude and Preventive Practices

Knowledge concerning malaria was generally high. A large majority of inmates (90.8%) believed malaria was preventable, while 87.9% knew that mosquitoes cause malaria and 81.3% reported being able to recognize malaria symptoms. However, preventive practices were considerably weaker. Only 30.0% reported consistent use of mosquito nets, 57.5% reported early illness reporting, and 52.5% reported completing their medication courses. Self-medication was reported by 39.2% of participants, as shown in Table 5.

Table 6. Comparison of malaria prevalence at Afokang Prison, 2023–2025

Year	Number examined	Positive	Prevalence (%)
2023	1,786	1,014	56.77
2024	1,835	1,201	65.45
2025	240	176	73.33

Source: Afokang Prison Health Centre records and 2025 study data

The data indicate an increase in malaria positivity over the three observation periods. The thesis attributes the increasing trend partly to inadequate fumigation, waterlogged or poorly drained areas, environmental deterioration and inconsistent vector-control activities. See Table 6.

Discussion

This study demonstrated a very high malaria prevalence of 73.3% among inmates of Afokang Prison. This finding indicates that malaria represents an important health problem within the correctional facility. The prevalence observed is higher than the 53.67% reported among inmates in Jos Prison by Mamman *et al.* (2014) and the 52.1% reported in Port Harcourt Maximum Security Prison by Abah *et al.* (2018). However, the finding is comparable with the high malaria burden reported in South-Eastern Nigerian prisons by Otuu and Shu (2018), where malaria was reported as the most prevalent disease among inmates see Table 1. The high prevalence may reflect the interaction of several factors rather than a single determinant. The prison environment provides conditions that can facilitate mosquito breeding and human-vector contact. In the present study, 84.2% of inmates reported stagnant water around the prison, 74.2% reported bushes or grasses near cells, 80.0% reported lack of regular fumigation, and 76.7% reported absence of window or ventilation screens. These conditions provide plausible ecological pathways for continued malaria transmission. Such environmental neglect directly sustains vector breeding and reinfection. Similar observations by Abah *et al.* (2018) and Mboya *et al.* (2019) link high malaria transmission rates in prisons to overcrowding, poor drainage, and waste accumulation.

Although females recorded a slightly higher prevalence than males (75.0% versus 73.1%), the difference was not statistically significant. The lack of statistical significance suggests that sex alone was not an important determinant of infection in this study. The high prevalence mirrors findings by Otuu & Shu (2018) and indicates that malaria transmission persists despite awareness programs. Continuous exposure, overcrowding, and poor infrastructure remain critical drivers as shown in Table 2. Age was also not significantly associated with malaria infection. Nevertheless, the highest prevalence was recorded among inmates aged 30–34 years (79.62%). The thesis suggests that inmates in this age group may have greater exposure because of involvement in activities such as farming, cooking and

maintenance. Such activities may increase exposure to mosquito bites, particularly during periods of mosquito activity. This interpretation should, however, be considered cautiously because exposure to prison work was not directly measured in the statistical analysis Table 3.

Duration of incarceration showed substantial variation in malaria prevalence, with the highest observed prevalence among inmates incarcerated for one year (80.64%). However, the association was not statistically significant. The findings therefore do not establish duration of incarceration as an independent determinant of malaria infection. This finding doesn't support Ibrahim *et al.* (2022), who concluded that prolonged exposure and poor sanitary conditions increase malaria risk, because there are times when malaria treatment is given to inmates. Nevertheless, prolonged residence within an environment with persistent mosquito breeding sites may increase opportunities for repeated exposure. A particularly important finding was the discrepancy between knowledge and preventive practice. Although 90.8% of inmates knew that malaria was preventable and 87.9% recognised mosquitoes as the cause, only 30.0% consistently used mosquito nets. Furthermore, only 36.7% reported having received malaria health education. This knowledge–practice gap suggests that awareness alone may be insufficient to achieve effective malaria control. Structural barriers, including lack of mosquito nets, poor cell screening and environmental conditions, may prevent inmates from translating knowledge into protective behaviour, see Table 4, 5 and 6.

Healthcare access was another important concern. More than one-third of inmates had never been examined for malaria, only 45.8% reported receiving treatment in the prison, and 52.5% reported delays in receiving treatment. This result agrees with Okareh *et al.* (2018), who found that low educational attainment and lack of consistent health education hinder malaria prevention among prison populations. Health education should thus be continuous,

participatory, and tailored to inmates' literacy levels to influence long-term behavioural change. These behavioural lapses reflect limited health literacy and insufficient reinforcement of preventive messages. The historical data further demonstrate a concerning trend. Malaria prevalence increased from 56.77% in 2023 to 65.45% in 2024 and 73.3% in 2025. Although differences in sampling and seasonal timing should be considered when interpreting these figures, the consistent increase indicates the need for stronger surveillance. The thesis identified delayed fumigation, stagnant or waterlogged drainage areas and inadequate environmental control as possible contributors. Overall, the findings suggest that malaria transmission at Afokang Prison is best understood as a multifactorial problem involving environmental, structural, and behavioural and health-system factors. The available data demonstrate strong descriptive evidence for these factors, although the study did not perform multivariable modelling to establish independent determinants. Therefore, environmental and behavioural factors should be described as potential or contributing determinants, rather than statistically proven independent predictors. The findings have important implications for correctional health and malaria-control policy in Nigeria. First, prisons should be incorporated into routine malaria surveillance and intervention programmes. Second, environmental management should be prioritized because treatment alone cannot sustainably control malaria when breeding sites remain abundant. Regular removal of stagnant water, clearing of vegetation, improvement of drainage, environmental sanitation and scheduled fumigation should form part of an integrated vector-management programme. The provision of insecticide-treated nets to all inmates should also be accompanied by education and monitoring to encourage consistent use. Healthcare services within the prison should be strengthened through adequate availability of RDT kits, appropriate antimalarial medicines and trained healthcare personnel. Early

diagnosis and treatment should be facilitated by reducing administrative and logistical delays. Finally, malaria education should be incorporated into inmate orientation and continuing health programmes. Education should focus not only on knowledge but also on practical behaviour, including consistent net use, early reporting of symptoms, avoidance of inappropriate self-medication and completion of prescribed treatment.

Limitations

This study acknowledges some limitations. First, it was conducted in a single correctional facility, limiting generalizability to other Nigerian prisons. Second, the cross-sectional survey was conducted between August and October 2025 and therefore may not capture malaria transmission throughout all seasons. Third, some information concerning environmental conditions and preventive practices was self-reported and may therefore be affected by recall or reporting bias. Fourth, the laboratory approach was based on rapid diagnostic testing kits and did not include molecular identification of *Plasmodium* species. These limitations were also acknowledged in the original thesis.

Conclusion

The study revealed high malaria prevalence of 73.3% among inmates of Afokang Prison, Calabar. Although malaria prevalence did not show statistically significant associations with sex, age or duration of incarceration, substantial environmental and structural risk factors were documented. Stagnant water, vegetation around cells, inadequate fumigation, and absence of window screens and inadequate provision of mosquito nets were common. In addition, significant gaps existed in malaria diagnosis and treatment, including delayed access to care. The study also demonstrated a clear knowledge-practice gap: although most inmates understood that malaria is preventable and mosquito-borne, consistent mosquito-net use was low.

Conflict of interest: The authors hereby declare no conflict of interest regarding the publication of this article.

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