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Prevalence of Asymptomatic Malaria and Demographic Influences Among Primary School Children in Dala, Kano State, Nigeria

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Abstract

Malaria poses a significant health challenges globally, disproportionately affecting vulnerable population such as children. This study aimed to ascertain the prevalence of asymptomatic malaria among primary school pupils in Dala Local Government Area, Kano State, Nigeria. Utilizing a cross-sectional design, blood samples were collected from 107 pupils through finger prick. These samples were then subjected to microscopic examination following the preparation of both thin and thick blood films. The overall prevalence of asymptomatic malaria was found to be 21.5%, with 23 pupils testing positive for the parasite. Gender-wise, male participants exhibited a higher infection rate (73.9%) compared to their female counterparts (26.08%). Age-specific analysis revealed that the 13-16 years age group had the highest prevalence of asymptomatic malaria at 73.9%, whereas the 5-8 years age group had the lowest at 2.38%. These results highlighted the substantial presence of asymptomatic malaria among school-aged children, particularly within the 13-16 years age bracket. The study underscores the need for targeted public health interventions to identify and treat asymptomatic malaria infections in order to mitigate the silent transmission within this vulnerable population.

Keywords: Asymptomatic malaria, Prevalence**,** Primary school, Pupils

INTRODUCTION

Malaria remains a formidable public health concern, especially within developing nations marked by constrained resources, poor living conditions, and inadequate health literacy. This issue is particularly pronounced in Africa, where the spread of the disease is primarily driven by the bites of infected Anopheles mosquitoes. These mosquitoes inject sporozoites into the bloodstream, kick-starting the infection process. It's important to note that sporozoites can also enter through the skin, requiring a journey through the dermis to reach and invade blood vessels, further spreading the infection (Douglas *et al*., 2015). Additional transmission pathways include transfusions of infected blood and vertical transmission, where the infection passes from mother to child through the placenta (Ryan *et al*., 2020).

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According to the World Health Organization (WHO), the global impact of malaria is staggering, with estimates suggesting over 216 million cases and approximately 655,000 deaths annually across 106 countries. The burden is heaviest in sub-Saharan Africa, which accounts for 91% of malaria deaths, followed by Southeast Asia at 6%, and the Eastern Mediterranean region at 3% (Ramos *et al*., 2005; WHO, 2010). The disease is caused by five primary Plasmodium species, with *Plasmodium knowlesi* primarily affecting Southeast Asia and involving monkeys as natural hosts. Recent advancements in molecular diagnostics have revealed additional species like *P. simium* and *P. cynomolgi*, though their prevalence and impact are yet to be fully understood (Brasil *et al*., 2017).

The economic and social development in Africa is significantly hindered by malaria. For instance, reports from the Ethiopian Federal Ministry of Health for the year 2009/2010 indicated that malaria accounted for a significant portion of both outpatient visits and hospital admissions, with millions of cases reported annually. Notably, a substantial number of these cases were confirmed positive through diagnostic testing (MacKintosh *et al*., 2014). The disease manifests in various forms, from severe anemia and cerebral malaria to hypoxia. While severe forms lead to high mortality rates, repeated exposure to the parasite may result in partial immunity, thereby reducing susceptibility to future infections and fostering asymptomatic carriers who continue to spread the disease (Bousema *et al*., 2004).

In sub-Saharan Africa, malaria poses a severe risk to school-aged children, affecting their health, cognitive abilities, and educational outcomes. For example, studies have demonstrated the beneficial effects of intermittent preventive treatment in improving focus and attention in classrooms among children in areas with seasonal malaria transmission (Clarke *et al*., 2008). Furthermore, older children and adults may serve as reservoirs for malaria transmission due to the presence of asymptomatic or minimally symptomatic infections, which are less likely to receive antimalarial treatment compared to the acute presentations in younger children (Carneiro *et al*., 2010). These asymptomatic cases, often missed by conventional surveillance methods, play a crucial role in the persistence of malaria transmission across seasons (Laishram *et al*., 2012).

Research in Zimbabwe and Malawi has shown varying trends in malaria prevalence, particularly highlighting a decrease in cases among younger children. The WHO 2020 report that malaria continues to affect millions globally, with the majority of cases and deaths occurring in Africa. This study seeks to determine the prevalence of malaria among school children in a specific area, highlighting the broader implications of the disease on affected populations.

MATERIALS AND METHODS

Study Area

The research was conducted in the Dala Local Government Area (LGA) of Kano State, a densely populated region within the Kano Metropolis. Spanning an area of 19 km², Dala had a population of 418,777 according to the 2006 census, making it the most populous LGA in Kano State.

Sample Size Determination

The sample size was calculated using the formula provided by Agarwal *et al*. (2014),

$$n = \frac{z^2 p(1-p)}{d^2}$$

Where n=level of confidence at 95%=1.96, P= 7.6%, d= 5% (d=0.05), n= 1.96x2 x 0.076(1-0.076)/0.05^2, n=3.8146 x 0.076 x 0.9241/0.0025, n=107
Resulting in a sample size of 107 participants.

Ethical Approval
Approval for this study was granted by the Research Ethics Committee of the Kano State Ministry of Health, ensuring adherence to ethical research standards.

Sample Collection and Processing
A 5 mL blood sample was collected from each of the 107 participants from the selected primary school pupils in the study area, using a sterile lancet through finger pricks by cleaning the collection site with alcohol swab.

For malaria parasite detection, a drop of blood was placed on a clean, grease-free slide and spread in a circular pattern to cover approximately 2 cm^2. The thick blood film was then air-dried without methanol fixation. Staining involved immersing the dried slides in Field's stain A for 3-seconds, followed by rinsing in tap water by agitation for 3-second. The process was repeated with Field's stain B for 3-seconds, followed by a rinse until the excess stain was removed. The slides were then left to dry vertically before examination (Ramos *et al*., 2005).
For thin blood films, blood was spread on a clean slide and air-dried. These slides were fixed in methanol for one minute and then stained with a mixture of diluted Field's stain B and undiluted Field's stain A for one minute, followed by rinsing and air-drying (Mathiason and Pritt, 2017).

Statistical Analysis
Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 20. The chi-square X^2 test was employed to assess the association between variables, with p-values less than 0.05 considered statistically significant.

RESULTS
This study enrolled 107 pupils from selected primary schools within the Dala Local Government Area of Kano State. Out of these participants, 23(21.5%) prevalence rate, tested positive for malaria. Conversely, 84(78.5%) of the sample, were found to be negative for the malaria parasite. The distribution of asymptomatic malaria prevalence across the three examined primary schools is detailed in Table 1. Notably, `Yan Mata Primary School recorded the highest prevalence (43.5%), while Prof. Ibrahim Y. Primary School exhibited the lowest at (21.7%). An analysis based on gender revealed that males had a higher infection rate (73.9%), compared to females at 26.08%. Further, the prevalence of asymptomatic malaria varied significantly across age groups, with the 13-16 age bracket showing the highest prevalence at 73.9%, and the 5-8 year age range the lowest at 2.38%.

Table 1: Prevalence of the disease according to schools involved

School	No. of Pupils	No. positive	Prevalence (%)
`Yan mata	40	10	(43.5)
HussainAdamu	40	8	(34.8)
Prof. Ibrahim Y.	27	5	(21.7)
Total	107	23	(100)

Table 2 Occurrence of the infestation according gender

Gender	Number examined	Positive (%)	Negative (%)
Male	67	17(73.9)	54(64.28)
Female	40	6(26.08)	30(35.71)
Total	107	23(100)	84(100)

X^2=0.387; P-value =0.750

Table 3: The infestation rate according to age group of the pupils

Age group	No. Examined	No. Positive (%)	No. Negative (%)
5-8	3	1(4.53)	2(2.38)
9-12	28	5(21.74)	23(27.30)
13-16	76	17(73.9)	59(70.00)
Total	107	23(100.00)	84(100)

X^2 =5.256; P=0.810

These results indicated a significant variation in the prevalence of asymptomatic malaria among different schools, genders, and age groups within the study area. The highest rate of infection was observed among older pupils and males, suggesting a pattern that may inform targeted interventions. Despite these differences, the statistical analysis (Chi-square test) suggested that the differences in prevalence by gender and age group were not statistically significant, with p-values of 0.750 and 0.810, respectively.

DISCUSSION

Our study assessed the prevalence of asymptomatic malaria among school-aged children in Dala Local Government Area, Kano State, revealing a prevalence rate of 21.5%. This rate aligns with the significant burden of malaria observed in similar settings but varies widely when compared to other studies. For instance, Rogath *et al*. (2019) reported a prevalence of 29%, whereas Abah et al. (2015) and Nji *et al*. (2021) documented substantially higher prevalence of 63.3% and up to 74.8% using different diagnostic methods, respectively. On the contrary, lower prevalence were noted by Ligabaw *et al*. (2014) and Osman *et al*. (2019), suggesting that environmental, socio-economic, and methodological differences might account for these variations.

The gender-based analysis of our study indicated a higher infection rate among males (73.9%) than females (26.08%), a finding that is echoed in the literature (Mensah *et al*., 2021; Mensah1 *et al*., 221) but not universally consistent (Kimbi *et al*., 2012). The lack of statistical significance (p -value = 0.750) in our study suggests that gender may not be a strong independent predictor of asymptomatic malaria within this population, pointing to the necessity of considering multifactorial influences on malaria transmission dynamics.

Age-wise, the prevalence of asymptomatic malaria was notably higher in the 13-16 age group. This observation might reflect increased exposure or susceptibility due to behavioral factors, such as more time spent outdoors or less adherence to protective measures. However, our findings did not show a significant statistical association between age groups and malaria prevalence (p -value = 0.810), indicating that while age appears to be a factor, it is not the sole

determinant of infection risk. This result contrasts with some studies that found higher prevalences in different age ranges (Osman *et al*., 2019; Baraka *et al*., 2015; Abah *et al*., 2015), suggesting the influence of local epidemiological patterns and the potential role of acquired immunity or exposure history.

The identification of a high prevalence of asymptomatic carriers, particularly among older children, underscores a significant public health challenge. These carriers serve as a reservoir for continued transmission, complicating efforts to control and eliminate malaria. Our findings support the need for targeted screening and treatment programs in schools, especially in endemic areas, to mitigate the silent spread of malaria. This approach, coupled with gender and age-specific interventions, could enhance the effectiveness of current malaria control strategies. Nonetheless, the observed lack of statistical significance in gender and age group differences suggests that comprehensive, community-wide measures, including vector control, environmental management, and health education, remain critical to reducing malaria's overall burden.

In conclusion, our research contributes important insights into the epidemiology of asymptomatic malaria among school-aged children in the Dala Local Government Area as a case study, emphasizing the complex interplay of demographic, behavioral, and environmental factors in malaria transmission. These findings highlight the critical need for integrated malaria control strategies that address both symptomatic and asymptomatic infections to achieve sustainable reductions in malaria transmission.

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