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Burden of Malaria Infection in the Elderly Population: Insights from Benin City, Edo State, Nigeria

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ABSTRACT

Background: Malaria remains a major global health challenge, particularly in sub-Saharan Africa, where it disproportionately affects vulnerable populations. While most studies focus on children and pregnant women, the elderly are also at high risk due to weakened immune system and comorbidities. This study investigated the prevalence and associated risk factors that contribute to Malaria parasite infection among the elderly population in Benin City, Edo State, Nigeria.
Materials and Methods: A cross-sectional study was conducted in Benin City, involving 250 participants aged 50 years and above. Blood samples were collected; Microscopic examination of Giemsa-stained thick and thin blood smears was used to identify malaria parasites. This method is the primary diagnostic standard. Demographic and risk factor data were collected using structured questionnaires. Data obtained were analyzed statistically using SPSS version 27.
Results: The study found a malaria parasite prevalence rate of 27.2% among the elderly population in Benin City. Sociodemographic factors such as age, gender, education, and residential location were not significantly associated with malaria prevalence in the study population. No significant association was also observed between malaria parasite infection, clinical symptoms and associated risk factors of malaria parasite infection of the study participants.
Conclusion: Public health campaigns should focus on educating older adults especially those with limited mobility or healthcare access about malaria prevention.

Key words: Burden, Edo State, Elderly Population, Infection, Malaria Parasite

INTRODUCTION

Malaria continues to pose a major global health challenge, especially those residing in tropical and subtropical areas. The burden of the disease is disproportionately concentrated in sub-Saharan Africa, which represented 94% of the total cases and 95% of the deaths. In sub-Saharan Africa, malaria is responsible for more than 2 million febrile episodes and approximately one million deaths annually (1). Malaria is an infection caused by protozoan parasites belonging to the genus *Plasmodium*, with five *species* identified as capable of infecting humans: *P. falciparum*, *P. vivax*, *P. malariae*, *P. ovale*, and *P. knowlesi* (2). These parasites are transmitted to humans through mosquito vectors of the genus *Anopheles* (3). Among these *species*, *P. falciparum* accounts for the majority of infections in Africa and is associated with the most severe clinical outcomes and mortality (4). Recent research in sub-Saharan Africa emphasizes the importance of including non-*falciparum* species in malaria surveillance efforts (5).

The term "Elderly" refers to a group particularly vulnerable to severe malaria and its complications. Research indicates that 61.5% of patients within this age bracket experience severe malaria, compared to 37.1% of those over 15 years old. Hospitalization duration also escalates with age, averaging 5 days for individuals under 45 and extending to 21 days for those 60 and above (6). Factors such as immune system decline, comorbidities, and healthcare access contribute to their heightened susceptibility, leading to complications like cerebral malaria and renal failure (6). Most epidemiological studies on malaria in Nigeria have focused on pregnant women and children under five years of age, the most vulnerable groups. However, limited attention has been given to the elderly population, despite their increased susceptibility to malaria due to their physiological state and comorbidities (7). Key risk factors include age, low income, non-use of insecticide-treated nets (ITNs), and inadequate sanitation.

Malaria can markedly worsen chronic health issues prevalent in older adults, especially cardiovascular diseases, hypertension, and diabetes, due to intricate interactions among the parasite, the host's immune response, and pre-existing physiological weaknesses. Endothelial damage from *Plasmodium*-infected red blood cells may induce circulatory disorders, exacerbating existing cardiovascular ailments. Such endothelial injury can heighten hypertension and elevate the risk of adverse cardiovascular events in older individuals with age-related cardiovascular decline. Additionally, age-related autonomic nervous system dysregulation can hinder

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the body's response to malaria, limiting older adults' capacity to manage the physiological stress of infection (8).

The current body of research on malaria prevalence among elderly populations in urban Nigeria reveals significant gaps and noteworthy findings. Documentation of malaria prevalence in this Demographic is scarce, with most studies concentrating on children under five or rural areas. Notably, (9) reported a 16.2% prevalence of asymptomatic malaria in individuals aged 60 and above in Osun State, indicating that the elderly may serve as an overlooked reservoir for malaria transmission in urban contexts. There is an urgent need for more extensive studies to explore the unique risk factors and health-seeking behaviors of this population, which is essential for developing targeted interventions and enhancing surveillance systems in Nigerian cities (10). The aim of this study therefore, was to determine the prevalence of malaria parasite infection among the elderly population in Benin City, Nigeria.

MATERIALS AND METHODS

Study Area and Study Design

This cross-sectional study was carried out to evaluate the prevalence of malaria parasite among the elderly population residing within Benin metropolis, Benin City, Edo State, Nigeria. Benin City consists of three Local Government Areas which are, Oredo, Egor and Ikpoba-Okha Local Government Areas respectively.

Study Population

A total of 250 elderly population within the age range 50 years to 85 years (consisting of 109 males and 141 females), residing in various apartments and family houses (randomly selected) within Benin metropolis, Edo State, Nigeria was recruited in this study.

Ethical Considerations

Ethical approval was sought and obtained from the Edo State Ministry of Health (Reference number HA/737/24/D/1030350) before commencement of the study. All participants were provided with detailed information about the study, including its purpose, procedures, potential risks, and benefits, in a language they understood. Written informed consent was obtained from each participant before sample collection. Participant confidentiality was strictly maintained throughout the study, and data were anonymized to protect personal information. No participant was coerced into participation, and they could withdraw from the study at any time without penalty.

Specimen Collection and Sample Analysis

Blood samples were obtained from participants by experienced Medical Laboratory Scientists (phlebotomists) who were trained in proper phlebotomy techniques. The collection process adhered to strict sterile procedures to ensure the safety of participants and the integrity of the samples. For each participant, thick and thin blood smears were prepared. Briefly, a drop of blood was placed on a clean, grease-free glass slide and spread evenly in a circular motion using an applicator stick to create a 15mm thick film. The blood films were then air-dried, heat fixed and stained with 10% Giemsa (pH 7.2) for 45 minutes; after which the stained slides were rinsed and air-dried again (This staining method highlighted the malaria parasites, making them visible for microscopic examination.). Microscopic examination was then performed on each stained slide using a 100× objective lens (oil immersion) under a light microscope. The number of parasites per high-power field were counted. A thick blood smear was considered positive if malaria parasites were observed in more than 100 fields at 100× high power magnification. The thin blood films were made by spreading a drop of blood on a slide, allowing it to air dry, heat fixed, stained with Giemsa stain and viewed microscopically. The thin films served as confirmatory test for the thick films. The entire process, from specimen collection to analysis, was conducted in accordance with established laboratory protocols to ensure the reliability and accuracy of the results (11).

Data Analysis

The data were analyzed using SPSS version 27. Descriptive statistics, including percentages and frequency distributions, were calculated to summarize the data. To examine the relationships and differences in the prevalence of malaria parasite infection across different groups, as well as to identify the factors influencing infection, the Chi-square test was employed. The multivariate logistic regression was used to determine the predictors of malaria parasite. A significance level of $p < 0.05$ was set for all statistical tests, indicating that any p-value below this threshold would be considered statistically significant.

RESULTS

Prevalence of malaria parasites among the elderly population in Benin City is shown in Table 1. Of the 250 participants studied, 68 participants (27.2%) tested positive for malaria parasites while 182 (72.8%) had no malaria parasite detected.

Relationship between Sociodemographic Profile and the Prevalence of Malaria Parasite Infection among the Elderly in Benin City is shown in Table 2. For age groups, 17.6% of those with malaria parasite were aged 50–54 years, 7.4% were aged 55–59 years, 16.2% were 60–64 years, 11.8% were 65–69 years, 19.1% were 70–74 years, 17.6% were 75–79 years and 10.3% were 80 years and above. Regarding gender, 64.7% of

participants with malaria parasites were female, while 35.3% were male. Educational levels varied, with 10.3% having no formal education, 32.4% having a primary education, 17.6% having a secondary education, and 39.7% attaining tertiary education. For mode of residence, 32.4% of participants with malaria parasites lived in the City Center, while 67.6% lived in the Suburbs. There was no statistically significant relationship between sociodemographic parameters of the study participants and the prevalence of malaria parasite ($p > 0.05$).

Impact of malaria infection on various health outcomes among the elderly in Benin City is shown in Table 3. There was no statistically significant impact of malaria infection on various health outcomes among the elderly in Benin City ($p > 0.05$).

Table 1: Prevalence of Malaria Parasite among the Elderly Population in Benin City

Malaria Parasite (MP) Detection	Frequency	Percent
MP Seen	68	27.2
No MP Seen	182	72.8
Total	250	100.0

Table 2: Relationship between Sociodemographic Profile and the Prevalence of Malaria Parasite Infection among the Elderly in Benin City.

Statement Frequency	Statement Frequency	No MP (n=182)	MP Seen (n=68)	p-value
Ages				
50–54	46(18.4)	34(18.7%)	12(17.6%)	0.856
55–59	14(5.6)	9 (4.9%)	5 (7.4%)	
60–64	52(20.8)	41(22.5%)	11(16.2%)	
65–69	33(13.2)	25(13.7%)	8 (11.8%)	
70–74	46(18.4)	33(18.1%)	13(19.1%)	
75–79	35(14.0)	23(12.6%)	12(17.6%)	
80 and above	24(9.6)	17 (9.3%)	07(10.3%)	
Genders				
Female	141(56.4)	97(53.3%)	44(64.7%)	0.105
Male	109(43.6)	85(46.7%)	24(35.3%)	
Educational Level				
No Formal	30(12.2)	23(12.6%)	7 (10.3%)	0.399
Primary	63(25.2)	41(22.5%)	22(32.4%)	
Secondary	55(22.0)	43(23.6%)	17.6%)	
Tertiary	102(40/8)	75(41.2%)	27(39.7%)	
Mode of Residence				
City Center	74(29.6)	52(28.6%)	22(32.4%)	0.56
Suburb	176(70.4)	130(71.4%)	46(67.6%)	

Table 3: Impact of Malaria Infection on the Health Outcomes of the Elderly in Benin City

Statement	No MP (n=182)	MP Seen (n=68)	p-value
Frequent Fever			
No	95 (52.2%)	36 (52.9%)	0.917
Yes	87 (47.8%)	32 (47.1%)	
Fatigue			
No	71 (39.0%)	32 (47.1%)	0.25
Yes	111 (61.0%)	36 (52.9%)	
Abdominal Pain			
No	133 (73.1%)	49 (72.1%)	0.872
Yes	49 (26.9%)	19 (27.9%)	
No Appetite			
No	147 (80.8%)	58 (85.3%)	0.407
Yes	35 (19.2%)	10 (14.7%)	
Nausea			
No	163 (89.6%)	64 (94.1%)	0.267
Yes	19 (10.4%)	4 (5.9%)	

Table 4: Risk Factors Associated with Malaria Parasite Infection among the Elderly in Benin City

Statement	No MP(n=182)	MP Seen (n=68)	p-value
Use of Mosquito Bed Net			
No	162 (89.0%)	58 (85.3%)	0.421
Yes	20 (11.0%)	10 (14.7%)	
Malaria in the Last 6 Months			
No	42 (23.1%)	11 (16.2%)	0.235
Yes	140 (76.9%)	57 (83.8%)	
Malaria in the Past Year			
No	46 (25.3%)	13 (19.1%)	0.308
Yes	136 (74.7%)	55 (80.9%)	
Last Malaria Treatment			
<3 months	26 (14.3%)	13 (19.1%)	
3 - 6 months	109 (59.9%)	39 57.4%)	0.7
7 months - 1 year	34 (18.7%)	10 14.7%)	
>1 year	13 (7.1%)	6 (8.8%)	
Chronic Health Condition			
No	82 (45.1%)	29 (42.6%)	0.733
Yes	100 (54.9%)	39 (57.4%)	
Presence of Hypertension			
No	108 (59.3%)	40 (58.8%)	0.941
Yes	74 (40.7%)	28 (41.2%)	
Presence of Diabetes			
No	154 (84.6%)	56 (82.4%)	0.664
Yes	28 (15.4%)	12 (17.6%)	
Closeness to Bushes			
No	72 (39.6%)	20 (29.4%)	0.139
Yes	110 (60.4%)	48 (70.6%)	
Closeness to Stagnant Water			
No	116 (63.7%)	45 (66.2%)	0.72
Yes	66 (36.3%)	23 (33.8%)	
Have Received Blood Transfusion			
No	141 (77.5%)	55 (80.9%)	0.56
Yes	41 (22.5%)	13 (19.1%)	

Risk factors associated with malaria parasite infection among the elderly in Benin City is shown in Table 4. The results indicate that none of the examined factors, including the use of mosquito bed nets, malaria history, chronic health conditions, proximity to potential mosquito breeding sites, or blood transfusion history, are significantly associated with malaria parasite infection among the elderly in Benin City ($p > 0.05$).

Predictors of malaria parasite in the elderly in Benin City is shown in Table 5. The result shows that none of the variables are predictors of malaria parasite in the elderly in Benin City.

Table 5: Multivariate Logistic Regression of Predictors of Malaria Parasite

Variables	P-value	Odd Ratio (OR)	95% C.I. for OR	
			Lower Bound	Upper Bound
Age	0.452	1.070	0.898	1.275
Gender	0.184	0.642	0.334	1.234
Tribe	0.452	0.950	0.830	1.086
Religion	0.804	1.134	0.421	3.051
Educational Level	0.782	1.046	0.761	1.438
Mode of Residence	0.842	0.928	0.446	1.932
Use of Mosquito Bed Net	0.350	0.665	0.283	1.565
Malaria in the Last 6 Months	0.498	1.372	0.550	3.420
Malaria in the Past Year	0.389	1.458	0.619	3.434
Last Malaria Treatment	0.563	1.141	0.730	1.782
Chronic Health Condition	0.887	1.064	0.455	2.484
Presence of Hypertension	0.992	0.996	0.440	2.255
Presence of Diabetes	0.582	0.787	0.335	1.849
Closeness to Bushes	0.080	1.887	0.927	3.841
Closeness to Stagnant Water	0.324	0.720	0.375	1.383
Have Received Blood Transfusion	0.912	0.959	0.455	2.021
Constant	0.280	0.112		

DISCUSSION

This study comprehensively examines the prevalence of malaria parasites and the factors influencing their occurrence among the elderly population in Benin City. By exploring the interplay of sociodemographic, environmental, and health-related characteristics, the study sheds light on the dynamics of malaria infection in this vulnerable demographic. The results reveal a malaria prevalence rate of 27.2% among the elderly, underscoring the persistent burden of the disease within this age group.

The observed prevalence aligns with findings from (9), who documented a malaria prevalence of 16.2% among older adults in Southwestern Nigeria, and (12), who reported a 4.6% prevalence among individuals aged 60 and above. Conversely, this study's prevalence is notably lower than the 63.3% reported by (13) among febrile adults in rural Nigeria. (14) recorded an alarmingly high prevalence of 93.4% in rural and peri-urban communities, with a staggering 100% prevalence in the 51–60 age group. Such disparities highlight the influence of varying climatic conditions, socioeconomic factors, vector control measures, and access to healthcare across different regions. For instance, (13) attributed the high prevalence in rural areas to farming occupations, low literacy levels, and substandard housing, which collectively increase malaria susceptibility.

This study found no statistically significant association between malaria parasite presence and clinical symptoms, including frequent fever, fatigue, abdominal pain, appetite loss, or nausea. These findings corroborate (15), who also reported no significant link between malaria infection and symptoms such as fatigue or frequent fever among older adults. Interestingly, Buchwald *et al*. highlighted the high prevalence of asymptomatic infections, suggesting that such individuals may exhibit reduced risk of progressing to malaria illness, likely due to partial immunity. However, (16) observed strong associations between malaria and symptoms like prolonged fever, headache, and nausea, particularly in populations with lower immunity levels.

The apparent discrepancy between studies can be attributed to variations in immunity and comorbidities. Older adults in malaria-endemic regions often develop partial immunity due to repeated exposure, resulting in milder or asymptomatic infections (15). Additionally, differences in diagnostic methods and symptom-reporting accuracy may contribute to the inconsistencies.

Sociodemographic factors, including age, gender, educational attainment, and residential location, were not significantly associated with malaria prevalence in this study. This outcome contrasts with (13), who linked high malaria prevalence with rural residency, farming occupations, and low educational levels. Similarly, (14) emphasized the heightened vulnerability of rural dwellers due to inadequate access to vector control measures and poor living conditions. While this study's high proportion of urban residents (70.4%) may have mitigated such disparities, (9) reported significant gender differences, with higher prevalence rates among males (24.4%) compared to females (13.7%). The occupational dimension, particularly farming, has also been highlighted as a critical factor driving malaria susceptibility (14).

Environmental factors, such as proximity to bushes and stagnant water, did not show a significant association with malaria prevalence in this study. This finding diverges from the conclusions of (17), who identified proximity to stagnant water as a significant predictor of malaria infection among older adults. Additionally, (18) associated environmental conditions, including rainfall, temperature, and proximity to water bodies, with increased malaria risk. (19) further emphasized the roles of altitude and housing quality in shaping malaria dynamics. The lack of significant associations in the current study could reflect the mitigating impact of widespread

vector control measures, such as the use of insecticide-treated nets (ITNs), within the study population.

The findings emphasize the need for sustained and adaptive malaria control strategies tailored to the unique challenges faced by the elderly population in urban and peri-urban settings. Despite the lack of statistically significant associations between malaria prevalence and identified risk factors, the high prevalence rate among this demographic underscores the importance of routine malaria surveillance and targeted interventions. Urban-specific strategies, such as improved waste management to eliminate mosquito breeding sites and the continued distribution of ITNs, remain essential components of malaria control programs.

The study underscores the multifaceted nature of malaria infection among the elderly, highlighting the interplay of sociodemographic, environmental, and health-related factors. Effective malaria management in this demographic requires a nuanced and integrated approach, combining robust surveillance with tailored preventive and therapeutic strategies.

Conclusion: The prevalence of malaria infection among the elderly population in Benin City is 27.2%. The findings revealed that sociodemographic factors such as age, gender, education, and residential location were not significantly associated with malaria prevalence in the study population. No significant association was also observed between malaria and clinical symptoms of participants. Public health campaigns should focus on educating older adults especially those with limited mobility or healthcare access about malaria prevention.

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