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Research Article

Environmental and Health System Factors Influencing Malaria Recurrence among Patients Using Selected Primary Healthcare Centres in Sagamu, Ogun State

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Abstract

Malaria remains a pervasive public health challenge in Nigeria, particularly in hyperendemic regions such as Sagamu, Ogun State, where individuals experience multiple Plasmodium falciparum infections annually. This study investigates the environmental and health system factors influencing malaria recurrence among

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patients attending selected primary healthcare centres in Sagamu. Employing a descriptive cross-sectional design, data were gathered from 160 respondents using structured interviews and surveys, and analysed using SPSS v26.0. Results indicate that 53.1% of respondents experienced malaria recurrence 2–5 times in the past year, with 43.1% reporting reinfection within three months of initial treatment. Key contributing factors included proximity to stagnant water (45.6%), persistent power outages (100%), limited access to insecticide-treated nets (42.5% rarely), and frequent shortages of malaria medication (39.4% often, 26.3% always). Moreover, 65% of respondents reported difficulties accessing malaria treatment, and 29.4% did not seek medical help during recurrences. Notably, 50% experienced more severe symptoms upon recurrence, while 25.6% reported incomplete recovery between episodes. The findings underscore the interplay of infrastructural inadequacies, environmental exposure, and healthcare limitations in sustaining malaria recurrence. The study recommends bolstering healthcare infrastructure, ensuring consistent supply of antimalarial medications, scaling up preventive measures, and improving environmental sanitation and power reliability to mitigate malaria recurrence and its public health burden.

Keywords: Malaria recurrence, Plasmodium falciparum, healthcare access, environmental health.

Introduction

Individuals who live in areas where malaria remains endemic frequently get attacked by malaria multiple times during a single season [1]. The occurrence patterns for several malaria attacks depend on specific community health conditions found in the environment [2]. Nigeria is a malaria hyperendemic regions experiencing Plasmodium falciparum attacks that occur approximately every four until six weeks of each year [3]. In the hyperendemic areas of Nigeria, children may suffer repeated Plasmodium falciparum attacks every 4 to 6 weeks over many years [4].

A study of P. falciparum and Plasmodium vivax symptomatic malaria from the Nkomazi municipality, South Africa detected 21.5% and 31.5% patient recurrence rates for P. falciparum and P. vivax respectively within the 63-day period following P. falciparum malaria treatment [5]. Even in low-transmission settings in Nigeria, it was estimated that on average a person might have 1–3 episodes of malaria infection in a year [6]. A study conducted in the extra-Amazon Region of Brazil, where both P. falciparum and Plasmodium vivax are symptomatic, found that the cumulative proportions of patients having recurrent P. falciparum and P. vivax infections within 63 days after treatment of acute P. falciparum malaria were 21.5% and 31.5%, respectively [7].

African currently holds the maximum number of worldwide malaria cases. P. falciparum retains its position as the primary cause of fatal outcomes throughout Africa [6]. Multiple elements affecting malaria transmission include environmental climate conditions along with economic factors together with the location of geographic regions and human activities and operating within insecure domains [8]. Rapid

infections coupled with late medical interventions have resulted in a substantial increase of patients who carry plasmodium without classical malaria symptoms or maintain silent parasitic infections [9]. Consequently, these individuals face substantial challenges in proper medical assessment [10].

African countries achieved notable development in malaria control and elimination through various initiatives that span rapid malaria testing alongside screening programs for mosquito defenses and agency-certain preventive medicine and artesunate combinations as well as vaccine production [8]. It has been revealed that from 2000 to 2022 the WHO African Region saw a 40% decrease in reported malaria cases while mortality rate decreased by 60% [2]. The fight against malaria faces emerging obstacles in Africa including insufficient health services while battling poverty conditions alongside rising outdoor transmission rates and new vector invasion together with growing drug and insecticide resistance problems [11,12]. This study identifies the environmental and health system factors influencing malaria recurrence among patients using Selected Primary Healthcare Centres in Sagamu, Ogun State.

Research Method

The study adopted a descriptive cross-sectional research design to uncover and analyze specific-time factors that lead to malaria recurrence events. The study location is Sagamu, Ogun State. The researcher selected Sagamu because the town serves as the state's primary settlement with both urban and rural inhabitants yet diverse healthcare service levels. The primary healthcare facilities across Sagamu comprise a sufficient group to allow researchers to understand local malaria care strategies.

The data was collected utilizing both structured interviews and surveys. The data was analysed using Statistical Package of Social Sciences v. 26.0. Informed Consent was gotten from every participant of the study before commencing the study. The researcher ensured that confidentiality was maintained.

Results and Discussion

Table 1. Socio-demographic Characteristics

Variable	Response	Frequency (n=160)	Percentage (%)
Age Range (Mean = 31.4 ± 0.5)	15 - 20	20	12.5
	21 - 35	87	54.4
	36 - 60	48	30.0
	60>	5	3.1
Current marital status	Divorced	6	3.8
	Married	100	62.5
	Single	50	31.3

	Widowed	4	2.5
Religion	Christianity	125	78.1
	Islam	35	21.9
Occupation	Civil Servant	24	15.0
	Private Employee	12	7.5
	Self-Employee	96	60.0
	Unemployed	28	17.5
Income	100 - 150,000	32	20.0
	150,000>	12	7.5
	30 - 50,000	55	34.4
	50 - 100,000	61	38.1
Education Level	High School Graduate	63	39.4
	Primary school graduate	15	9.4
	Tertiary Institute Graduate	82	51.3
Household Size	1	15	9.4
	2 - 5	102	63.8
	More than 5	43	26.9
Duration of Residency	1 - 3 years	59	36.9
	Less than 1 year	21	13.1
	More than 3 years	80	50.0

The largest age group is 21-35 years (54.4%), indicating that the majority of respondents are young adults. This is followed by 36-60 years (30.0%), suggesting a smaller but significant middle-aged group. The smallest groups are 15-20 years (12.5%) and over 60 years (3.1%). (Mean = 31.4 ± 0.5). The majority of respondents are married (62.5%), followed by single individuals (31.3%), with divorced (3.8%) and widowed (2.5%) respondents comprising the smallest portions.

Christianity is the predominant religion (78.1%), with Islam making up the remaining 21.9%. Cultural beliefs influenced by religion may affect attitudes towards healthcare practices and adherence to malaria preventive measures.

The majority of respondents are self-employed (60.0%), followed by unemployed (17.5%), civil servants (15.0%), and private employees (7.5%). Self-employed and unemployed individuals may have variable

income levels and limited access to consistent healthcare, potentially impacting their ability to afford malaria treatment and preventive measures.

The income bracket distribution shows that 38.1% of respondents earn ₦50,000 - ₦100,000, while 34.4% earn ₦30,000 - ₦50,000. A smaller portion, 20.0%, earns ₦100,000 - ₦150,000, and 7.5% earn more than ₦150,000 Most respondents are tertiary institute graduates (51.3%), followed by high school graduates (39.4%), with a small group of primary school graduates (9.4%).

Most respondents have 2-5 members in their household (63.8%), with households of more than 5 members (26.9%) and single-member households (9.4%) being less common. Half of the respondents have lived in their area for more than 3 years (50.0%), followed by 1-3 years (36.9%) and less than 1 year (13.1%).

Table 2. Environmental and Health System Factors Influencing Malaria Recurrence

Question	Frequency (n =160)	Percentage (%)
How often do you live near areas with stagnant water, such as ponds or ditches?		
No	87	54.4
Yes	73	45.6
How often do you experience power outages that prevent the use of fans or air conditioners to reduce mosquitoes?		
Yes	160	100.0
Always	43	26.9
Never	35	21.9
Often	39	24.4
Rarely	43	26.9
How often do you observe poor waste disposal systems that contribute to mosquito breeding?		
Always	28	17.5
Never	33	20.6
Often	37	23.1
Rarely	62	38.8

A considerable portion (45.6%) of respondents live near areas with stagnant water, such as ponds or ditches. All respondents (100%) report experiencing power outages, which hinder the use of fans or air conditioners to prevent mosquito bites. Power outages occur always for 26.9%, often for 24.4%, and rarely

for 26.9%. Poor waste disposal systems are frequently observed, with 17.5% always and 23.1% often witnessing poor waste management, while 38.8% rarely observe it.

Table 3. Environmental and Health System Factors Influencing Malaria Recurrence

Question	Frequency (n =160)	Percentage (%)
How often do you experience difficulty in assessing malarial treatment at health care facilities?		
Always	23	14.4
Never	56	35.0
Often	22	13.8
Rarely	59	36.9
How often do you lack access to insecticide-treated nets or indoor residual spraying services?		
Always	17	10.6
Never	58	36.3
Often	17	10.6
Rarely	68	42.5
How often do health care centers in your area run out of malaria medication?		
Always	42	26.3
Never	13	8.1
Often	63	39.4
Rarely	42	26.3
How many times have you tested positive for malaria in the past 12 months		
2 - 5 times	85	53.1
5 - 10 times	14	8.8
More than 10 times	2	1.3
Once or never	59	36.9
How long after testing positive for malaria does it take you to get sick of malaria again		
After 1 - 3 weeks	53	33.1
After 1 month	12	7.5

After 2 - 3 months	26	16.3
After more than 3 months	69	43.1
Did you seek medical attention after experiencing symptoms of malaria recurrence?		
No	47	29.4
Yes	113	70.6
Were your symptoms milder or more severe during the recurrence compared to the first episode?		
No	80	50.0
Yes	80	50.0
Did you feel fully recovered between malaria episodes, or did the symptoms persist in some form?		
No	41	25.6
Yes	119	74.4

Table 3 revealed that 14.4% of respondents always experience difficulty in accessing malaria treatment, and 13.8% often do, while the majority experience difficulty either rarely (36.9%) or never (35.0%). Access to insecticide-treated nets or indoor residual spraying services is limited, with 10.6% always lacking access and 10.6% often lacking access, while 42.5% report rarely lacking access. Medication shortages are a recurrent issue, with 26.3% always and 39.4% often experiencing shortages, while only 8.1% never face this issue.

Most respondents have tested positive for malaria 2-5 times (53.1%) in the past year, while 36.9% report once or never. A small group experienced 5-10 episodes (8.8%) or more than 10 (1.3%). For those who experience recurrence, 33.1% report symptoms returning after 1-3 weeks, while 43.1% experience recurrence after more than 3 months. Smaller portions report intervals of 1 month (7.5%) and 2-3 months (16.3%).

The majority (70.6%) seek medical attention upon recurrence, while 29.4% do not.

The severity of symptoms during recurrence with 50% reporting symptoms being more severe during recurrence and 50% experiencing similar or milder symptoms. The majority (74.4%) report feeling fully recovered between episodes, while 25.6% do not.

Discussion

The study revealed that access to proper treatment is a critical factor in preventing malaria recurrence. The results show that 35% of respondents reported never experiencing difficulty accessing treatment, which suggests that for some individuals, healthcare services are relatively accessible. However, a combined 65% of respondents either "rarely," "often," or "always" experienced difficulties accessing malaria treatment.

This finding indicates that a significant portion of the population faces barriers to treatment, such as long waiting times, lack of medication, or inadequate healthcare infrastructure [13]. These challenges likely contribute to delayed or incomplete treatment, increasing the risk of malaria recurrence [12].

Stagnant water serves as a breeding ground for *Anopheles* mosquitoes, the primary vector for malaria. 45.6% of respondents reported living near areas with stagnant water, which significantly increases their exposure to mosquito bites and, consequently, their risk of contracting malaria. Thus while more than half of the respondents (54.4%) reported not living near stagnant water, the presence of such areas in proximity to healthcare centers or residential areas could still pose a significant risk. This environmental factor underscores the need for effective vector control interventions, such as water management and community-level mosquito eradication programs [4].

Power outages are a ubiquitous problem, as all respondents (100%) reported experiencing power outages. 26.9% reported frequent power outages (always), which disrupt the use of fans or air conditioners to reduce the presence of mosquitoes indoors. Mosquitoes are more active in warm, humid environments, and using fans or air conditioners can help limit their presence by making the environment less hospitable [14]. The frequency of power outages thus indirectly increases the risk of malaria transmission, as households may not be able to effectively manage indoor mosquito populations. This suggests that addressing power instability may be a critical aspect of reducing malaria recurrence in the region [1].

Insecticide-treated nets (ITNs) and indoor residual spraying (IRS) are proven methods for preventing malaria by reducing mosquito contact with humans. However, the 42.5% of respondents who reported rarely having access to ITNs or IRS services, coupled with 10.6% who indicated they never had access to these preventive measures, indicates a significant gap in malaria prevention strategies. This is not in agreement with a study conducted in conflict-affected state of South Sudan that 88.9% (257) had environmental measures and/or insecticide treated nets as malaria prevention measures [6]. These gaps in access could be due to factors such as supply shortages, insufficient distribution networks, or lack of education regarding their importance [15]. The 10.6% of respondents who reported always having access may indicate areas where malaria prevention services are functioning well, but for the majority, this lack of preventive measures could significantly contribute to the high recurrence of malaria in the community.

The availability of malaria medication at healthcare facilities is essential for timely and effective treatment. Forty two respondents reported always encountering shortages, which could result in patients seeking alternative sources of treatment or delaying care. The lack of timely access to malaria medications increases the risk of inadequate treatment and fosters drug resistance, which can further contribute to recurrence [6]. Thus, when medications are unavailable or unaffordable, patients may resort to self-medication or turn to informal healthcare providers, which may not be as effective or may contribute to incorrect treatment regimens [11].

The findings highlight a combination of health system challenges and environmental risk factors that contribute to the recurrence of malaria in Sagamu. Factors such as difficulty accessing malaria treatment**,** living near stagnant water**,** frequent power outages, and inconsistent access to preventive measures (ITNs,

IRS, and malaria medications) directly influence the community's ability to prevent and treat malaria effectively [1, 7]. Addressing these challenges requires a multifaceted approach that includes improving healthcare infrastructure, increasing the availability of malaria medications, providing consistent vector control measures, and addressing power instability [1,10].

A substantial proportion of respondents (53.1%) reported testing positive for malaria between 2 to 5 times within the past 12 months, which suggests that malaria recurrence is a frequent issue in this community. This frequency of recurrence highlights the need for more effective malaria control strategies, including better access to preventive measures such as insecticide-treated nets (ITNs) and indoor residual spraying (IRS), as well as more reliable and continuous treatment regimens [15]. The fact that **36.9%** of respondents had tested positive only once or never in the past year could indicate that a significant portion of the population may have access to effective malaria prevention or may be living in areas with fewer mosquito vectors, but this is not enough to offset the larger issue of recurrent infections [14]. This is in agreement with a study by [6], they revealed that prevalence of severe recurrent malaria was 66.1% (191) while 74.4% (215) did not complete their anti-malaria treatment.

A significant portion of participants (43.1%) reported that they experienced a relapse of malaria after more than 3 months, which could suggest that while they may have recovered from an initial episode, they were not fully protected against future infections. On the other hand, 33.1% of participants reported a relapse within 1 to 3 weeks, pointing to the possibility of incomplete recovery or inadequate treatment, which may not have fully eradicated the malaria parasite from their system, increasing the likelihood of recurrence. This finding also raises concerns about the effectiveness of malaria treatment in the region. If malaria recurs within such a short time frame (1 to 3 weeks), it may indicate issues such as improper dosage or treatment regimens, or that patients are not adhering to the full course of prescribed medications [2, 3].

An interesting finding is the equal split between participants who reported that their symptoms during the recurrence were either more severe (50%) or not more severe than during their first episode. This suggests that for some patients, recurrence may either be due to incomplete treatment or the accumulation of factors such as low immunity or the presence of drug-resistant malaria strains [6]. In some cases, recurrent infections can be more severe if the patient’s immune system is weakened, or if there are complications from delayed or inadequate treatment. It would be important to investigate the underlying causes of these more severe recurrences, which could include suboptimal treatment protocols, misdiagnosis, or delayed diagnosis leading to complications [8].

A majority of respondents (74.4%) felt fully recovered between malaria episodes, which suggests that in most cases, the treatment provided is effective in eliminating the symptoms of malaria temporarily. However, **25.6%** of participants reported that they did not feel fully recovered, indicating the presence of lingering symptoms. This could reflect issues like suboptimal treatment, co-infections, or other underlying health issues that may contribute to persistent or recurrent symptoms [16]. Long-term or chronic symptoms that are perceived as part of malaria recovery could point to complications, including fatigue, anemia, or spleen enlargement, which may not have been fully addressed during initial treatment [5]. This highlights

the need for more comprehensive post-malaria care and follow-up to ensure that patients are fully recovered and that potential long-term complications are managed [7].

The findings reveal several key factors that contribute to the recurrence of malaria, including the frequency of infections, delayed or inadequate treatment, and difficulties in accessing healthcare [4]. The short time between initial treatment and recurrence, as well as the high percentage of individuals who experience more severe symptoms during relapses, underscores the importance of improving the effectiveness of malaria treatment and prevention measures [2].

Conclusion

This study indicated access to proper treatment is a critical factor in preventing malaria recurrence. Also, stagnant water serves as a breeding ground for *Anopheles* mosquitoes, the primary vector for malaria. However, the 42.5% of respondents who reported rarely having access to ITNs or IRS services. The availability of malaria medication at healthcare facilities is essential for timely and effective treatment. Forty-two respondents reported always encountering shortages, which could result in patients seeking alternative sources of treatment or delaying care. A substantial proportion of respondents (53.1%) reported testing positive for malaria between 2 to 5 times within the past 12 months, which suggests that malaria recurrence is a frequent issue in this community. A significant portion of participants (43.1%) reported that they experienced a relapse of malaria after more than 3 months, which could suggest that while they may have recovered from an initial episode, they were not fully protected against future infections. The majority of respondents (70.6%) sought medical attention after experiencing symptoms of malaria recurrence, which is a positive indicator of health-seeking behavior in the community. A majority of respondents (74.4%) felt fully recovered between malaria episodes, which suggests that in most cases, the treatment provided is effective in eliminating the symptoms of malaria temporarily. Based on these results, it was recommended among others that the government needs to strengthen healthcare access by improving the availability of essential malaria medications and treatment at healthcare facilities. The government also need to educate the public about the importance of using ITNs, IRS, and other preventive measures consistently. Furthermore, the need to **i**mplement community-based initiatives to reduce stagnant water and improve waste management to control mosquito breeding sites as well as the need to enhance power supply stability to ensure that cooling systems, such as fans and air conditioners, can be used to mitigate mosquito exposure indoors were suggested.

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