



## **Socioeconomic Determinants of Malaria in Selected Urban and Rural Areas in Anambra State, Nigeria**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors CCN and POA designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript.*

*Authors CCN and HNC managed the analyses of the study. Author AFC managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

Malaria, a disease of poverty, is of significant public health concern. It is endemic in Nigeria with the risk of transmission appearing to be high because of favorable climatic and environmental factors. Increased susceptibility to malaria has also been linked to dirty surroundings that favor the breeding and propagation of the vector, poor access to quality health care and ignorance especially of malaria prevention strategies. However, this study investigated the role of socioeconomic factors responsible for the observed difference in malaria prevalence between selected rural and urban areas of Anambra, Nigeria. A descriptive comparative cross-sectional study, data on demographic and socioeconomic variables were collected from 202 urban and rural respondents, then analyzed using SPSS platform to generate chi-square test of significance. The results were presented in figures, table and charts for clarity. All the subjects were aware of the term malaria but only 63.4% had adequate specific knowledge of malaria. Generally, 25.7% of rural participants had no formal education while the urban group had only 4% of that particular category. About 52.5% of rural participants earned below 50,000 naira monthly, with 14.9% earning above 100,000 naira while the

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reverse was the case in the urban area. Also, the number of malaria episodes was inversely proportional to the household monthly income ( $X^2=24.30$ ,  $p<0.001$ ). More episodes of malaria were also reported among the unskilled workers and skilled workers (71.3%) compared to Professionals (28.7%), yet all the participants reported the presence of a healthcare facility <3km from their houses with 95% and 80.2% of them in the rural and urban areas respectively having to pay out-of-pocket for healthcare services. It is clear that socioeconomic factors play a role in the persistence of malaria as an endemic disease in Nigeria. Therefore, existing control measures should incorporate strategies to end poverty and ignorance especially among the rural populace.

**Keywords:** Socioeconomic determinants; malaria; urban; rural; Nigeria.

## 1. INTRODUCTION

Malaria is one of the deadliest infectious diseases second only to the Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome pandemic and is among the first five diseases with the highest total annual health burden globally [1]. Malaria is a disease of significant public health concern and according to the World Health Organization (WHO 2018), estimates reported in 2016 revealed that there were about 216 million morbidity and 0.45 million mortality due to malaria globally [2]. This is even more worrisome when the inequity in the distribution of the disease is considered, whereby 80% of the global malaria burden is borne by only fifteen countries which are all in sub-Saharan Africa except one, with Nigeria accounting for about a quarter of the global burden of morbidity (27%) and mortality (24%) due to malaria [2]. This is further emphasized by noting that over 50% of the Nigerian population, particularly among the vulnerable under-fives, has at least one incidence of malaria annually [3-5].

It has been identified that the disease is caused by five different species of the *Plasmodium* parasite namely: *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae*, *Plasmodium ovale* and *Plasmodium knowlesi* with *Plasmodium falciparum* being the most virulent of them all and usually responsible for cases of complicated malaria and contributing about 90% of malaria cases in the country [6]. Due to the high prevalence of the disease in Nigeria, a significant percentage of the population gets infected but do not come down with symptoms and signs of malaria like fever, headache, muscle aches, dizziness, chills and rigor which is often when the diagnosis of malaria is made and treatment commenced [7]. Currently, the recommended first line of treatment for malaria is Artemisinin-based

Combination therapy which has been proven to be efficacious.

The disease is endemic in Nigeria and its transmission is fairly stable year-round although during the rainy season, risk of transmission appears to be higher because of favorable climatic and environmental factors. Certain factors have been widely implicated as rendering individuals more susceptible to acquiring the infection, and these are dirty surroundings that favor the breeding and propagation of the malaria vector, poor access to quality health care and ignorance especially of malaria prevention strategies [8]. More importantly, the disease has been described to be one of poverty as it is both a cause of poverty and is at the same time caused by poverty [9]. This assertion is borne up by the fact that the greatest prevalence of malaria worldwide occurs in the poorest of countries and even within those countries with a high disease burden, malaria prevalence is higher among the most disadvantaged who are mostly found in the rural areas [9]. Researchers have proposed that this observed difference in prevalence of malaria between rural and urban areas can be explained by the fact that urban areas possess better social infrastructure than their rural counterparts in terms of better housing, sanitation, access to health care and education, all of which contribute to the increased malaria prevalence in rural areas thus further impoverishing them [10,11]. A case in point is that a poor country like Nigeria still records a gross annual economic cost of NGN132 billion due to malaria [11] and this economic impact includes sick days which leads to work and school absenteeism, decreased brain activity and output from complicated malaria, loss of investments and further impoverishment due to diversion of resources from other areas of human development. It therefore stands to reason that a reduction in the prevalence of malaria would entail an overall

increase in the country's human development index [12].

Research has shown that even as at the 17<sup>th</sup> century, there have been records of malaria worldwide though many developed countries successfully eliminated it along with many other infectious diseases by the 20<sup>th</sup> century. This elimination was achieved through no particularly sophisticated medical practice but via improvements in the social, economic, education and public health character [13,14]. Even recently, six countries have also been certified as free from malaria and they include: Armenia, Turkmenistan, Morocco, Maldives, Kyrgyzstan and Sri Lanka [2]. Meanwhile, it is pertinent to note that the incidence and prevalence of malaria have remained on the increase in those poor countries where it is endemic, from 211 million cases in 2015 to 216 million in 2016 [2], despite efforts by the affected countries and the international community to curtail it, leading to a vicious cycle of poverty and disease in many of such countries as malaria causes great annual economic loss [9,15].

This area of study was chosen for investigation because overtime malaria has proved to be of grave public health concern especially in Nigeria that bears the greatest malaria burden worldwide and where the incidence and prevalence of the disease appear to maintain a steady rise despite both local and international efforts to curb it [2]. Secondly, in Nigeria like many other developing countries where the disease is endemic, the prevalence of malaria is higher in rural areas than the urban areas, coupled with the observed socioeconomic gap between residents of the two areas where the urbanites are generally wealthier than the rural residents, it becomes pertinent to investigate if there is an association between socioeconomic factors and prevalence of malaria [16].

Despite the findings of numerous studies showing that socioeconomic factors contribute significantly to the incidence/prevalence of malaria, current malaria control programs in Nigeria and even globally have remained based on approaches such as health education, provision of insecticide treated nets, early detection and treatment with artemisinin-based combination therapy including intermittent preventive treatment of pregnant women [5,17] which are all important but fail to pay adequate attention to these socioeconomic factors that have been noted as being crucial to the

persistence of malaria and in fact, to its rising incidence/prevalence thus, accounting for the 'failure' of these interventions [9]. According to Lt. Col. S.P. James in 1929, "...the diminution of local malaria in England was due neither to natural causes nor to the intentional application of any particular preventive method reputed to be specific, but to progressive improvements of a social economic, educational, medical, and public health character" [18]. This statement lends further credence to the assertion that malaria control measures should lay greater emphasis on the fundamental determinants of malaria, most importantly poverty, by addressing the socioeconomic factors driving the malaria epidemic if they are to succeed [11].

This study therefore sought to investigate the role of socioeconomic determinants as the missing link in malaria control measures responsible for their apparent failure, by determining if socioeconomic factors are responsible for the observed difference in malaria prevalence between rural and urban areas, which will in turn play a relevant role in contributing information to already existing scientific literature that may be utilized by policy makers in creating appropriate measures for the control of malaria or modifying already existing ones [19]. Since Nigeria contributes approximately a quarter of the global malaria burden, elimination of malaria in Nigeria would be a giant stride towards global malaria elimination [11].

The specific objectives include: 1) to determine the prevalence of malaria amongst the selected rural and urban areas, 2) to identify the factors perpetuating malaria in the selected rural area and urban area, and 3) to investigate the role of socioeconomic factors in the observed difference in prevalence of malaria between urban and rural areas.

## **2. METHODOLOGY**

### **2.1 Study Area**

The study area was in Anambra State, in South Eastern Nigeria. It has a population of about 8 million people which makes it the second most densely populated state in Nigeria after Lagos State. The state is made up of twenty-one local government areas (LGAs) of which about 15 are rural and semi-urban while the remaining 6 are urban. Simple random sampling was utilized to select Nnewi North local government area (LGA)

and Anaocha LGA as the urban and rural LGAs respectively. Anaocha LGA has an area of about 104km<sup>2</sup> and a population of about 284, 215 people with 142, 961 males and 141, 254 females. The spoken language is Igbo. Nnewi North LGA has an area of 60km<sup>2</sup> and a population of about 155, 443 people with 77, 517 males and 77, 926 females. The spoken language is English and Igbo.

## 2.2 Research Design

This was descriptive comparative cross-sectional study.

## 2.3 Sample Size Determination

The sample size was determined using the sample size formula for comparative cross-sectional descriptive studies [20]:  $n = 2z^2pq/d^2$  Whereby, n= desired minimum study population size; z= confidence limit taken as 1.96; p= prevalence of the condition from previous similar studies done elsewhere =59.8% [12]; q= 1-p =0.4; d= margin of error tolerable = 0.1; Therefore,  $n = 2(1.96)^2(0.6)(0.4)/(0.1)^2 = 184$ . In order to adjust for attrition, 10% of the minimum sample size was calculated and added to obtain the optimal sample size to be used for the study.

$$\text{i.e. } 0.1 \times 184 = 18.4; 184 + 18 = 202$$

This means that a total of 202 participants were to be enrolled from the selected communities into the research project, 101 participants from the rural LGA and 101 participants from the urban LGA.

## 2.4 Data Collection and Analysis

Adequate community entry of the selected communities was conducted since the general population was the study population to ensure its representativeness. Households were visited to ascertain their willingness to participate in the study and schedule a convenient time for data collection. Then to ensure thorough community mobilization, the aid of all relevant stakeholders especially the community leaders was enlisted to organize a 2 day mini outreach for the community on a weekend, when they did not have any other prior scheduled function, at the town square whereby the already sensitized community members gathered and details on demographics, socioeconomic status, knowledge of malaria and health care access were obtained via structured questionnaires which were printed in English.

The specific variables that were recorded included age, gender, marital status, place of residence, family size, occupation, monthly income, level of education, knowledge about malaria and access to healthcare. Participants who were able to respond well to at least two out of the four questions on knowledge about malaria were considered to have adequate knowledge while those unable to respond to at least two questions were considered to have poor knowledge. Secondly, participants with a monthly income of <N50,000 were classified as low income earners, those earning N50,000 – N100,000 classified as average income earners while those earning >N100,000 are the high-income earners. The value for monthly income was obtained by enquiring into their assets, salary/products sales and other income.

Data obtained from the printed questionnaires were entered into the computer via Microsoft Access to ensure consistency and completeness of information [19]. Then the SPSS statistics software was used to analyze data as it provides a conducive avenue for statistical analyses like this to be conducted with minimal error margins and for more accurate results [21]. In order to assess the validity and reliability of the proposed hypothesis, the Pearson chi-square statistical test was applied as it was deemed most appropriate to test the hypothesis since the variables involved are categorical [21]. Finally, the obtained results were presented in figures, table and charts for clarity.

As would be expected of any research study, some potential ethical issues that could arise in the course of data collection including methodological issues such as falsifying information required on the questionnaire in order to satisfy perceived expectations of the researcher or to avoid being identified which could affect the quality of data collected were addressed by proper explanation of the research purpose and assuring participants of utmost autonomy [19].

## 2.5 Practical Considerations

Like every other research, there were some hurdles that had to be overcome and limitations addressed in order to make it viable.

First, there was the issue of convincing the study population especially those in the rural area on the importance of the research and their need to participate in it because studies have shown that

malaria is not usually regarded as a deadly disease especially in rural areas in countries where it is endemic with the various misconceptions about the causes [11], thus a study into its' determinants with a view to modifying control measures in order to reduce incidence and prevalence of the disease was not entirely considered worthwhile. This notion was emphasized by the fact that the study did not provide any direct compensation to participants. To mitigate this, the researchers commenced the study with proper community entry and adequate health education on malaria as a precursor to winning the interest and consents of the study population to achieve maximal cooperation. In addition, data collection was conducted at the participants' convenient time.

Also, this research project prohibited the use of a research assistant, thus management of time was quite challenging as it took the researchers more time to administer the questionnaires personally to all participants.

Finally, since the analysis of the quantitative data was conducted using the SPSS statistical tool, the researchers had to attain a certain proficiency in the software package through some books and self-help videos available online.

## 2.6 Strengths and Limitations

In order to ensure internal validity, random sampling was employed. To this end also, the subjects were made to understand that participation in the study was entirely voluntary and they could withdraw at any point in order to ensure genuinely willing participants prepared to offer data freely thus enhancing the study reliability [22].

Although it is hoped that the findings of this study can be applied to other situations, a complex interplay of numerous factors are responsible for the incidence of malaria and many of them are obtainable depending on the specific region under observation and are mostly inter-dependent such that the factors at play in a particular region may differ significantly from those found in another region. Thus, while the findings of this study may be transferrable to similar populations, it may not be entirely generalizable to all populations because an understanding of the association between

malaria and relevant associated factors in a particular region is required to design effective policies to tackle malaria there [9].

## 3. RESULTS

The results revealed that of the 202 participants in the study, with a total of 101 participants recruited from each of the target urban and rural areas, 100% was aware of the term malaria but only 63.4% had adequate knowledge of malaria specifically. Generally, 25.7% of participants from the rural area had received no formal education whatsoever while the urban had only 4% of that particular subset. In the rural area, 52.5% of participants earned below 50,000 naira monthly, with only 14.9% earning above 100,000 naira a month while the reverse was the case in the urban area where 59.4% earned above 100,000 naira a month with only 15.8% earning below 50,000 naira monthly. There was a preponderance of unskilled workers (67.3%) in the rural area with 24.8% skilled and 7.9% professionals while the urban area had more professionals (49.5%) and only 14.9% unskilled workers. Up to 44.6% of participants in the rural area experienced >5 mosquito bites daily but only 9.9% experienced same in the urban area. The report showed at least one episode of malaria in the past year in 90.1% and 65.3% of participants from the rural and urban areas respectively. However, in the rural area only 39.6% were of the opinion that Artemisinin based combination therapy (ACT) was the first line treatment for malaria with 13.9% believing it should be supplemented with herbal medications and 46.5% saying herbal medications were the drug of choice. The urban area on the other hand had 83.2% opting for ACTs. These findings are captured in Table 1.

There were significant associations noticed between the prevalence of malaria and some of the noted socioeconomic characteristics of participants involved in the study. For instance, as shown in Fig. 1, the number of malaria episodes in the past one year was found to be inversely proportional to the household monthly income as more episodes of malaria were observed among people who earned a monthly income of less than 50,000 naira (60.0%) compared to those who earned above 50,000 naira and the episodes of malaria in the past year reduced as the monthly income increased ( $X^2=24.30$ ,  $p<0.001$ ).

**Table 1. Relationship between place of residence and demographic/socioeconomic variables**

Variables	Rural residents (%)	Urban residents (%)	X <sup>2</sup>	P-value
<b>Gender</b>				
Male	36.6	45.5	1.657	>0.05
Female	63.4	54.5		
<b>Occupation</b>				
Professional	7.9	49.5	66.241	<0.001*
Skilled	24.6	35.6		
Unskilled	67.3	14.9		
<b>Monthly income</b>				
<50,000naira	52.5	15.8	47.944	<0.001*
50,000-100,000	32.7	24.8		
>100,000	14.9	59.4		
<b>Education level</b>				
Primary	34.7	26.7	28.594	<0.001*
Secondary	29.7	39.6		
Tertiary	9.9	29.7		
None	25.7	4.0		
<b>Treatment</b>				
ACTs	39.6	83.2	41.964	<0.001*
Herbal medications	46.5	6.9		
Combination	13.9	9.9		
<b>Number of mosquito bites</b>				
<1	13.9	49.5	42.535	<0.001*
1-5	41.6	40.6		
>5	44.6	9.9		
<b>Malaria episodes</b>				
<1	9.9	34.7	32.123	<0.001*
1-5	50.5	55.4		
>5	39.6	9.9		

Occupation was also found to be significantly associated with the occurrence of malaria ( $X^2 = 22.36$ ,  $p < 0.001$ ) as more episodes of malaria within the past year were reported among the unskilled workers and skilled workers (71.3%) as compared to professionals (28.7%) which is shown in Fig. 2.

A significant linear trend was also observed between the number of mosquito bites daily and number of episodes of malaria in the past year among study participants as represented in Fig. 3. All the participants who had reported >5 mosquito bites daily reported at least one malaria episode in the past year as compared to those with a record of <5 mosquito bites per day ( $X^2 = 89.66$ ,  $p < 0.001$ ) and even some of those who had reported <1 mosquito bite daily (19.3%) had experienced an episode of malaria within the past year.

Knowledge about malaria specifically, including level of education in general had no appreciable influence on prevalence of malaria as there was

no significant difference in the prevalence of malaria among people with poor knowledge as compared to those with adequate knowledge about malaria or among people within the various levels of education ( $X^2 = 13.01$ ,  $p > 0.001$ ).

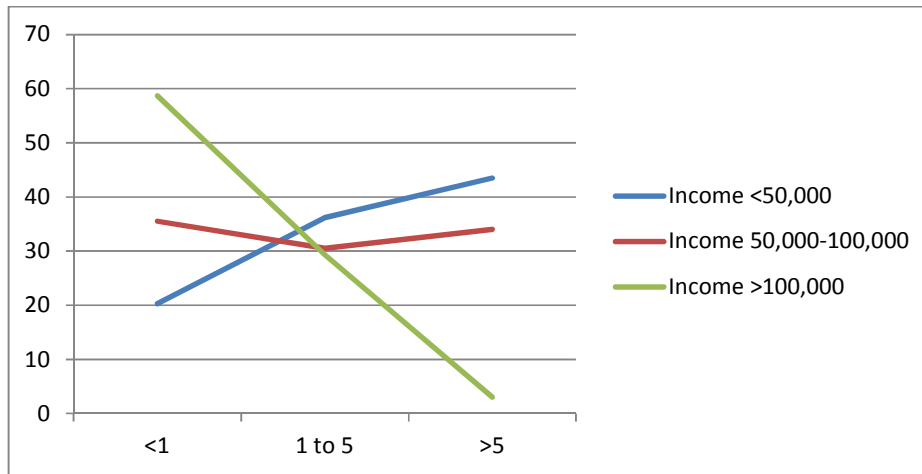
Interestingly, all the participants reported the presence of a healthcare facility <3km from their house with 95% and 80.2% of them in the rural and urban areas respectively having to pay out-of-pocket for healthcare services.

#### 4. DISCUSSION

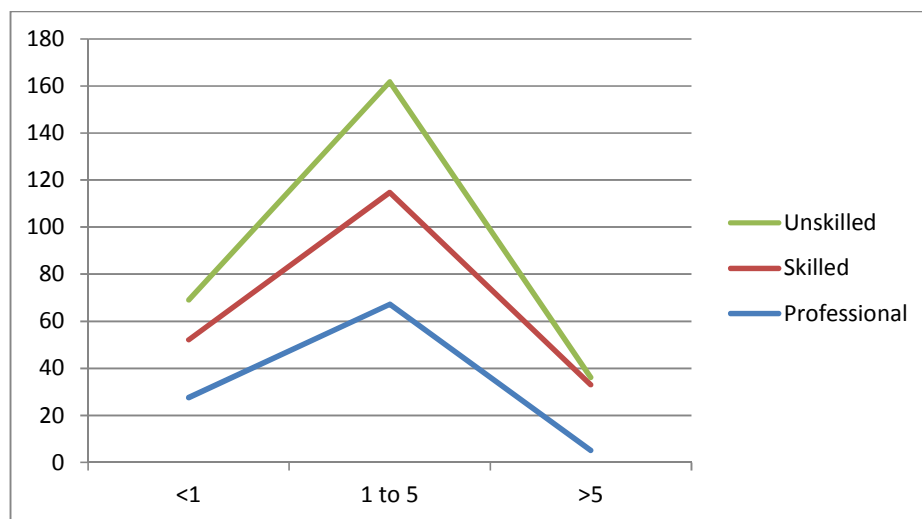
The global scope of malaria and its burden on Sub-Saharan Africa with a special focus on Nigeria cannot be over emphasized as the disease continues to play a significant role in crippling efforts towards improved human development index [5]. It has been noted that countries with high levels of malaria mortality also record low levels of human development while those with better human development have lower malaria mortality [12]. According to the

World Health Organization, countries that have ongoing malaria transmission can be classified into two broad categories: those about to achieve elimination of the disease and those with a high disease burden that have reported significant rise in the prevalence of malaria [2]. From the available data, Nigeria is not anywhere close to achieving elimination of malaria from its shores rather the prevalence of the disease remains on the increase despite some local and anecdotal assertions to the contrary. Nnewi North and Anaocha Local Government Areas of Anambra State, Nigeria from which the target populations were culled are not left out of the malaria epidemic obtainable in the country.

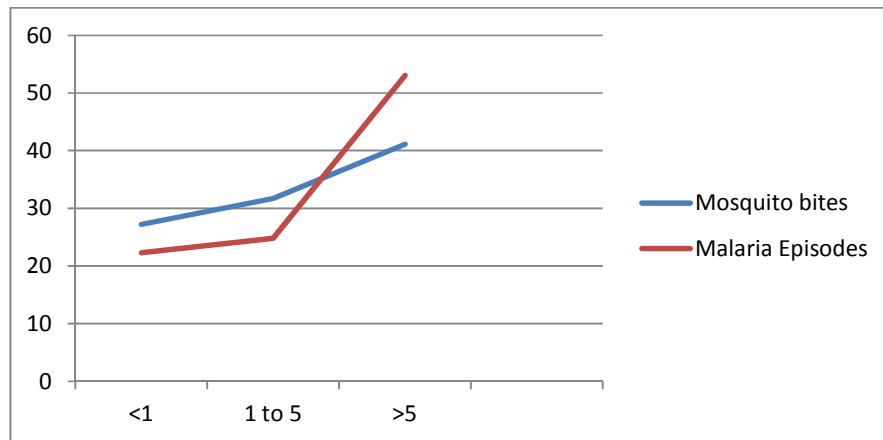
Results of the research revealed that the urban area had better socioeconomic indices in terms of education, occupation and monthly income when compared to the rural area. This was also the report in the review conducted by Adefemi et al. in Nigeria where they linked these factors in the sense that formal education translates to qualifications for good job opportunities which in turn translate to higher earning power in terms of income [11]. This disparity in physical and social infrastructure between rural and urban areas even within the same country or region has been the subject of numerous discourses in recent times as it has been shown to cause and promote existing health inequalities [16].



**Fig. 1. Interaction effect between household monthly income and number of episodes of malaria in the past year**



**Fig. 2. Interaction effect between occupation and number of episodes of malaria in the past year**



**Fig. 3. Interaction effect between number of daily mosquito bites and number of episodes of malaria in the past year**

An association was observed by the study between income and occurrence of malaria whereby the higher the income, the lower the likelihood of suffering from malaria and vice versa with the poorest being at greatest risk. This only goes to buttress the assertion that malaria is a disease of poverty in the sense that it is caused by poverty and at the same time prevents individuals from escaping the scourge of poverty as various research has revealed that the disease thrives in a milieu of poverty which is highlighted by the fact that majority of the global burden of disease is borne by the poorest countries and even within those countries, the most disadvantaged bear a greater burden [9]. In addition to the aforementioned factors, this has also been attributed to the inability of the poor to afford proper nutrition containing required macronutrients and micronutrients that contribute to building the necessary immunity; a clean and healthy environment; and marginalization by the health sector whereby qualified health personnel migrate to more affluent locations leaving the poor vulnerable to ineffective diagnosis and treatment even when they can afford to seek health care [16]. Similar studies have arrived at the same conclusions [11]; recognized poverty as emphasized by the World Health Organization as the singular most important risk factor for malaria, Nyarko & Cobblah in their study carried out in India also found a strong association between poverty and malaria occurrence in their study population [23].

There was also a strong association between occupation and the occurrence of malaria whereby professionals were found to be at significantly lower risk of malaria than the skilled

and unskilled workers. It was also discovered that the majority of the unskilled workers reside in the rural areas where they mostly engage in farming, fishing, hunting, palm wine tapping and other menial jobs often conducted outdoors which leaves them in contact and at the mercy of mosquitoes for prolonged periods especially in Nigeria with its tropical climate giving rise to pools of stagnant water due to frequent rainfalls in the wet season and marked humidity in the dry season all of which promote the breeding and spread of mosquitoes [24]. Also various agricultural practices and technologies such as deforestation and irrigation schemes including the site of these farms contribute to environmental changes that produce conducive climatic and ecologic conditions for the malaria vector to breed and survive [12,25]. In contrast, it could be argued that such agricultural technologies like irrigation, rather than increasing malaria would reduce it by reason of wealth creation such that people are able to afford to protect themselves. Meanwhile, the Professionals on the contrary mostly find themselves engaged behind the safety of office walls with limited exposure and contact with the malaria vector. The observed association between the number of mosquito bites daily and occurrence of malaria was only to be expected and it was also found that with increasing number of daily mosquito bites, the risk of malaria occurrence increased [26]. This was also the case in the study by Kalu et al in which they suggested that the relationship could be explained by the fact that with increased mosquito bites, the chances of being bitten by an infected female anopheles mosquito (known to be the most common vector for malaria in Nigeria



and able to transmit the *Plasmodium* parasite) also increase and as such limited opportunity for contact with the vector becomes a protective factor.

Sequel to these, noting that the rural area had a malaria prevalence of 90.1% in the past year compared to the 65.3% reported by the urban area becomes a matter of course as these factors have already been noted as contributory to the occurrence of malaria. The roots of this, as elucidated by Adefemi et al. [11], could be traced to financial constraints and the numerous cultural beliefs of the people especially in the rural area where a lot of people (60.4%) believe in the efficacy of herbal medications over the orthodox variety in the treatment of malaria whose effects cannot be verified which is further exacerbated by the poor access to standard health care services as was also seen in other Nigerian studies [26,27]. Therefore, malaria continues to thrive on account of the significant pool of reservoir of the *Plasmodium* parasite continuously re-infecting those who actually receive proper treatment. This is in concordance with the result gathered by Nyarko & Cobblah, in a similar study conducted in Ghana where the region of residence was found to be a key malaria predictor [23].

Surprisingly, in this study, no association could be made between level of education including knowledge about malaria and malaria occurrence as they were found to have no impact on malaria occurrence which is in sharp contrast to many studies such as that by Adefemi et al. [11] and Egenti et al. [13] in Nigeria; and Yadav et al. in India [9] where knowledge was found to be significantly associated with malaria occurrence, although the Indian study also noted that level of education had no impact on occurrence of malaria [9]. An important factor which could determine this difference is the non-clear-cut demarcation of rural and urban areas in Anambra State whereby access to public health information via numerous communication media is usually available to everyone unlike what obtains in most places whereby rural areas usually lack access to public health information. Also, Anambra State is one of the most literate States in the country such that even the few without formal education are likely surrounded by those that are who would keep them informed and abreast of new developments in health. It is also worthy of note that each participant either in the selected rural area or urban area reported the presence of a health care facility within 3 km

to their residence although payment remains out-of-pocket such that while these facilities are physically accessible, they might not be accessible financially and the qualification of personnel could not be determined.

## 5. CONCLUSIONS

A comparative cross-sectional study has been conducted with the objectives of determining the prevalence of malaria in the selected rural and urban area, identifying the factors perpetuating the disease in those places and investigating the role of socioeconomic factors in the observed prevalence. The results of this study have illuminated that prevalence of malaria is higher in the rural area than the urban area. It was noted that incidence of malaria was higher among people who earned lower income with the occurrence reducing as the household monthly income increased. Also, the higher the number of mosquito bites an individual encountered daily, the higher the malaria occurrence in such people. However, knowledge about malaria including the highest level of education achieved by the study participants was found to have no significant effect on the prevalence of malaria. Therefore, following these findings it is safe to conclude that indeed, socioeconomic factors play a role in the persistence of malaria in Nigeria.

The distribution of malaria had mostly been considered to be determined by climatic and environmental factors that influence the reproduction and proliferation of *Plasmodium* species, the malaria vector responsible for transmitting the disease, as the disease is found predominantly in tropical regions of the world with their favorable temperature and rainfall patterns [12]. However, evidence in recent times have shown that socioeconomic factors are also important predictors for the disease as it has been discovered that the burden of disease is greatest on the poorest countries of the world and even in those countries, it thrives more among the most disadvantaged who are found majorly in the rural areas [11].

Therefore, in spite of the widely agreed upon assertion that the incidence of malaria depends on a myriad of factors and variable, this study goes ahead to illustrate the importance of recognizing socioeconomic factors especially as it relates to place of residence in any serious attempt to control malaria.

## 6. RECOMMENDATIONS

The finding of this study serves to throw more light on the reasons for the continued rise in the prevalence of malaria despite the various malaria control measures being instituted. In addition to revealing the role that socioeconomic factors play in this observed phenomenon, the common knowledge that the rural area had an abundance of poor people (people living beneath the poverty limit of <1 USD per day) compared to the urban area was also verified and it would have been worthwhile to explore if people resided in the rural areas because they are poor or if they were poor because they resided in the rural area but this was outside the scope of this study.

Public Health was defined by Acheson in 1998 as "the art and science of preventing disease, prolonging life and promoting health through the organized efforts of society" (WHO, No date). Public health activities are aimed at strengthening capacities and providing enabling environment for people to maintain and/or improve their health, preventing any health deterioration. Hence, it should focus on the entire health spectrum and not just eradication of any particular disease (WHO, No date).

The aim of a good public health system is delivering appropriate health services to everyone who needs it, when and where they need it [28]. The public health system of Nigeria remains very inadequate which has been attributed to lack of resources as health financing is only 4.6% of the GDP [29] yet donors keep funding vertical malaria programs to the tune of billions of dollars [2] which further weakens the health system. Sequel to this, government leaders, policy makers and all relevant stakeholders in Nigeria should quit concentrating on parallel malaria programs and focus on strengthening the public health systems capacity so that it can conduct its primary functions of regulating health activities amongst the population, financing operation of the system, allocating resources and providing required services as this is an established benchmark for achieving malaria control evidenced by countries that have succeeded in eliminating the disease from their shores. This would also ensure equity between all social classes and places of residence such that everyone has access to quality healthcare in line with the Sustainable Development Goals and also that any instituted control measure is equitably distributed.

Although this study revealed a 100% awareness of malaria, only 63.41% had adequate knowledge about the disease revealing a very dangerous gap, as anecdotal evidence has shown that half knowledge is even more dangerous than ignorance. This gap needs to be addressed by public health professionals who are to ensure that appropriate and adequate public health information are produced and disseminated regularly to the entire population not just to people who present in the hospitals or clinics given that the importance of health education cannot be over emphasized.

Similarly, malaria has been widely agreed to be a disease of poverty, it is only rational to address malaria and poverty concurrently for as long as poverty thrives, malaria will continue to flourish. For instance, donations keep being made by various donor agencies for malaria control programs in Nigeria yet the poverty rate keeps rising as the number of people living in extreme poverty multiplies. This could be addressed by the government and relevant stakeholders providing better and adequate social infrastructure especially in places like the rural areas where they are lacking in terms of schools to offer standard education to inhabitants as this has been shown as a stepping stone to gainful employment and thus escape from poverty [11]; clean and healthy environment in terms of provision of potable drinking water and proper sewage disposal mechanisms which enables the public promote, maintain and restore their health; including social welfare schemes such as provision of loans to establish means of livelihood.

Finally, since it has been proven that socioeconomic factors play a role in the persistence of malaria as an endemic disease in Nigeria, neglecting them while dealing with malaria would only continue to frustrate the efforts being made and the prevalence of malaria would keep rising.

## 7. FURTHER RESEARCH

The use of Herbal Medicine as preferable treatment for malaria among rural inhabitants-the behavioral component' is a potential area for future study design and exploration.

## CONSENT AND ETHICAL APPROVAL

Prior to the commencement of this research project, ethical approval was sought and obtained from the University of Roehampton

online Ethics committee, consent approval was also sought and obtained from the Chairmen of from Nnewi North and Anaocha Local Government Areas respectively to ensure proper community entry and promote usability of findings. Participants were also adequately debriefed about the purpose of the study and an informed consent to participate in the study duly obtained.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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