Original Research Article

Prevalence of *Plasmodium falciparum* Malaria among Children Residing in Urban and Peri-urban Settlements in Rivers State.

ABSTRACT

Urban and peri-urban areas are considered to be at lower risk of malaria compared to rural areas because of improved housing, higher socioeconomic status, improved environmental sanitation, and a limited number of breeding sites for mosquitoes. Reports have shown that there is an increased prevalence of malaria in urban and peri-urban areas but it has not been established which of these areas is at risk. The aim of this study, therefore, is to determine the prevalence rate of Plasmodium falciparum malaria infection among children in urban and peri-urban areas of Rivers State. A total of 601 and 500 blood samples were collected from urban and peri-urban areas respectively and examined using standard microscopy technique for detection of malaria parasites in blood samples. From the urban area, 282 tested positive out of 601 blood samples that were examined, giving the prevalence rate of 47% while in the peri-urban settlement, a total of 210 out of 500 tested positive to Plasmodium falciparum giving the prevalence rate of 42%. When the age was considered, the highest prevalence was recorded in children between 1-3 years and 7-12 years in urban settlement while in peri-urban, the highest prevalence was recorded in children between the age of 4-6 years with a prevalence of 45% and 46% respectively. Although the prevalence rates are relatively high. There is no significant difference between the prevalence rate in urban areas and that of peri-urban areas. Conclusively, intensive efforts should be made in controlling malaria parasites not only in rural areas but also in urban and peri-urban areas in Rivers State.

Keyword: *Plasmodium falciparum*, Malaria, Children, Urban, Peri-urban, Settlement

1.0 INTRODUCTION

Transmission of *Plasmodium falciparum* and burden of malaria infection differ from one location to another within a geopolitical region due to some environmental factors (Nahum *et al*., 2010). Studies have shown that a wide variety of factors affect malaria transmission which includes but is not limited to socio-economic factors, housing conditions, and level of environmental sanitation (Nahum *et al*., 2010). Before now, malaria has been categorized as a disease of concern in rural areas, it is now one of the problems of urban settings for years. Nevertheless, economic development and environmental changes have been shown to decrease the incidence of malaria in urban areas (Tatem *et al*., 2013). In addition, improved housing, drainage of *Anopheles* breeding sites, household mosquito proofing, expanded personal protection, effective diagnosis, and treatment, and other factors have contributed to the recent global decline in malaria incidence. Whether, where, and to what extent such improvements have affected urban dwellers is still being debated (Wilson *et al*., 2015).

Malaria is endemic in most of the 3rd World countries. Children especially those within the age of 6 months and 5 years are most affected (Schumacher and Spinelli, 2012). In peri-urban and rural areas, the epidemiology of plasmodial infection is not easy to determine because most of the clinical symptoms are not specific and most times, routine testing is unavailable (Schumacher and Spinelli, 2012). Children less than 5 years constitute about 86% of death caused by malaria in the world (WHO, 2011). International bodies, government, policy makers and land planners have no consensus or commonly adopted definition of urban settlement (Tetam and Hay, 2004). The characteristic features considered while defining urban community include population size, density of specific geographical areas, units of people with governance responsibilities and level of non-agricultural activities (Hay *et al*., 2005). This consideration varies from one nation to another. Nevertheless, most researchers consider urban settlement as an area with huge density of housing and population with considerable changes in their feeding pattern, economic status, lifestyle and available social amenities (Phillips, 1993). General determinants for urban health were determined by WHO as social, cultural and environmental. Some characterize the by-products of innovation and industrialization. It is highlighted that urbanization, and high population of human beings into new areas in particular, can introduce contact to new risk factors for large numbers of people (Wilson *et al*., 2015). It becomes very critical to recognize the growth of infectious and parasitic disease in some urban settings so as to ascertain the level of investment into health and social care. It is also quite challenging to define urban malaria because significant vagueness habitually exists about the travel histories of infected people and the evidence for urban transmission within endemic areas. A better knowledge of "imported" malaria is mostly necessary in urban settings, which establish cores of human movement and relocation. Information on travel histories is very important in determining the activities and locations of risk. For infections that are acquired in urban settings, it is then imperative to know when and where transmission is arising and how urban transmission may vary from that in rural settings. Specifically, it is essential to describe and know how urban microhabitats encourage *Anopheles* vector abundance and effect their performance of biting humans. Urban microclimate variables are also critical to survival, reproduction, and development of mosquito, thereby promoting the existence and abundance of vector urban environments (Cator *et al*., 2013). Rivers state is experiencing a higher rate of urbanization and its effect on *Plasmodium* transmission and malaria risk are not well understood. In Nigeria, malaria is holoendemic in rural areas and mesoendemic in urban areas (Nwaorgu & Orajaka, 2011). Studies have been conducted on the prevalence of malaria and its risks in the state but less attention is being paid to the prevalence rate among children in urban and peri-urban areas of the state.

2.0 METHODS

2.1 Study Design

This research work was a cross-sectional study conducted in urban settlement and peri-urban settlement both in Rivers State Nigeria. It was a hospital-based study where children who were attending the health center within the study areas as of the time of this study were recruited.

2.2 Study Area

The study was done in Primary Health Center, Mile 3 Port Harcourt (urban settlement), and Primary Health center Ozuoba (peri-urban settlement) both in Rivers State Nigeria. Mile 3 is one of the busiest parts of Port Harcourt surrounded by a very busy market, schools, and churches.

Because of the large market situated in this locality, enabling an environment for the breeding of mosquitoes is critical. Ozuoba is a new area developing gradually. It is not very busy but the standard of living is very high compared to that of rural areas. The region is composed of new houses and some bushes. Both mile 3 and Ozuoba are situated in the largest city in Rivers State which is Port Harcourt. The climate of this city is characterized by two seasons viz rainy season and the dry season which is always short. Evergreen mangrove rainforest is the typical vegetation of this zone.

2.3 Study Population

Children between the ages of 1 to 15 years were included in this study. The study was done in urban areas and Peri-urban areas in Rivers State. A total of one thousand one hundred and one blood samples (1101) were collected and examined; 601 were from the urban area and 500 were from peri-urban areas both in Rivers State.

2.4 Eligibility criteria

Inclusion criteria

Children who are within the age range of 1-15 years, who are attending the Health center within the study location, and have not been in antimalarial drugs for the past one month of the study were included in this study.

Exclusion criteria

Children above the age of 15 years were excluded. Those within the age range who are attending the health center within the study area or those attending but their parents did not give oral consent were excluded from this study. Those who were already on antimalarial drugs were also excluded from the study.

2.5 Sampling method

The children were selected on a systematic sampling style at a regular interval within the sampling frame. Samples were collected according to WHO, (2010a). About 5mls of venous blood was aseptically collected from each participant into EDTA bottles, labeled, and taken to the laboratory for analysis

2.6 Laboratory method

Giemsa Staining Technique: Principle

A properly stained blood film is critical for malaria diagnosis, especially for the precise identification of malaria species. The use of Giemsa stain is the recommended and most reliable procedure for staining thick and thin blood films. Giemsa solution is composed of eosin and methylene blue (azure). The eosin component stains the parasite nucleus red, while the methylene blue component stains the cytoplasm blue. The thin film is fixed with methanol. De-haemoglobinization of the thick film and staining takes place at the same time. The ideal pH for demonstrating stippling of the parasites to allow proper species identification is 7.2.

2.7 Laboratory procedure

Thin and thick blood films were made as described by Cheesbrough (Cheesbrough, 2006), and thin films were fixed in methanol. Both were stained with 10% Giemsa stain for ten minutes. The stained slides were allowed to be air-dried and then examined for the presence of trophozoites of *Plasmodium falciparum* using an oil immersion objective lens (×100 objective lens). Parasite density was calculated base d on the number of parasites per 200 white blood cells assuming a total WBC count of 8000/ul as described by *Agomo et al*.,(2009). Slides were considered negative if no parasites were found after examining 100 high-power fields

2.8 Statistical Analysis

Data generated from the study were collated into excel spread sheet. The prevalence rate was calculated as the ratio of “number of infection” to “sample size” and the product of the quotient and 100% was the prevalence.

3.0 RESULTS

Table 1: Demographic parameter

Table 1 shows the gender distribution of male subjects and female subjects across number examine, number infected and number uninfected in urban and peri-urban areas.

Parameters	**Urban**			**Peri-urban**		
SEX	**NE**	**NI**	**NU**	**NE**	**NI**	**NU**
MALE	309(51.5)	154(54.5)	155(48.6)	255(51.0)	111(52.9)	144(49.7)
FEMALE	292 (48.5)	128(43.8)	164(51.4)	245(49.0)	99(47.1)	146(50.3)
TOTAL	**601(54.6)**	**282(47.0)**	**319(53.0)**	**500(45.4)**	**210(42.0)**	**290(58.0)**

Of 601 children examined in the urban settlement of Rivers State, 282 (47%) were infected while 319 (53%) were not infected. In the peri-urban settlement, 500 children were examined, 210 (42%) were infected while 290 (58%) were not infected. This is shown in table 1. The examined children were also grouped according to their age and prevalence is shown in table 2.

TABLE 2: OVERALL LOCATION-BASED PREVALENCE

LOCATION	**NE**	**NI(%)**	**NU(%)**
URBAN	601(54.6)	282(47.0)	319(53.0))
PERI URBAN	500(45.4)	210(42.0)	290(58.0)
TOTAL	1101	492(45.0)	609(55.0)

NE=Number examined; NI – Number infected, NU =Number uninfected

TABLE 3: PREVALENCE BASED ON AGE

PARAMETER	**LOCATION**					
	URBAN(%)			**PERI-URBAN(%)**		
AGE GROUPS	**NE**	**NI**	**NU**	**NE**	**NI**	**NU**
1-3	203(33.8)	92(45.3)	111(54.7)	183 (36.6)	79(43.1)	104(56.9)
4-6	158(26.3)	86(54.4)	72(45.6)	135(27.0)	62(46.0)	73(34.0)
7-12	138(23.0)	62(45.0)	76(55.0)	102(20.4)	38(37.3)	64(62.7)
13-15	102(16.7)	42(41.2)	60(60.8)	80(16.0)	31(33.8)	49(51.2)

TOTAL	**601(54.6)**	**282 (47.0)**	**319(53.0)**	**500(45.4)**	**210(42.0)**	**290(58.0)**

NE=Number examined; NI – Number infected, NU =Number uninfected

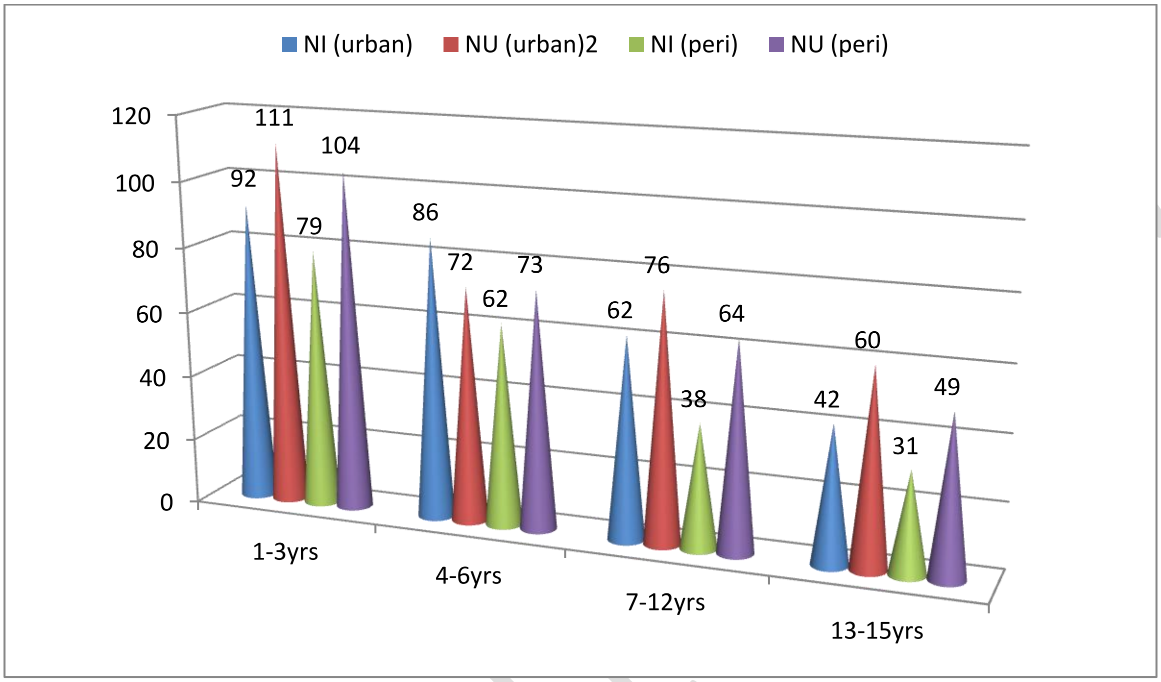

Figure 1.: A distribution of infected and uninfected subjects in urban and peri-urban areas in the state.

NI: Number infected

NU: Number uninfected

This figure shows that the number of malaria infected subjects were lesser compared to those uninfected except for subjects between 4-6yrs in the urban area that showed higher infected subjects compared to the uninfected group.

4.0 DISCUSSION

This study had the participation of 1101 children in the urban and peri-urban areas of Port Harcourt. Out of the 1101 subjects, 601 subjects were in the urban area, accounting for 54.6% of sample size. The 601 subjects were both males and females which were grouped based on Number examined (NE), Number infected (NI) and Number uninfected (NU). The total number of males examined in the urban area was 309 while females were 292 accounting for 51.5% of males and 48.5% of females. The number of infected males and females were 154 and 128 respectively, accounting for 54.5% of infected males and 43.5% infected females. Total number of infected subjects was 282 accounting for 47% of the 601 number of examined subjects in the urban area. The number of uninfected males and females were 155 and 164 respectively, accounting for 48.6% of infected males and 51.4% infected females. Total number of uninfected subjects was 319 accounting for 53% of the 601 number of examined subjects in the urban area.

Out of the 1101 subjects, 500 subjects were in the urban area, accounting for 45.4% of sample size. The total number of males examined in the peri-urban area was 255 while females were 245 accounting for 51.0% of males and 49.0% of females. The number of infected males and females were 111 and 99 respectively, accounting for 52.9% of infected males and 47.1% infected females. Total number of infected subjects was 210 accounting for 42% of the 500 number of examined subjects in the peri-urban area. The number of uninfected males and females were 144 and 146 respectively, accounting for 49.7% of infected males and 50.3% infected females. Total number of uninfected subjects was 209 accounting for 58% of the 500 number of examined subjects in the peri-urban area.

Prevalence rates in urban and peri-urban areas are high. This could be because rapid urbanization sometimes creates uncontrolled commercial activities at the periphery of the areas which could provide conducive conditions for the breeding of Anopheles mosquitoes. This assumption is in tandem with findings made by Mathanga *et al*., (2016). The prevalence rate in urban settlement from this study is similar to the report recorded in Cameroon last year (Eyong *et al*., 2021). To an extent, age affected the prevalence rate in both urban and peri-urban settlements with the highest prevalence observed in children between the ages of 4-6 years although the difference is not much from that of 1-3 and 7-12 years. The finding agreed with work done by some researchers in Rivers state, and other parts of the countries (Opara & West, 2017; Abah *et al*., 2017; Nwaorgu & Orajaka, 2011). The study also agreed with the previous report which stated that age has no significant influence on the incidence of malaria (Wokem *et al*., 2021). The general increased prevalence rate in children could be attributed to more exposure to female anopheles mosquito bites as a result of regular outdoor playing, poor hygiene, poorly developed immunity as they are still young, non-specific clinical manifestations to mention but a few.

Although the prevalence rate was higher in urban than in peri-urban area of Port Harcourt, there seems to be a similar or shared prevalence pattern among the age groups between the two studied areas. The urban area had the highest prevalence rate in children between the ages of 4-6yrs (54.4%), followed by a sharp fall in ages between 1-3yrs (45.3%), the decline continues in 7-12yrs (45%) and 13-15yrs (41.2%). Similar pattern was reported in peri-urban area; A sharp rise in prevalence in 4-6yrs age group (46.0%), followed by a fall in 1-3yrs age group and a continuous decline in 7-12yrs and 13-15yrs age groups. This finding has particularly shown that the age group with the high impact of malaria infection is 4-6yrs. From figure 1, the age group with the highest number of participation or subjects was 1-3yrs in both urban and peri-urban. The number began to drop as the age increases. Although the number of subjects or participation was highest in age group 1-3yrs in urban and peri-urban areas, age group 4-6yrs still had the highest prevalence. In agreement with this study, Daniella and Glenda, (2016) reported that children below the age of five years old are more prone to malaria than older age groups. Thie study was conducted in Uganda, a country with high malaria edemicity like Nigeria. Reason for the high rate prevalence in this age group is believed to be due to poorly developed immunity against diseases including malaria.

Conclusion and recommendation

This study clearly showed that *Plasmodium falciparum* malaria among children in Urban and peri-urban settlements in Rivers State is high, especially those between the ages of 1-6 years. It is therefore recommended based on this finding that sharing of treated mosquito bed nets should be sustained especially to mothers who have children, free medical treatment advocated for children, and finally, Government should constantly support environmental sanitation agencies in carrying out regular cleaning of drainages and steady waste disposal to appropriate location away from settlements. By so doing, the breeding of vectors that transmit malaria and other pathogens will be controlled.

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