

Malaria prevalence in rural and urban communities of Mpohor district of Ghana

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ABSTRACT

This study was aimed mainly at determining the prevalence of malaria in rural and urban settlements in the Mpohor district of Ghana. It was also crucial determining if malaria prevalence was dependent on age (above age of five or below the age of five).There was the need to also determine the effect of malaria incidence on hospitalization in the wet and dry seasons.

Confirmed monthly malaria morbidity data was collected over six year period (2008-2013) from four hospitals in the District.

The malaria incidence per thousand (1000) people of the population was then calculated. The Chi-square test was used to assess the nominal variable difference between malaria prevalence in rural and urban communities.

Malaria prevalence was 81.9 % and 18.1 % respectively in rural and urban communities. Malaria prevalence in rural and urban settlements was found to differ $(\text{P}-\text{value},\ 0.112 > 0.05)$

Malaria prevalence was found to be not independent of age $\left(\chi^2 = 10.65,\ \text{df} = 2,\ \text{p} < 0.05\right)$.

There was no significant difference between malaria infection resulting and not resulting in hospitalization $(\text{P}-\text{value},\ 0.157 > 0.05)$ in in the district during wet and dry seasons. Nonetheless higher incidence (52%) of malaria infection was identified in the wet season which resulted in hospitalization.

It was recommended among other things that malaria prevention and control measures such as ITN's (Insecticide Treated Nets), IRS (indoor residual spraying) with insecticides, Mass screening and treatment (MSAT) with effective anti-malarial drugs, use of mosquito coils and repellants should be targeted mostly at rural communities.

INTRODUCTION

In Ghana, malaria is the number one cause of morbidity (hospitalization) and mortality (death) in children under five years of age. 38 % of outpatient illnesses in the under-five age group are attributed to malaria while malaria causes nearly 33 % of hospital deaths in children under five (GHS facility data, 2008). This translates to 14, 000 children under five dying due to malaria in Ghana every year (WHO, World Malaria Report 2000).

Children under 5 years of age and pregnant women are the worst affected by malaria. (Connor *et al*, 2006). Malaria is most prevalent in warmer regions of the world – typically tropical and subtropical areas, including Africa (UNICEF, 2000). Each year, almost 300 million cases of malaria occur worldwide and more than one million people die.

In Ghana, West Africa, these social changes, particularly among the urban population, are reflected in increasing numbers of educated and relatively affluent persons, more widespread knowledge about health and disease, and greater access to health care facilities.

The Mpohor District is 74.8 % rural and 25.2 % urban. In order to ascertain the impact of urbanization on malaria distribution, we undertook a comparative cross-sectional survey of four communities in the Mpohor District. The survey principally investigated malaria prevalence (morbidity) in the communities.

STUDY AREA

1.1 Location and size of study Area

The Mpohor District is one of the 22 districts in the Western Region. The District is located at the south-eastern end of the region and was carved out from the erstwhile Mpohor Wassa East District in 2012 and established with a legislative instrument (L . I). It is bounded on the west by Ahanta West District, east by Wassa East District, north-west by Tarkwa-Nsueam Municipal and Shama District. The District covers a total land area of 524.533 square kiometers. The District capital Mpohor is located 19 km off the Takoradi-Agona Nkwanta main road.

Table 1 : Number of major communities in Mpohor District

Area Council	**Number of Communities**
Edum Banso	14
Manso	9
Mpohor	8
Ayiem	6
TOTAL	**37**

The Mpohor district is made up of four (4) Area Councils which has a total of 37 major communities.

1.2 Population Size and Distribution

Mpohor District has a total population of 42, 923 consisting of 21, 486 males and 21,437 females. The District is predominantly rural with 74.8 percent of the residents in the villages (Fig 1.2). Figure 1.2 shows that, the population among urban and rural localities are 74.8 percent and 25.2 percent respectively. This shows that majority of the population in the District reside in the rural communities.

Fig.1.2 Population by locality of recidence

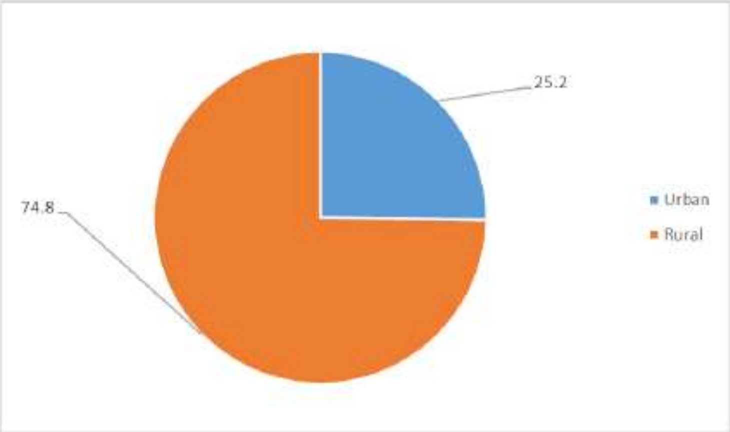

Fig.1.2 Source: Ghana Statistical Service2010 Population Census

Fig. 1.3 Population Pyramid

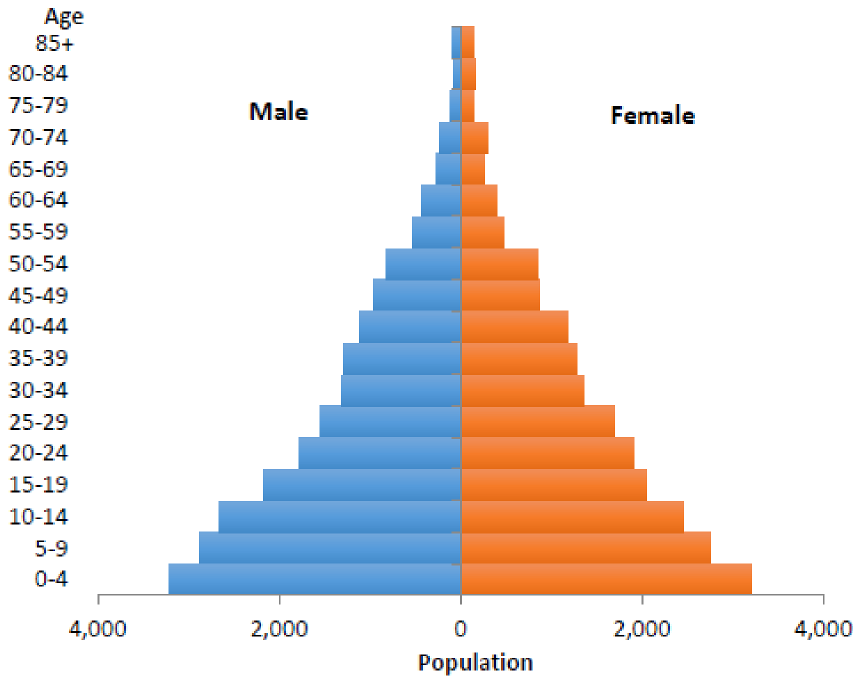

Fig.1.3 Source: Ghana Statistical Service2010 Population Census

1.3 Relief and drainage

The District lies within the low-lying areas of the country with most parts below 150 meters above sea level. District is largely dendritic. There are a number of rivers and streams in the District (e.g Subri, Butre and Hwini). The landscape is generally undulating landscape with an average height of about 70 metres. The highest elevation ranges between 150 and 200 metres above sea level. The draingae pattern of the Mpohor .

METHODS

The demographic data of the areas involved in the study were obtained using the 2010 Population and

Housing Census of Ghana. The populations from 2011 to 2013 used in the study were extrapolated using the 2009 and 2010 growth rates computed with the help of SPSS software.

The malaria cases data were obtained from Mpohor District Health Centre. The malaria incidence per thousand (1000) people of the population was then calculated. That is, $\text{Prevalence} = \{(\text{number of cases/population}) \times 1000\}$ for the communities under study (at each cell level). The malaria rates from 2011-2013 were computed as well as the total rates of the years under study.

The chi-square test statistic is given by:

$$\lambda^2 = \sum_{i=1}^{p}\sum_{j=1}^{m}\frac{(f_{ij}-e_{ij})^2}{e_{ij}}$$

As $e_{ij} \geq 5$ for every ***i*** and ***j***, the chi-square test with level of significance α for

H_o : Row variable ***is independent*** of column variable

H_a : Row variable ***is not independent*** of column variable.

Reject $H_o : \lambda^2 > \lambda^2(p-1)(m-1), \alpha$

Not reject $\lambda^2 \leq \lambda^2(p-1)(m-1), \alpha$

Where , $\lambda^2{}_{(p-1)(m-1),\alpha}$ can be obtained by

$$p(\lambda^2{}_{(p-1)(m-1)} > \lambda^2{}_{(p-1)(m-1),\alpha}) = \alpha .$$

In addition**,**

$$p - value = p(\lambda^2{}_{(p-1)(m-1)} > \lambda^2) .$$

As H_o : is true, the random variable with sample value λ^2 is $\lambda^2{}_{(p-1)(m-1)}$.

Suppose there are two variables, column variable (with ***m categories***) and row variable (with ***p categories***). We want test the hypothesis

H_o : Row variable ***is independent*** of column variable

vs.

H_a : Row variable ***is not independent*** of column variable.

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Suppose the sample size is ***n***. The ***contingency table*** is

		Column Variable (m columns)					
		1	**...**	***j***	**…**	***m***	***proportions***
Row Variable (p rows)	***1***	f_{11}	…	f_{1j}	…	f_{1m}	$p_{r1} = \frac{\sum_{k=1}^{m} f_{1k}}{n}$
	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$
	i	f_{i1}	…	f_{ij}	…	f_{im}	$p_{ri} = \frac{\sum_{k=1}^{m} f_{ik}}{n}$
	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$
	p	f_{p1}	…	f_{pj}	…	f_{pm}	$p_{rp} = \frac{\sum_{k=1}^{m} f_{pk}}{n}$
	proportions	$p_{c1} = \frac{\sum_{k=1}^{p} f_{k1}}{n}$	…	$p_{cj} = \frac{\sum_{k=1}^{p} f_{kj}}{n}$	…	$p_{cm} = \frac{\sum_{k=1}^{p} f_{km}}{n}$	***1***

If H_0 ***is true,*** then ***the expected numbers*** under H_0 are

		Column Variable (m columns)					
		1	**...**	**j**	**...**	**m**	**proportions**
Row Variable (p rows)	**1**	$e_{11} = np_{r1}p_{c1}$	$\cdots$	$e_{1j} = np_{r1}p_{cj}$	$\cdots$	$e_{1m} = np_{r1}p_{cm}$	p_{r1}
	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$
	i	$e_{i1} = np_{ri}p_{c1}$	$\cdots$	$e_{ij} = np_{ri}p_{cj}$	$\cdots$	$e_{im} = np_{ri}p_{cm}$	p_{ri}
	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$
	p	$e_{p1} = np_{rp}p_{c1}$	$\cdots$	$e_{pj} = np_{rp}p_{cj}$	$\cdots$	$e_{im} = np_{rp}p_{cm}$	p_{rp}
	proportions	p_{c1}	$\cdots$	p_{cj}	$\cdots$	p_{cm}	**1**

$$e_{ij} = np_{ri}p_{cj} = (\text{sample size})\cdot(\text{row i proportion})\cdot(\text{colmmn j proportion})$$

$$= n\cdot\left(\frac{\sum_{k=1}^{m} f_{ik}}{n}\right)\cdot\left(\frac{\sum_{k=1}^{p} f_{kj}}{n}\right) = (\text{sample size})\cdot\left(\frac{\text{row i total}}{\text{sample size}}\right)\cdot\left(\frac{\text{column j total}}{\text{sample size}}\right)$$

$$= \frac{\left(\sum_{k=1}^{m} f_{ik}\right)\cdot\left(\sum_{k=1}^{p} f_{kj}\right)}{n} = \frac{(\text{row i total})\cdot(\text{column j total})}{\text{sample size}}$$

where

$$\text{row i total} = \sum_{k=1}^{m} f_{ik}, \text{column j total} = \sum_{k=1}^{p} f_{kj}, i = 1,\ldots,p;\ j = 1,\ldots,m.$$

and

$$\text{sample size} = \sum_{i=1}^{p}\sum_{j=1}^{m} f_{ij} = n.$$

Thus, the chi-square statistic used to reflect the difference between the observed number and the expected number is

$$\chi^2 = \sum_{i=1}^{p}\sum_{j=1}^{m}\frac{\left(f_{ij}-e_{ij}\right)^2}{e_{ij}} = \frac{\left(f_{11}-e_{11}\right)^2}{e_{11}} + \frac{\left(f_{12}-e_{12}\right)^2}{e_{12}} + \cdots + \frac{\left(f_{1m}-e_{1m}\right)^2}{e_{1m}}$$

$$+ \frac{\left(f_{21}-e_{21}\right)^2}{e_{21}} + \frac{\left(f_{22}-e_{22}\right)^2}{e_{22}} + \cdots + \frac{\left(f_{2m}-e_{2m}\right)^2}{e_{2m}}$$

$$+ \cdots + \frac{\left(f_{p1}-e_{p1}\right)^2}{e_{p1}} + \frac{\left(f_{p2}-e_{p2}\right)^2}{e_{p2}} + \cdots + \frac{\left(f_{pm}-e_{pm}\right)^2}{e_{pm}}$$

RESULTS

5.2 Malaria Prevalence and Settlement

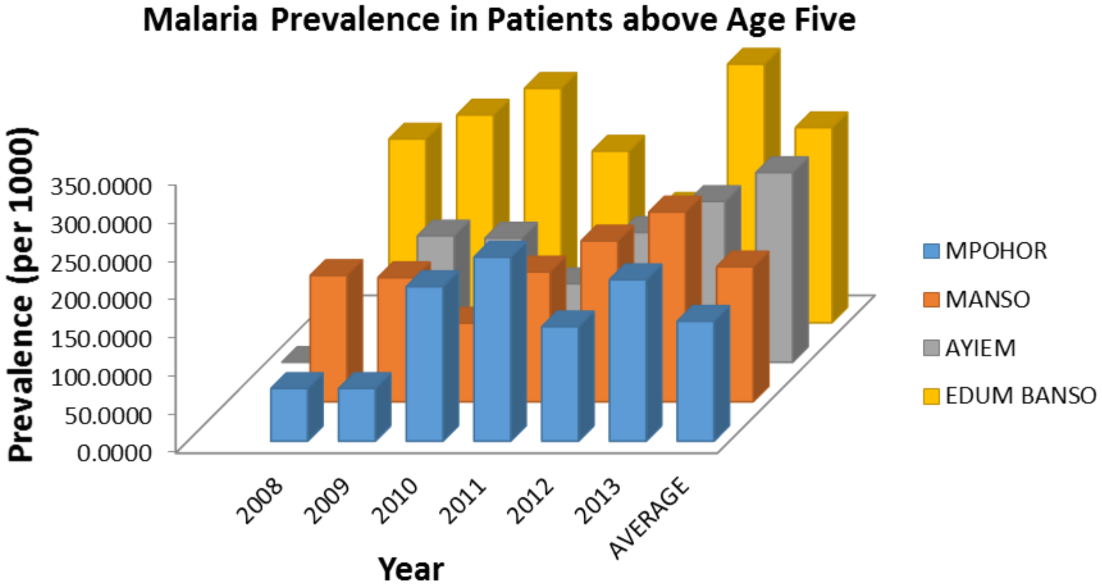

Figure 5.2 Malaria Prevalence among Patients above Five

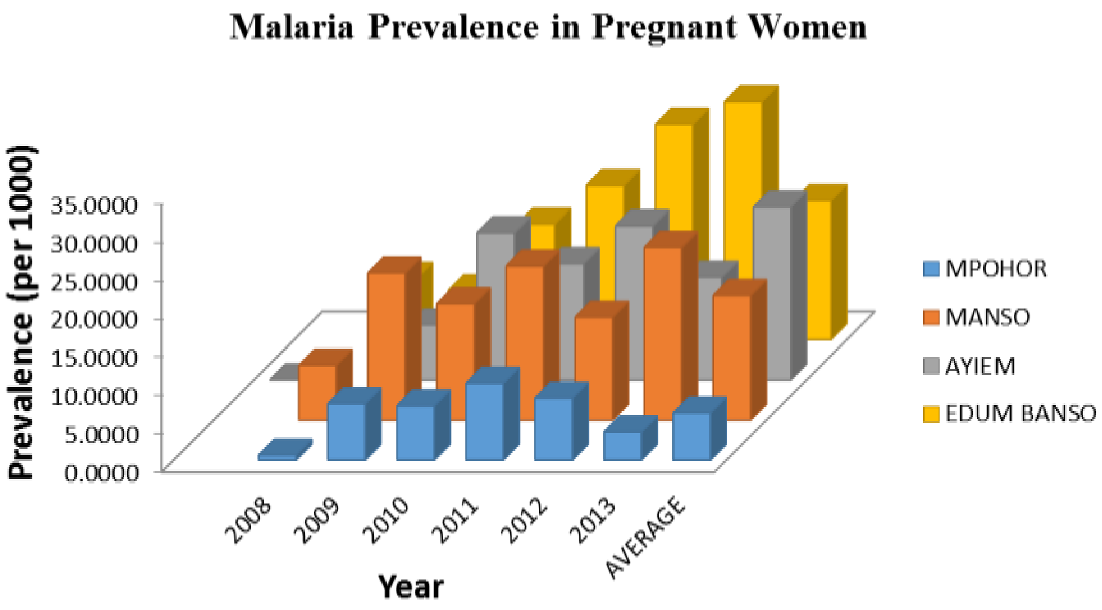

Figure 5.3 Malaria Prevalence in Pregnant Women

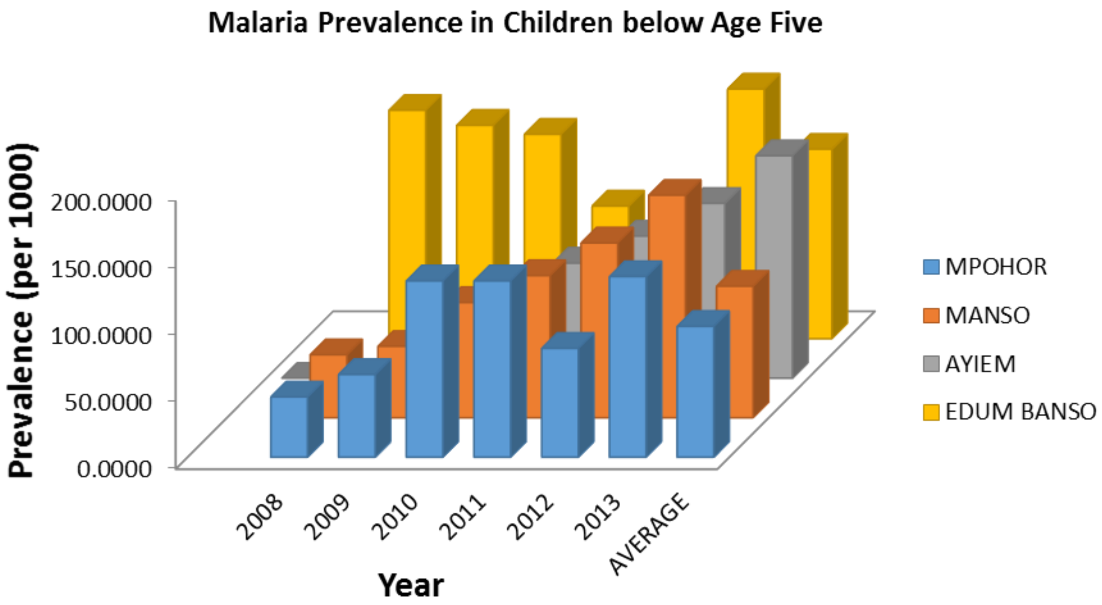

Figure 5.4 Malaria Prevalence in Children below Age Five

From Figures 5.2, 5.3 and 5.4, Mpohor (an urban settlement) was found to have the lowest incidence of malaria infection (86.95 per 1000 population) compared to the rural settlements Ayiem, Edum Banso, and Manso which had higher incidence of malaria infection (158.89, 138.33 and 96.99 per 1000 population respectively).

Children below the age of five years were found to be at a higher risk in Ayiem (196.24/1000) than in Edum Banso, Manso and Mpohor.

Again, pregnant women were found to be at a higher risk in Edum Banso (18.20/1000) community of the District.

Also, people above the age of five years were found to be at a greater risk in the Ayiem community of the District.

Table 5. 2 Chi-Square Test of Difference in Prevalence due to Settlement

	Value	df	P-value
Pearson Chi-Square	6.000[a]	3	0.112

From Table 5.2, malaria infection was not equal $(\text{P} - \text{value},\ 0.112 > 0.05)$ in rural and urban settlements. The findings are in line with the study by Pindolia *et al*. (2013) who found that malaria infections in rural and urban settlements differ.

Table: 5.3 Observed Frequencies

		Malaria prevalence per 1000 population					
		Mpohor	**Edum Banso**	**Ayiem**	**Manso**	**Total**	**Proportion**
Age	**Above age five**	***164*** (f_{11})	***173*** (f_{12})	***280*** (f_{13})	***193*** (f_{14})	***810***	$^{135}/_{224}\,(p_{r1})$
	Below age five	***98*** (f_{21})	***142*** (f_{22})	***196*** (f_{23})	***98*** (f_{24})	***534***	$^{89}/_{224}\,(p_{r2})$
	Total	***262***	***315***	***476***	***291***	***1344*** (n)	***1***
	Proportion	$^{131}/_{672}\,(p_{c1})$	$^{15}/_{64}\,(p_{c2})$	$^{17}/_{48}\,(p_{c3})$	$^{97}/_{448}\,(p_{c4})$	***1***	

Table 5.4: Expected Frequencies

		Malaria prevalence per 1000 population				
		Mpohor	**Edum Banso**	**Ayiem**	**Manso**	**Proportion**
Age	**Above age five**	$n \cdot p_{r1} \cdot p_{c1} = e_{11} = 157.90$	$n \cdot p_{r1} \cdot p_{c2} = e_{12} = 189.84$	$n \cdot p_{r1} \cdot p_{c3} = e_{13} = 286.88$	$n \cdot p_{r1} \cdot p_{c4} = e_{14} = 175.38$	$^{135}/_{224}(p_{r1})$
	Below age five	$n \cdot p_{r2} \cdot p_{c1} = e_{21} = 104.10$	$n \cdot p_{r2} \cdot p_{c2} = e_{22} = 125.17$	$n \cdot p_{r2} \cdot p_{c3} = e_{23} = 189.13$	$n \cdot p_{r2} \cdot p_{c4} = e_{24} = 115.62$	$^{89}/_{224}(p_{r2})$
	Proportion	$^{131}/_{672}(p_{c1})$	$^{15}/_{64}(p_{c2})$	$^{17}/_{48}(p_{c3})$	$^{97}/_{448}(p_{c4})$	

$$p - value = P\left(\chi^2_{(p-1)(m-1)} > \chi^2\right) = P\left(\chi^2_3 > 10.65\right) = 0.0049 < 0.05 = \alpha$$

We ***reject*** H_0 based on p-value. Therefore, we conclude that the malaria prevalence ***is not independent*** of the age.

Figure 5.5 Hospitalization and No Hospitalization in wet and dry seasons

It could be inferred from Figure 5.5 that hospitalization due to malaria prevalence was more predominant in the wet than dry season.The dry season was found to be in a larger scale associated with uncomplicated malaria in the district.

There was 52% incidence of malaria resulting in hospitalization and 48% resulting in no hospitalization in the wet season.

The increased hospitalization rate could be as a result of increased severity of the disease.Uncomplicated malaria rate has been found by many researchers to be associted with no hospitalization.

Table 5. 5 Chi-Square Test of Difference in Prevalence due to Hospitalizion and No Hospitalization

	Value	df	P-value
Pearson Chi-Square	2.000[a]	1	0.157

From Table 5.5, there was no significant difference between malaria infection resulting and not resulting in hospitalization $(P - \text{value},\ 0.157 > 0.05)$ in in the district during wet and dry seasons.

CONCLUSSIONS

Malaria prevalence was 81.9 % and 18.1 % respectively in rural and urban areas. There was a statistical outcome that malaria prevalence was not the same $\left(\chi^2 = 7.00,\ df = 3,\ p > 0.05\right)$ in the rural and urban areas of the Mpohor district.

Again, malaria prevalence was found to be not independent of age$\left(\chi^2 = 10.65,\ df = 3,\ p < 0.05\right)$.

Finally, there was no significant difference between malaria infection resulting and not resulting in hospitalization $(P - \text{value},\ 0.157 > 0.05)$ in in the district during wet and dry seasons. Nonetheless, higher incidence (52%) of malaria infection was identified in the wet season which resulted in hospitalization.

RECCOMMENDATIONS

There is the need to develop a compendium of good practices in rural-urban-sensitive malaria service provision as well as improve capacity for rural-urban analysis and programming.

Subsequently, malaria prevention and control measures such as ITN's (Insecticide Treated Nets should be targeted more at rural communities in the district.

Pregnant women in Edum Banso should be provided with mosquito nets in order to reduce malaria infection.

Children under age five in Ayiem should sleep under mosquito nets.

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