Science World Journal Vol 12(No 3) 2017
www.scienceworldjournal.org
ISSN 1597-6343

Full Length Research Article

DEMOGRAPHIC AND SOCIOECONOMIC FACTORS INFLUENCING MALARIA INCIDENCE IN CALABAR, CROSS RIVER STATE, NIGERIA

[1]U. W. Ibor and [2]E. M. Okoronkwo

[1]Department of Geography, Federal University Lokoja, Nigeria
[2]Department of Geography, Benue State University, Nigeria

* E-mail address of the authors: [1]uguru.ibor@fulokoja.edu.ng, [2]uguruwisdomibor@gmail.com

ABSTRACT
Although the physical environment provides the primary conditions for the breeding of malaria vectors, the socio-demographic environment also plays a significant role in the incidence of the disease. Nevertheless, relatively few multivariate studies have been carried to identify individual-level factors most influencing malaria in high risk areas. This study sets out to examine the demographic and socioeconomic factors of malaria incidence in Calabar, Cross River State. A set of 300 copies of questionnaire designed for the study were administered on household heads. Principal Component Analysis (PCA) was performed on a set of socioeconomic data to identify significant and major demographic/socioeconomic variables that predispose people to malaria. The PCA results identified type of accommodation (0.816), number of children (0.745), marital status (0.761) and occupation (-0.883) as the main socioeconomic variables that predispose people to malaria in the study area. These components accounted for 68.2% of total variance in the original data set. The study recommended that Insecticide Treated Nets (ITNs) and malaria vaccines should be made easily accessible to members of households alongside with environmental hygiene in order to reduce the incidence of malaria in the area.

Keywords: Malaria, Incidence, Prevalence and Socioeconomic factors

INTRODUCTION

Malaria is one of the major tropical health challenges in the world today. Although, Africa is the hardest hit, it is estimated that more than one-third of clinical malaria cases occur in Asia and 3 percent occur in the America (World Health Organization, 2003). Roll (2000) asserted that malaria kills over millions of people worldwide every year and most of this preventable death manifests in among the labour force of African region. Malaria is caused by four distinct species of plasmodium parasite, transmitted by mosquitoes of the genus Anopheles, which are most abundant tropical/subtropical regions, although they are also found in limited numbers in temperate climes. Several studies have shown that the transmission of malaria is associated with changes in temperature, rainfall, humidity as well as level of immunity (Bai, 2013; Huang *et al*, 2011).

Although environmental factors provide the primary conditions for the breeding of malaria vectors, the socio-demographic environment also plays a significant role in the prevalence of the disease. In Nigeria, the causes and consequences of malaria incidence have been linked to the social, cultural, political and economic factors (Okoronkwo, 2013). However, it is somehow difficult to accurately assess the true scale of the disease in terms socioeconomic losses, although the cost to effectively control malaria in the 82 countries with the highest burden is about 3.2 billion dollars annually (WHO, 2003). It has been documented that poor people are at increased risk both of becoming infected with malaria and of becoming infected more frequently (FMOH, 2004). Also, Child mortality rates are known to be higher in poor socioeconomic households than the rich. The reason is the poor live in houses that offer little protection against mosquitoes and are less able to afford effective prevention. As a result, they are less likely to be able to afford preventive measures or pay for effective malaria treatment.

In Cross River State, both direct and indirect cost associated with malaria episode represents a substantial burden on the poorer households. Young children and pregnant women are the population groups at highest risk of malaria morbidity and mortality (World Health Report, 2002). Relatively few multivariate studies have been carried to identify the set of socio-economic factors most influencing malaria incidence in high risk areas. Therefore, this study seeks to identify the most important socioeconomic factors of malaria incidence in Calabar, Cross River State, Nigeria.

Malaria is endemic in Cross River State, Nigeria. The state is situated in Nigeria's delta region, in the tropical rainfall belt. It lies between latitudes 5º32' and 4º27' North and longitudes 7º50' and 9º28' East of the equator (Figure 1). It is bounded in the north by Benue State, in the South-West by Akwa Ibom State, in the West by Ebonyi and Abia States. The State shares an international boundary with the Republic of Cameroon, and an Atlantic coastline in the south. Cross River State occupies the catchments of the Cross River, which originated from the Cameroon Mountains, across the flat lying Cross River Basin into a vast estuary located along the Southern Nigeria/Cameroon border. With an area of 23,074 square kilometers and population of 1.8 million and it's divided into 18 local government areas. Its capital is Calabar and other major towns in the state include; Akamkpa, Ikom, Obubra, Odukpani, Ogoja, Okundi, Ugep, Obudu, Obanliku, Akpabuyo among others.

The climate within Cross River State is tropical humid with wet and dry seasons, with average temperature ranging between 15ºc-30ºc and the annual rainfall between 1300-3000mm. The high plateau of Obudu experience climatic conditions which are markedly different from the generalized dry and wet period in the

rest of the Cross River State. Temperature is 4^0c- 10^0c lower due to high altitude than in the surrounding areas. Similarly, the annual rain fall is higher than in areas around them, particularly on the windward side. Cross River State, can thus be broadly divided into the following sub-climatic regions; the moderate sub-temperate within the high plateaus of Obudu and the hot wet tropical extending from the southern lowland to the central and northern hinterland part. Precisely, the area is characterized by high temperature, rainfall and humidity. Higher rainfall combined with increasing temperature may offset evaporation, so that both factors tend to increase surface water available for breeding of vectors. This climatic pattern has serious effects on the abundance and seasonal distribution of malaria vectors.

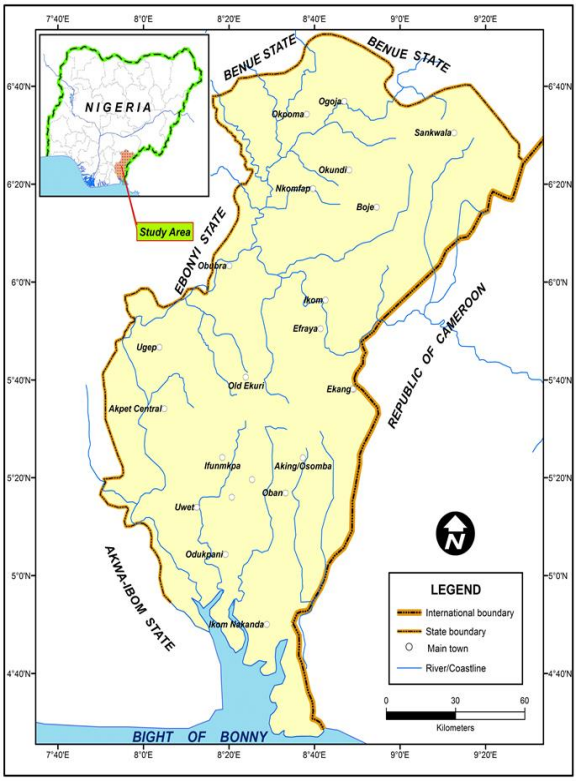

Fig. 1: Cross River State Showing Rivers as Mosquitoes Breeding Sites
Source: Cross River State Ministry of Lands and Surveys (2013)

MATERIALS AND METHODS

A well-structured 300 copies of questionnaire designed for the study was distributed to heads of households who bear healthcare cost of their respective families. The systematic random sampling technique was adopted in the distribution of questionnaire. This sampling method was applied using table of random numbers. All the houses were listed and numbered based on the population and sample size for the respective communities. The table of random numbers was then used to select each household and in each household (building) only a family was sampled. The numbers randomly selected from the table of random numbers were 0056 and 0067. From the outcome, starting from the first house in each road transect, the third building or household was chosen after which the eighth was sampled in that order. Also, annual case registry of malaria incidence for twenty-nine years (1983-2012) was collected from the record unit of the General Hospital, Calabar, Cross River State. Both descriptive and inferential statistics were used to analyze the collected data. The descriptive statistics used include bar graphs, mean, percentage and tables whereas the inferential statistic mainly comprises the Principal Component Analysis (PCA). PCA was used due to the multidimensional nature of the demographic and socioeconomic data. The analysis was performed to identify significant variables that influence malaria prevalence and the results are discussed below.

RESULTS AND DISCUSSION

Malaria prevalence in Calabar Metropolis

Table 1 shows malaria cases from 1983 to 2012. In 1983, 74 cases of malaria were reported. The number of reported cases of malaria increased substantially to 104 in 1986 and then dropped drastically to 61 cases in 2003, which perhaps represents the lowest reported cases of malaria in Calabar. The number of malaria cases increased steadily thereafter.

Table 1: Malaria prevalence in Cross River State

S/n	Year	Malaria reported cases
1	1983	74
2	1984	81
3	1985	72
4	1986	104
5	1987	98
6	1988	73
7	1989	94
8	1990	67
9	1991	83
10	1992	91
11	1993	73
12	1994	94
13	1995	67
14	1996	83
15	1997	92
16	1998	74
17	1999	81
18	2000	72
19	2001	104
20	2002	98
21	2003	61
22	2004	105
23	2005	85
24	2006	160
25	2007	150
26	2008	90
27	2009	189
28	2010	91
29	2011	234
30	2012	302

Source: General Hospital, Cross River State Ministry of Health (2013)

The reported cases of malaria increased to 189 cases in 2009 and 302 malaria cases in 2012. The trend in malaria prevalence from 1983 to 2012 revealed a 75.5% increase. As could be seen, the prevalence shows an upward trend in the cases of malaria within the period under review. This increasing trend may be attributed to the presence of suitable environmental factors and poor socioeconomic conditions. The Table also reveals that the highest prevalence of malaria was 302 cases reported in 2012, while the smallest number of 61 cases was recorded in 2003. However, the increasing number of people reporting the disease calls for effective control measures that would reduce the effect of malaria to the barest minimum.

Analysis of the Socioeconomic Characteristics of Respondents

Table 2 gives information on the demographic and socioeconomic characteristics of respondents in the area of study. The information shown on the table reveals that females dominated the survey. There were 52 females representing 52%, while males constituted 48%. The dominance of women in this survey could be blamed on the nature of jobs of their husbands, which require them to leave home early and retire home late. Similar result was reported by Cochran and Williams (2013). The table shows that the age range of the respondents was 18-45 years, majority of them were within 30- 35 years of age (50%), 18% of the respondents were within the ages of 18 – 29 years, while 32% representing 32 respondents were within the ages of 36 and above 45 years. This implies that majority of the respondents were young people who are conscious of their health and are more likely to seek for care on infection of malaria (Cochran and Williams, 2013).

Information on the marital status of respondents indicates that seventy-five (75%) were married, twenty-one (21%) were unmarried, four (4%) of the respondents had marital issues as such were divorced. This information means that majority of the respondents were married and are believed to be closer to the most vulnerable group (pregnant women and children). The religion of respondents indicates that they were basically Christians. This is not surprising considering the area of the study, which is completely dominated by Christians. Several studies in Nigeria and elsewhere in the world have shown that Christians, especially Christian women have better health education than their Muslim counterparts and this is likely to reflect in the way they prevent and treat malaria. Similar result of Christian dominance was also reported by Lowassa *et al*., (2012). Information on the educational qualification of respondents depicts that eight (8%) had no formal education, 24% had primary school education, 16% had post-primary education, while 52% had post-secondary education. This implies that majority of the respondents were literates who are knowledgeable of malaria. Some of these individuals are people who had suffered malaria in the past and can give possible reasons or factors that are responsible for the rising malaria incidence in recent time.

Table 2: Socio-economic characteristics of respondents

Socio-economic variables		Frequency	Percentages
Gender	Male	48	48.0
	Female	52	52.0
Age	18 - 23yrs	5	5.0
	24 - 29yrs	13	13.0
	30 - 35yrs	50	50.0
	36 - 40yrs	23	23.0
	41 - 45yrs	2	2.0
	>45yrs	7	7.0
Marital status	Married	75	75.0
	Single	21	21.0
	Divorced	4	4.0
Occupation	Farming	6	6.0
	Civil service/public servant	54	54.0
	Trading	40	40.0
Education	No formal education	8	8.0
	Primary education	24	24.0
	Secondary education	16	16.0
	Tertiary education	52	52.0
Religion	Christianity	100	100.0
Income	<N5000	2	2.0
	N5000 - N20,000	2	2.0
	N21,000 - N50,000	17	17.0
	>N50,000	79	79.0
Household size	3 - 5	49	49.0
	0 - 2	47	47.0
	6 - 8	4	4.0

Source: Fieldwork, 2013

Furthermore, the occupational information of respondents shows that majority, fifty-four (54%) were civil/public servants, forty (40%) were traders, while 6% were farmers. This result indicates that majority of the respondents were civil/public servants and traders. It is notable that all respondents are vulnerable to malaria infection irrespective of where they work. Similar finding was reported by Cochran and Williams (2013). The assessment done on the income of respondents indicates that majority of the respondents earned above ₦50, 000, while 4% earned less than ₦21, 000. The seemingly better income range among the respondents is indicative of their occupation and desire for better urban life which could have some impacts on malaria prevention and treatment. Information on the household size of respondents further reveals that majority of the households in the area have 3 – 5 persons. This means that majority of the respondents are married with children, and some with their relatives.

Malaria Incidence, Prevention and Control Practices

Table 3 gives information on the incidence of malaria between males and females. The information implies that both sexes have experienced or had malaria infection in the past. However, malaria incidence happens to be higher among the females than the males. This is apparent as female spend more time in mosquitoes prevalent areas such as the market places. Fig. 2 gives vital information on the rate of malaria occurrence in the area. It shows that 45% of the respondents had malaria infection monthly, 43% had malaria yearly, and 8% had malaria infection in every two weeks, while 4% had weekly infection. The result therefore indicates that malaria infection is a monthly infection, as majority of the people claimed to have been infected once in a month. In all, the result indicates that malaria infection is frequent and this calls for concern to reduce the alarming rate of infection due to the devastating effect of the disease on human health and household income.

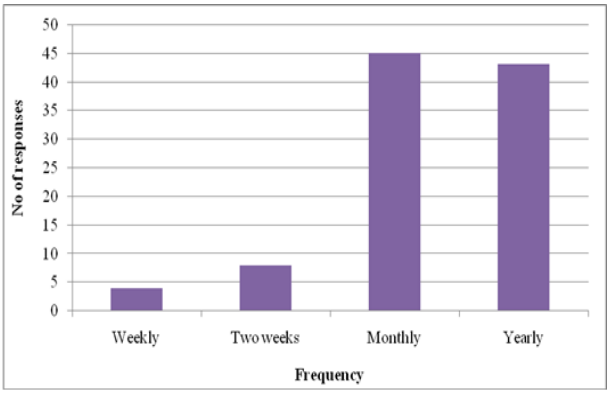

Fig. 2: Malaria occurrence rate

Insecticide treated nets (ITNs) is one of the ways through which the people prevent themselves from malaria infection. Hence, its awareness and utilization has been in the increase in the past two decades. Information on the ownership of ITNs in Table 3 shows that majority (73%) of the respondents have or owned ITNs, which could translate to low frequency of malaria infection. However, since many people believed malaria is endemic in the area, ownership may therefore not translate into protected individuals (Ibor *et al*, 2012). This is apparent as respondents claimed to be infected once in year. However, 27% did not own ITNs but are aware of its importance in preventing mosquito bites and subsequent infection. In all, people in the area are aware of ITNs and have made bold steps to have or acquire them from different sources. This result indicates that access and use of ITNs could help reduce the effects of malaria to a significant scale.

The finding of this study like many other studies elsewhere has shown that malaria infection and reported cases vary with seasons; its incidence could be high in the wet season and low in the dry season and vice versa. The study identifies the rainy (wet) season as a period with high reported cases of malaria infection. This could be argued on the basis that the wet season favours mosquitoes' survivals as its productivity is high during this season. It could be argued that during this season, mosquito breeding sites are given life mostly areas with immoveable (stagnant) or pools of water are common.

Table 3: Malaria prevention and control practices

Ownership of ITNs	Frequency	Percent
Own ITNs	73	73.0
Do not own ITNs	27	27.0
Total	100	100.0
Season of malaria incidence		
Rainy season	71	71.0
Dry season	29	29.0
Total	100	100.0
Incidence of malaria		
Male	48	48.0
Female	52	52.0
Total	100	100.0
Malaria control methods adopted		
Visiting the doctor	12	12.0
Use of herbal/traditional medicine	2	2.0
Use of insecticides	37	37.0
Ensuring environmental sanitation	42	42.0
Use of preventives	6	6.0
Others	1	1.0
Total	100	100.0

Source: Fieldwork, 2013

In Fig. 3, respondents were asked to state factors responsible for the continuous spread in malaria infection. Information contained in the Fig identifies indiscriminate dumping of wastes (dumpsites), poor drainage and poverty as the principal factors responsible for the spread malaria cases in the area. These identified factors give different reasons for malaria incidence. For instance, indiscriminate dumping of wastes attracts mosquitoes; they form convenient breeding sites for the reproduction and growth of mosquito parasite. This is obvious as houses close to dumpsites experience more mosquito than those far away. This also applies to clean/sanitary environment as opposed to filthy environment; filthy environment attracts mosquitoes as they thrive well in such area. Poor drainage encourages mosquito reproduction since the water in it is stagnant. In addition, poverty forces people to leave in areas that favour mosquito growth. Since they are poor and cannot afford better houses in well planned layouts, they become easy prey of mosquito. Obviously, people who live in slums and shanty areas are more predispose to malaria parasite compared to government reserved areas (GRAs). Other factors that are responsible for malaria spread are bushy areas/environment, open gutter and availability of stagnant water.

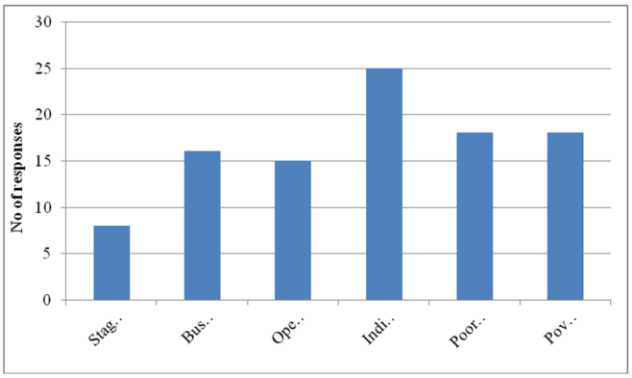

Fig.3: Factors responsible for malaria spread

The different methods employed by respondents in controlling malaria infection are provided in Table 3. Since mosquito parasites cannot be completely killed in our homes, physical, chemical and biological approaches have been used over the years to reduce it population as well as its infection rate. From the table, ensuring environmental sanitation (daily cleaning of the environment), the use of insecticides and visiting the doctor are the primary methods adopted to control malaria infection in the area. In order to effectively control malaria infection at the lowest cost (avoiding to see a doctor and to buy insecticides), the surrounding ought to be kept clean. In doing so, wastes dumps need to be burnt and grasses cleared. Gutters have to be washed and made to flow to destroy malaria breeding sites. If these practices are regularly carried out, malaria infection rate will be low. Another effective method of controlling malaria infection is through the use of insecticides. Though this method is cost effective, but it is able to kill mosquitoes thereby reducing their bites. Different insecticides are available in the market and shops for use. It is believed that the use of insecticide would reduce mosquito loads and rates of malaria infection.

The roles carried out by the government to control malaria infection as well as ensure a healthy workforce is shown in Fig. 4. From the figure, provision of free medical care and ensuring

proper environmental sanitation are the major roles played by the government in fighting malaria infection. Government sometimes gives out free malaria treatment for children and pregnant women. This approach provides relief to poor households, as their medical bills are paid by the government.

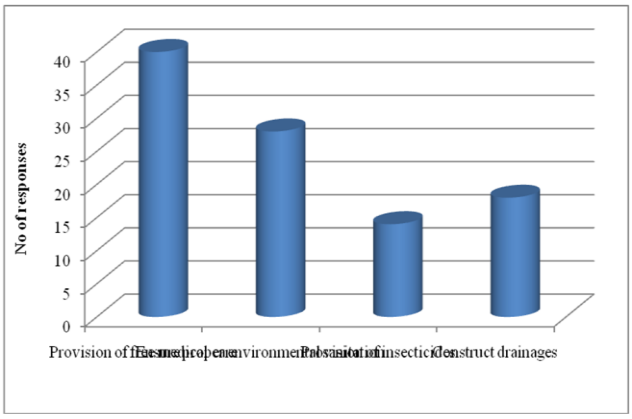

Fig 4**:** Role of government in malaria control

Presently, the government through Society for Family Health (SFN) is giving out malaria kits where malaria tests are carried out free of charge. Also, malaria drugs (e.g. ACTm) have been subsidized (N50) to enable the vulnerable group have access to treatment. Another effective way though not being enforced these days is mandatory environmental sanitation. This practice affords residents the opportunity to come together and keep their surrounding clean. Through this approach, breeding sites of mosquitoes are destroyed. This in the long-run will have significant effects on biting rates and infection.

Principal Component Analysis of Socioeconomic Factors

In order to ascertain the set of demographic and socioeconomic factors responsible malaria incidence, the Principal Component Analysis was applied. The PCA procedure using varimax rotation (variable maximization) as well as the Kaiser rule of extracting only components with eigenvalues >1(Gaur and Gaur, 2006) yielded four extracted principal components. The extracted components accounted for 68.2% of total variance in the original data set (Table 4). PC_1 had two sets of socioeconomic variables that loaded on it. The variables included type of accommodation (0.816) and monthly income of respondent (0.723). Also, based, on the concept of CDV, PC_1 epitomized type of accommodation. PC_2 also had two sets of socioeconomic variables; they included number of children (0.745) and sex of respondents (0.814). This component symbolized number of children. PC_3 contained one set of socioeconomic variable; which is marital status of respondent (0.761). This component signified marital status. PC_4 had also had one socioeconomic variable that loaded heavily on it; the socioeconomic variable on this component was occupation of respondent (-0.883). PC_4 signified occupation. The result above therefore indicates that type of accommodation, number of children, marital status and occupation as the main socioeconomic variables that predispose people to malaria incidence in the study area.

Table 4: Varimax –rotated socioeconomic characteristics of respondents

Socioeconomic variables	Principal components			
	PC_1	PC_2	PC_3	PC_4
Type of accommodation	.816	.128	.208	-.178
Monthly income of respondents	.723	-.243	-.414	.018
Age of respondent	.687	.262	.154	.245
No of children of respondents	.138	.745	.053	.170
Sex of respondent	.072	-.729	.118	.346
No of occupants	.334	.518	-.389	.348
Marital status of respondents	-.083	-.334	.761	-.064
Educational status of respondents	.312	.188	.662	.142
Occupation of respondent	.019	.006	-.026	-.883
Eigenvalues	**1.901**	**1.646**	**1.424**	**1.166**
% variance	**21.124**	**18.289**	**15.826**	**12.957**
Cumulative explanation	**21.124**	**39.412**	**55.239**	**68.195**

The underlined coefficient with loadings ±≥0.70 are considered significant

In addition, the least socioeconomic factors that predispose people in the area to malaria incidence include the set of socioeconomic variables with coefficients (loadings) ±<0.70. Theses set of socioeconomic variables include age of respondent, number of occupants and educational status of respondents (Table 4). The identified socioeconomic factors are considered least factors or variables that predispose people in the area to recurrent incidence of malaria.

The result obtained from the findings of the study show that male and females have experienced or had malaria infection in the past. But malaria incidence was higher among the females than the males. This is apparent as female spend more time in malaria endemic areas such as the market. Result of principal components analysis (PCA) extracted four socioeconomic variables responsible for malaria incidence. The latent components explained 68% of the total variance in the socioeconomic data set. PCA identifies type of accommodation, number of children, marital status and occupation as the main socioeconomic variables that predispose people to malaria incidence in the study. It also categorizes age of respondent, number of occupants and educational status of respondents as least or insignificant variables that make people susceptible to recurrent incidence of malaria.

The identified significant factors exert significant influence on malaria incidence. For instance, the income of respondents may have a direct or an indirect effect on malaria infection. High-income groups are more likely to have access to malaria prevention than low-income groups. This is obvious as the higher the income of an individual, the more his or her taste for better living standards. These sets of people will be able to purchase insecticides, leave in decent areas and are able to access medical care as when necessary. This influences peoples' taste and way of life, which has implication on malaria incidence. The result obtained indicates that the socioeconomic characteristics of respondents exert some influence on malaria infection. Information on the rate of malaria occurrence in the area shows that malaria infection is a monthly and yearly problem. This calls

for concern to reduce the alarming rate of infection mostly with the changing climate. The study shows that people in the area are aware of ITNs and have made efforts to have or acquire them from different sources. Wet season was identified as a period with high incidence of malaria-related behaviour. This is apparent because this period favours mosquitoes' survivals and its high productivity. During this season, mosquito breeding sites are common. Also, during this season, grasses blossom or grow rapidly which constitutes breeding sites for the reproduction and spread of malaria parasites. The result shows that indiscriminate dumping of wastes (dumpsites), poor drainage and poverty as the major factors responsible for the spread malaria cases in the area. These identified factors give different reasons for malaria incidence. Indiscriminate dumping of wastes attracts mosquitoes; they form suitable breeding sites for mosquitoes. Poverty forces people to live in malaria high-risk areas. These areas are usually inhabited by the vulnerable poor. Consequently, they become easily susceptible to mosquito bite. This observation has been made by Ettliing (1994) and Humphreys (2001) who noted that malaria is not just a disease commonly associated with poverty but also a cause of poverty. It could be explained that the use of mosquito nets and other protective measures would be improved with a concurrent improvement in the socioeconomic status of the people.

Conclusion and Recommendation

The study has identified type of accommodation, number of children, marital status and occupation as the principal socioeconomic variables that predisposed people to malaria incidence. It also categorized age of respondent, number of occupants and educational status of respondents as least or insignificant variables that made people susceptible to recurrent incidence of malaria. The four extracted principal components that mostly contribute to malaria incidence explained 68% of the total variance in the socioeconomic data set. Indiscriminate dumping of wastes (dumpsites), poor drainage and poverty were identified as the principal factors responsible for the spread of malaria in the area. The inhabitants in the area were aware of ITNs and had made efforts to acquire them from different sources in order to protect themselves against mosquito bite. The study noted that ensuring environmental sanitation (daily cleaning of the environment), the use of insecticides and visiting the doctor are the primary methods adopted to control malaria infection in the area. Based on the findings of this study, it is suggested that more malaria intervention kits (such as ITNs) should be made readily available to people in high-risk places, especially women who may not have the money to access medical care. Malaria intervention plans should be carried out during the outset of the rainy and dry season. These periods are responsible for the increasing trend in malaria. Environmental education should be organized to create necessary awareness on the need for clean environment. The monthly sanitation exercise should be re-instituted to provide residents opportunity to keep their surroundings clean. This approach will go a long way in destroying mosquito breeding sites.

REFERENCES

AL-Smadi M. H, Zuhier A and Radwan A. G. (2013). Approximate Solution of Second-Order Integro-differential Equation of Volterra Type in RKHS Method. *International Journal of Mathematical Analysis,* **7**: **44**, 2145 – 2160

Bai, L., Morton, L. & Liu, Q. (2013) Climate change and mosquito-borne diseases in China: a review. *Globalization and Health*, 9 (10): 2 – 22.

Cochran, R. & Williams, I. (2013) Incidence of malaria among various rural socio- economic households. *European Journal of Medical Sciences*, 11: 24 – 34.

Ettling, M., McFarland, D.A., Schultz, L. J. & Chitsulo, L. (1994) Economic impact of malaria in Malawian households. *Trop. Med. Parasitol*, 45 (1): 74 – 79.

Huang, F., Zhou, S., Zhang, S., Wang, H. & Tang, L. (2011) Temporal correlation analysis between malaria and meteorological factors in Motuo County, Tibet. *Malaria Journal*, 10:54

Ibor, U. W, Aigbe, G. O, Iwara, A. I, Okongor, O.E and I. I. Okino (2012) Ownership and Utilization of Insecticide of Nets in Cross River State, Nigeria. Journal of Medical Science, DOI: 10: PP. 1-9.

Lowassa, A., Mazigo, H. D., Mahande, A. M., Mwang'onde, B. J., Msangi, S., Mahande, M. J., Kimaro, E. E., Elisante, E. and Kweka, E . J. (2012) Social economic factors and malaria transmission in Lower Moshi, Northern Tanzania. *Parasites & Vectors*, 5:129

Ohwofasa, E. I. (2010) The incidence and periodicity of malaria in residential zones of Warri metropolis. Unpublished M.Sc., University of Ibadan, for the award of M.Sc. Geography.

Okoronkwo, E. M. (2014) Variation on malaria prevalence in Calabar Metropolis, Cross River State, Nigeria. Unpublished M.Sc., Benue State University.

Roll, B. M. (2000). Abuja Declaration on Roll Back Malaria in Africa

WHO (2003) "National Malaria Situation Analysis" Retrieved from (http:/www/who.int)