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Full length research paper

Temporal analysis of malaria prevalence in Cross River State, Nigeria

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Malaria is one of the most serious health problems that affect millions of people globally and a leading cause of death in Nigeria and Africa at large. Inspite of the alarming rate of the disease, recent trends have not been adequately established to match interventions. This study therefore examined trends in the prevalence and occurrence of malaria in Cross River State, Nigeria. Specifically, the study used malaria prevalence data of 30 years (1983 – 2012) collected from the General Hospital Calabar, Cross River State to understand the temporal (monthly) trend in malaria infection between males and females. The results showed that a total of 3,228 cases of malaria were recorded in 30 years (1983–2012). The number of reported cases of malaria increased substantially from 1986 and dropped drastically in 2003. The trend in malaria prevalence from 1983 to 2012 revealed an average of 75.5% increase. The study revealed that malaria was still on the increase. The monthly trend in malaria cases showed that December, January, July and February/April had the highest reported cases of malaria, while August and September had the lowest prevalence of malaria of 152 and 167 cases respectively. The Temporal trend in number of males and females with malaria for a period of 30 years indicated that males reported more cases of malaria than their female counterpart. Based on the results of the findings, the study recommended that more malaria intervention kits such as Insecticide Treated Nets (ITNs) should be provided to both males and females in the area, alongside with advocacy on the benefits of optimizing such intervention especially at the onset of the dry and rainy seasons.

Keywords: Analysis, Malaria, prevalence, Temporal and Trend

Introduction

Malaria is one of the major tropical health challenges in the world today. Roll Back Malaria (2005) asserted that malaria kills several millions of people worldwide every year and most of this preventable death manifests in the labour force of African region. Transmission of malaria is associated with changes in temperature, rainfall, humidity as well as level of immunity (Ayanlade, Adeoye and Babatimehin, 2010). Despite the uncertainties in malaria data, there is a recent consensus that there was resurgence in malaria related deaths in some parts of the world, between the 1980s and the 1990s. This is partly due to the increasing resistance of the parasite to malaria drugs. By the end of 2004, malaria was endemic in over 105 countries across the globe (Africa Malaria Report, 2003).Malaria has impacted so much on the people of Nigeria and the continent at large. World Health Organisation (2003) in its report revealed that malaria affects the lives of almost all people living in Africa. Also, Onwujekwe and Okonkwo (2000) concluded that, malaria has demographic effects on the Nigerian economy as decision on where to live, work or reside are significantly determined by their propensity and vulnerability to malaria. The study of Irefin *et al* (2013) also revealed that malaria contributes to both poverty and underdevelopment in Nigeria through reduced productivity/output and absenteeism from work. Malaria causes 30 -50 per cent of in-patient admissions, incur 40 per cent of total public health expenditure and up to 50 per cent of out patients visits hospital and medical

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centers for follow up management (Roll, 2000). Consequently, recent intervention efforts have focused on effective prevention and control measures. Successive governments have attempted to eradicate malaria through anti malaria campaign, seminars and workshop on malaria, free distribution of mosquito nets and vaccines. In spite of these efforts at combating malaria, the disease continues to account for 90 per cent of under five year mortality and also constitute 10 per cent of the continent overall diseases burden. In reality, data from health facilities are potentially useful for monitoring time trends in the number of malaria cases that can guide interventions. In Nigeria, most cases of malaria are diagnosed on the basis of clinical symptoms and treatment is presumptive, rather than based on laboratory confirmation (Breman, 2001). However, trends of routinely collected data over a prolonged period and over a wide geographical area can be useful for local programmes planning and can engender major investments in improving both access to health services and monitoring changes. Although various interventions are now available to ensure that the burden of the disease is reduced, few studies have been conducted to identify the period of peak infection of the disease that would have improvement on the prioritization and allocation of resources. This task becomes necessary because there is a close relationship between malaria incidence and seasonality. Also, several studies have highlighted the significant methodological difficulties in undertaking such analyses (Craig, Snow, and le Sueur, 1999; MicMichael, Campbell-Lendrum, Corvalan, Ebi, Githenko, Scheraga and Woodward, 2003; and Toulmin, 2005). Hitherto, earlier studies on malaria prevalence focused on causes of malaria (WHO, 1999; UNICEF, 1999; Makanjuola, 2000). Others focus on spatial distribution of malaria and its incidence (see Raheem, 1999: Olaniran, 1999: Adebayo, 2000). Some other scholar categorized malaria occurrence (see Iyun, 1988; Grange, 1996). While it is generally agreed that scholars have explored the resultant effort of malaria in the tropics, studying the trends in malaria incidence is few and scanty due to lack of time series data, especially in the South-southern part of Nigeria. Hence, this study aims at analyzing trends in malaria incidence, with a view to identifying the period of peak infection that can guide sound epidemiological intervention in Cross River State, Nigeria.

Statement of problem

Malaria is one of the major endemic tropical health challenges in Nigeria. The disease is highly prevalent in Cross River State. The disease is trending in so many villages, towns and major cities and affecting both young and old, male and female, rural and urban dwellers, classed and classless. The presence of water logging and riverine areas create suitable breeding grounds for the mosquito vectors. Malaria imposes heavy burden on the people, peals much from the people and also affects productivity. As a result, the increasing rate of the disease is alarming such that the extent of its trend has not been adequately captured to accurately know the magnitude or extent of its effects over time. The trend, dynamics and impact of malaria is worrisome to policy makers, professionals and scholars because it has been extremely difficult to accurately assess the true scale of the burden of the disease. This gap in knowledge has necessitated thoughts and scholarly works that would give better insight to the ways of minimizing and possibly eradicating the toll of the disease. It is against this backdrop that this study seeks to estimate and analyze the trends of malaria among the inhabitants of Calabar metropolis, Cross River state, Nigeria.

Objectives of study

The main objective of this study is to analyze the temporal changes in the prevalence of malaria in the area while the specific objectives are to: analyze the trends in malaria incidence; determine the prevalence in sex and period of peak infection; recommend policy issues based on the findings

Research Methodology

Description of the study area

Cross River State, tagged the “people’s paradise”, is situated in the tropical rainfall belt, Nigeria’s delta region. It lies between latitudes $5^{o}32$” and $4^{o}27$” North and longitudes $7^{o}50$” and $9^{o}28$” East of the equator.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. Cross Rivers state has an area of 23,074 square kilometers, a population of 1.8 million and it is divided into 18 local government areas (National Population Commission, 2006). Its capital is Calabar and other major towns in the state include; Akamkpa, Ikom, Obubra, Odukpani, Ogoja, Okundi, Ugep, Obudu, Obanliku and Akpabuyo.

Cross River State is one of the major petroleum producing areas in Nigeria. Because of its geographical location and enormous geologic potentials, the State is

crucial to the strategic interest of Nigeria due to high reliance of the Nigerian economy on oil. The state is divided into basement and sedimentary basins. It is one of the fastest growing states in Nigeria with agriculture as its main and growing economic sector. This accounts for approximately 42% of the state GDP (CBN, 2012).

Climate of the area

The climate within Cross River State is tropical humid with wet and dry seasons. It has an average temperature ranging between 15^0C-30^0C and the annual rainfall between 1300mm-3000mm. The high plateau of Obudu experiences climatic conditions which are markedly different from the generalized dry and wet period in the rest of the Cross River State. Temperature 4^0C- 10^0C lower due to high altitude than in the surrounding areas similarly, the annual rain fall figures are 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

Methodology

The study used secondary data only which has been collected from the record unit of the General Hospital, Calabar on the reported cases of malaria for twenty-nine years (1983-2012). The study used both descriptive and inferential statistics to analyze the collected data. The descriptive statistics used which is necessitated by the simple nature of data obtained include line and bar graphs, mean, mode, percentage and tables whereas the inferential statistic mainly comprises the OrdinaryLeast Square (OLS) method. This is employed to find out if there is a significant trend in malaria incidence over time in Calabar. The test statistic for linear regression is the regression gradient. According to Kundzewicz and Robson (2004), linear regression is one of the most common tests for trend analysis. It assumes in its basic form that data are normally distributed. The idea here is that the t-statistic on β_1 is tested to determine if it is significantly different from zero. If the slope is non-zero (i.e. $\beta_1>0$), it therefore means that there is a linear trend in Y (malaria incidence) over time, but if the slope is zero (i.e. $\beta_1=0$), it means that there is no trend, and the equation results in zero percent change (National Non point Source Monitoring Programme, 2011). Data on malaria prevalence was taken as the cumulative of all reported cases of malaria from 1983 to 2012. The linear trend for this study is modified after Kareem *et al*., (2012) and mathematically defined thus:

$$Y_t = \beta_0 + \beta_{1t} \quad \ldots\ldots 3.1$$

Where: Y_t = linear trend forecast in period (t) [malaria prevalence] β_0 = intercept of the linear trend line, β_1 = slope of the linear trend line (regression coefficient),t = time period (1983 – 2012). The statistical analysis was carried out using the Statistical Package for Social Sciences (Version 17) for Windows.

Results and Discussions

Trends in malaria prevalence

Table.1 shows the time series data of malaria prevalence from 1983 to 2012. In 1983, a total of 74 cases of malaria were reported comprising 36 males and 38 females. The number of reported cases of malaria increased substantially to 104 in 1986 and then dropped drastically to 61 cases of malaria reported in 2003. Perhaps, this represents the lowest reported cases of malaria in Calabar. Three years after this low occurrence, the reported cases of malaria were about 2.5 folds greater. Thereafter in 2003, the number of reported cases increased steadily to 105 and 160 in 2004 and 2006 respectively. It later rose to 165 and 234 in 2010 and 2011 respectively. The peak was reached in 2012 with 302 cases reported. The trend revealed an upward trend and a positive relationship with time with an average growth rate of 13.2% per annum. Male recorded 12.3% growth rate while the female folk recorded 14.2% growth rate in malaria cases as evidenced in table 1. This increasing trend is attributed among numerous factors to poor access to mosquito treated net, dirty environment, increasing amount of rainfall. The table also reveals that the maximum case of malaria was witnessed in 2012. This amounted to 302 while the minimum number of cases was recorded in 2003 with 61 individual affected with malaria. In addition, the first ten year of the study recorded and average of 83 cases of malaria, 86 cases in the second decade while average of 153 cases were recorded in the third decade which spans 2003-2012. On the whole, the cases of malaria reported within the period under study stands at 109. Furthermore, out of the 3228 cases of malaria reported, 1,725 were male and 1503 were female. These respectively constitute 54% and 47% for male and female. Similarly and on the average, 58 cases of male and 50 cases of female were reported to have malaria per annum between the periods of 1983-2013. The report showed that the reported cases of male having malaria was 16% more than that of female. By implication, this suggests that male were more prone to malaria than female in Calabar. The study also reveals that the cases of malaria reported for both sexes is about 4 folds as it was in 1983. Similarly, while the cases of male affected with malaria increased by 361.1% from 1983 to 2012, that of female increased by about 258%.

Table 1: Malaria prevalence in Cross River State

	Reported Malaria Cases		Male Inpatient			Female Inpatient		
Year	No	Growth Rate (%)	No	Growth Rate (%)	% of Reported Cases	No	Growth Rate (%)	% of Reported Cases
1983	74	-	36	-	48.6	38	-	51.4
1984	81	9.5	39	8.3	48.1	42	10.5	51.9
1985	72	-11.1	43	10.3	59.7	29	-31.0	40.3
1986	104	44.4	54	25.6	51.9	50	72.4	48.1
1987	98	-5.8	59	9.3	60.2	39	-22.0	39.8
1988	73	-25.5	41	-30.5	56.2	32	-17.9	43.8
1989	94	28.8	48	17.1	51.1	46	43.8	48.9
1990	67	-28.7	37	-22.9	55.2	30	-34.8	44.8
1991	83	23.9	50	35.1	60.2	33	10.0	39.8
1992	91	9.6	48	-4.0	52.7	43	30.3	47.3
1993	73	-19.8	41	-14.6	56.2	32	-25.6	43.8
1994	94	28.8	46	12.2	48.9	48	50.0	51.1
1995	87	-7.4	37	-19.6	42.5	50	4.2	57.5
1996	83	-4.6	40	8.1	48.2	43	-14.0	51.8
1997	92	10.8	48	20.0	52.2	44	2.3	47.8
1998	74	-19.6	36	-25.0	48.6	38	-13.6	51.4
1999	81	9.5	39	8.3	48.1	42	10.5	51.9
2000	72	-11.1	43	10.3	59.7	29	-31.0	40.3
2001	104	44.4	54	25.6	51.9	50	72.4	48.1
2002	98	-5.8	59	9.3	60.2	39	-22.0	39.8
2003	61	-37.8	29	-50.8	47.5	32	-17.9	52.5
2004	105	72.1	59	103.4	56.2	46	43.8	43.8
2005	85	-19.0	50	-15.3	58.8	35	-23.9	41.2
2006	160	88.2	89	78.0	55.6	71	102.9	44.4
2007	150	-6.3	87	-2.2	58.0	63	-11.3	42.0
2008	124	-17.3	52	-40.2	41.9	72	14.3	58.1
2009	147	18.5	117	125.0	79.6	30	-58.3	20.4
2010	165	12.2	65	-44.4	39.4	100	233.3	60.6
2011	234	41.8	113	73.8	48.3	121	21.0	51.7
2012	302	29.1	166	46.9	55.0	136	12.4	45.0
Total	3228		1725			1503		

Sources: General Hospital, Cross Rivers State Ministry of Health, 2014

Temporal trend in malaria incidence

The monthly trend in cases of malaria is shown in Fig 5.1. It shows that the number of malaria cases was high in January with 308 cases; this reduced by 14.1 per cent in February to 270 cases, and increased again in July to 277 cases. Thereafter, the reported cases of malaria declined steadily and started to increase in November and climaxed in December with 344 reported cases of malaria. The figure indicates a stationary trend in the monthly reported cases of malaria. This is apparent as there was a general increase in malaria cases with above 200 cases. This pattern observed implies that there is no significant reduction in malaria prevalence between the seasons, as high prevalence is experienced in both seasons. The trend further shows that December, January, July and February/April were months with the highest reported cases of malaria, while August and September had the lowest prevalence of malaria of 152 and 167 cases respectively. Hence, it could be deduced that high malaria incidence is basically recorded during the dry season and rainy season mostly in April and July with the commencement of heavy thunderstorms (rain).

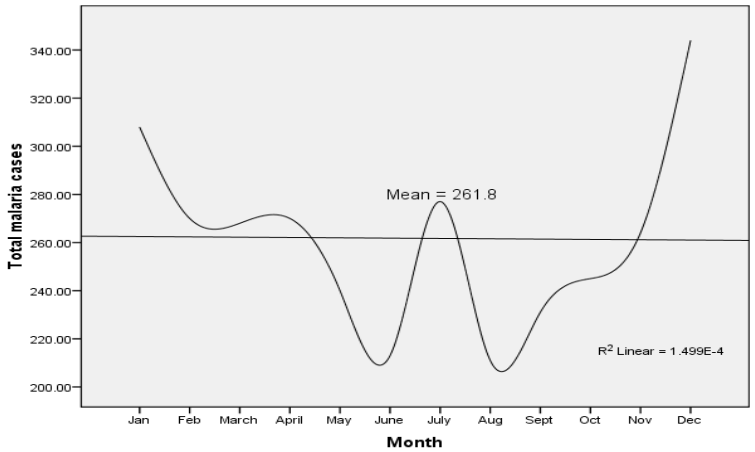

Figure.1 Temporal (Monthly) trend of malaria cases

Table 2: Summary of linear regression result

Variables	Coefficient		
N		**β_2**	**t-value**
30		0.59	3.90*
Test results			
F- value	15.17*		
R	0.593		
R^2	0.351		
Constant	-7055.16		-3.84*
DF	0.0357		

Source: Computed by the Authors fieldwork, 2003 (Using SPSS Window Output, Version 17.0)
*significant at 1% significance level

Furthermore, the figure shows that more malaria cases of male were reported than the female counterpart within the period under review. Indeed, the prevalence of malaria for the period under review was higher in males than in females. For the males, December, January, and July recorded high malaria prevalence, while for the females, high prevalence or reported cases of malaria were recorded in December, January and February. Both males and females recorded high cases for the month of January and December. This indicated that malaria cases for both sexes were high in the dry season mostly in January through February. On the contrary, low malaria prevalence for male and female was recorded September and October. This also occurred for males and females in June and August respectively. A cursory look at the fig shows that the incidence in malaria in both sexes trend upward or positive.

Interpretation

The multiple R^2 result in table 2 reveals that 35 per cent of the malaria cases among the people is attributed to time (year), while 65 per cent are accountable by other factors different from time. As evident from the slope, there exists a positive relationship between time and cases of malaria reported within the period under study. This implies that as the period increases, the prevalence rises and perhaps vise versa. The slope suggests that cases of malaria increases by 59 units as every one year is added. By implication, the result indicates that malaria is still on the increase as it has not been properly tackled in the past three decades. This trend shows that government effort at various levels within the state has not yielded the expected optimal results. Hence, the need to accrue resources in this regards in order to curb its consequences is essential. Furthermore, the test statistic result shows that the slope of the trend (β_2) is non zero. This means that there is a significant positive linear trend in malaria prevalence ($t = 3.90$, $p<0.01$). The standardized regression coefficient shows that increase in time period would result in 59 per cent increase in the number of reported malaria cases. The linear trend equation of malaria prevalence over time in Calabar is given as follows:

M_t=-07055.16+0.59t……eqn 4.2

The above equation shows that the slope of the model is 0.59. This suggests that over the period of twenty nine years under study, the prevalence of malaria proportionally varied with time as it is evidenced from and also justified by the positive (+) sign of the slope. The equation also revealed that malaria prevalence rose by 59% on continuous and annual basis. That is, as another year is added, 59% of the sampled population probably got infected by malaria and the consequential effect of this phenomenon is an increase in malaria prevalence. Hence, more relief materials are needed to reduce the burden of malaria in the area.

Discussions

A total of 3,228 cases of malaria were recorded in the period under review (1983–2012), with minimum and maximum cases of 61 and 302 respectively. The reported cases of malaria for the time period reveals that 1,720 were males, while 1,485 were females. This simply implies that males are more infected by malaria than their female counterparts probably due to their immunological characteristics. The Temporal trend in number of males and females with malaria for a period of 29 years indicates that males reported more cases of malaria than their female counterpart. The result indicates that the prevalence of malaria for the period under review is higher in males than in females. For the males, December, January and July recorded high malaria prevalence, while for the females, high prevalence or reported cases of malaria were recorded in December, January and February. This indicates that malaria cases for both sexes are high in the dry season mostly in January through February. On the contrary, low malaria prevalence for male and female was recorded in September and October as well as June and August respectively.

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 trend in malaria prevalence from 1983 to 2012 reveals 75.5% increase. The increasing trend is attributed among numerous factors to exposure and poor access to mosquito treated net and increase in rainfall. The trend of malaria prevalence among males reveals that 59% of the malaria cases among men could be attributed to time (year) or seasonality, while 41% are accountable by other factors not necessarily time. The pattern obtained indicates that malaria is still on the increase as it has not been properly tackled in the past three decades. For females, the pattern of females with malaria cases for the time period shows an upward trend, and is attributed to the low awareness and use of mosquito treated nets. Despite the increasing campaign on malaria and the need for protection against infection, malaria prevalence happens to be on the rise. This finding serves to highlight the fact that current interventions seem to be yielding little or no results in reducing the incidence of the disease. This is because reported cases from 2006 to 2012 are more significant than those in the 1980s. A plausible explanation for this result is the fact that majority of the inhabitants do not sleep under Insecticide Treated Nets. Similar observation has been made in the area by Ibor *et al* (2012) who reported a weak relationship between ownership and utilization of Insecticide Treated Nets. The monthly trend in malaria cases shows that December, January, July and February-April have the highest reported cases of malaria, while August and September have the lowest incidence of malaria of 152 and 167 cases respectively. The results of the analysis show that high malaria incidence is recorded during the dry season and rainy season mostly in April and July respectively with the commencement of heavy thunderstorms (rain). This provides the basis for intervention; as prompt distribution of malaria kits and vaccines is necessary during the onset of the dry season as well as during the start of the rains to enhance protection against malaria infection.

Conclusion and Recommendation

The study has shown that a total of 3,228 cases of malaria were recorded in 30 years (1983–2012). Males were more infected by malaria than their female counterparts. The number of reported cases of malaria increased substantially to 104 in 1986, then dropped drastically to 61 cases in 2003, which perhaps represented the lowest reported cases of malaria in Calabar. The trend in malaria prevalence from 1983 to 2012 revealed a positive relationship and 308% increase. The study also revealed that malaria was still on the increase as it had not been properly tackled in the past three decades. In view of the study therefore; our findings serve to highlight that: Targeting interventions would be more appropriate in the implementation and allocation of resources tackling the burden of the disease. Men should be given equal priority like their female counterparts in terms of interventions in order to reduce to proportion of males being infected by mosquitoes. The current strategy of distributing Insecticide Treated Nets (ITNs), primarily during antenatal care tends to favour the female folk. We therefore, recommend house to house distribution of ITNs in proportion with members of households with emphasis on utilization by not only the vulnerable group but also the male folk. The distribution of malaria kits and other protective resources should be done at the onset of the dry season and the start of the rainy season to ensure easier access to prevention during the peak period.

In addition, community involvement in advocating for funding and increased government commitment through local and state budgetary allocation, and community

acceptability of malaria control efforts and interventions should be encouraged.

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