People, Places, and Health Variations: A Case of Malaria Incidence in Ibadan, Nigeria

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Introduction

Against the background that social inequalities have a spatial variation, with many people who are on the lower pedestal of the socio-economic ladder living in not-so-good residential environments, having poor feeding habits made up of meals that are low in calories, and having constrained access to social infrastructure, and public goods and services, this paper investigates the relationships between the population's levels of social well-being and places of residence, and how these underlie the incidence and pattern of environmentally-induced diseases in a traditional African city. Specifically, the study seeks to explain the varying incidence and pattern of malaria along residential density lines in Ibadan, Nigeria as consequent on the population's social well-being. In the discussions that follow, socio-economic status, standard of living, quality of life and levels of social well-being mean the same thing and are used inter-changeably

Kawachi and Kennedy (1997) observe that increase in income inequality around the world exacerbates a residential concentration of poverty and affluence and affects health. Studies by Barker and Osmond (1991), Wilkinson (1992; 1996), Anderson and Armstead (1995), Kennedy et al (1996), Kaplan et al (1996), Kaplan (1996), Ben-Shlomo et al (1996), and Macintyre et al (2002) also show that income inequality results in social segregation with negative implications for the population's health. Kennedy et al (1996), Kaplan et al (1996) and Shomo et al (1996) specifically relate the outcomes to increased mortality among the population. These studies focus on the people (composition) or the places (contexts) in providing explanations for the geographical variations in health. A third line of explanation which provides the linkages between the socio-economic status of the people and the ecological characteristics of where they live and how these impact on the population's health is attempted in this work.

Malaria Pandemic

Malaria is a public health problem today in more than 100 countries of the world inhabited by over 2.4 billion people (Awake, 2003; Njoku, 2005; WHO, 2006; United States, 2011; MFI, 2010; MFI, 2013; Nigeria, 2013). According to the 2005 world malaria report, the number of deaths resulting from malaria is 1 million per annum. Malaria sickens between 350 and 500 million more people yearly and kills an African child every 30 seconds (WHO, 2005). In Nigeria, there are an estimated 100 million malaria cases annually with a resultant death of between 225,000 (Nigeria, 2013) and 300,000 people (WHO, 2006; United States, 2011). Malaria accounts for 11% of maternal mortality in Nigeria, 60% out-patients hospital visits, and 30% hospitalization among children under the age of 5 (United States, 2011; Nigeria, 2013). The most vulnerable groups to attacks of malaria are pregnant women and children (NMEP, 2014), largely because of their physiological conditions, levels of cognitive development and exposure to the vagaries of weather.

Malaria is a disease caused by five species of parasitic protozoa that infect human red blood cells. Initially known and referred to as ague or marsh fever owing to its association with swamps and marshland, the term malaria originated from medieval Italian phrase *mala aria* which literally translates as bad air (Reiter, 2000). The parasites are *Plasmodium vivax*, *Plasmodium malariae, Plasmodium ovale, Plasmodium falciparum and Plasmodium knowlesi*. The five different species of malaria parasites cause different types of malaria. *Plasmodium* *knowlesi* is a recently discovered malaria parasite responsible for zoonotic malaria; a form of malaria transmitted from animals to human and is predominant in South-East Asia (MFI, 2013; CDC, 2013). The worst type, which kills approximately 1-2 % of those (human) infected, is caused by *Plasmodium falciparum* (MFI, 2013; MFI, 2010).

Falciparum malaria is recognizable by fever, flu-like illness and cold, headache, muscle aches and general weakness as symptoms in mild cases. Nausea, vomiting and diarrhea may also be noticed. In severe cases, the brain and the placenta may be infected. Because of malaria's effect on the red blood cells, malaria may also result in anaemia and jaundice; yellow coloring of the skin and eyes of the victim (CDC, 2013). When the symptoms are ignored and treatment not sought, the severity of the infection can cause kidney failure leading to seizures, temporary madness, coma and ultimately, death. *Falciparum* malaria is the major type found in Nigeria and other sub-Saharan African countries. Humans contract malaria through a bite from a female mosquito of the *Anopheles* genus.

Malaria abounds mainly in the tropics largely because of rainfall and high temperature. Awake! (2003) reports that the hot temperature of the tropics shortens the mosquito's breeding cycle thereby speeding its reproduction rate and lengthening the season during which mosquito abounds. The hot temperature also increases the reproduction rate of the parasites and thus increases the likelihood that a single bite will cause malaria infection (Awake! 2003). Rainfall on the other hand leads to puddles of still water in areas of poor drainage network and mosquitoes are known to breed well in puddles of still water, open drains, construction sites and abandoned pools of water. They also thrive in places of inadequate waste disposal systems, cleared agricultural lands and irrigated gardens, swamps and marshland.

Disease Triangle and Health Inequality

The concept of disease triangle, also known as the human ecology of disease, is concerned with the ways human behavior, in its cultural and socio-economic context, interacts with environmental conditions to produce or prevent disease among susceptible people (Meade, Florin and Gesler, 1988). It sees disease production and prevention as consequent on the people's reaction to the physical environment. The concept provides explanation for the variation in space of human disease and health using three dimensions of habitat (environment), population and cultural behavior. While habitat in the triangle comprises both the biotic and abiotic elements of the environment, population is concerned with humans as organisms and hosts of diseases. The observable aspect of culture emanating from cultural precepts, economic constraints, social norms and individual psychology is implied by behaviour in the disease triangle.

The concept of disease triangle is apt in the analysis of the spatial variations of malaria essentially because malaria is largely habitat dependent and its prevalence is affected by habitat, population and behaviour. For example, while the mosquito vector breeds well in puddles of still water found around the home or in unhygienic water storage conditions within the home, its continued existence is encouraged or discouraged by conditions within the home. Such conditions include whether windows are screened, cleanliness of the toilets, bathrooms and kitchen, adequacy of ventilation and the availability of temperature regulation facilities among others. These conditions are mostly affected by income and socio-economic status; both of which are attributes of population in the disease triangle.

The locations of health facilities and by extension, access to healthcare are also a part of habitat and they also affect the prevalence of diseases as health personnel provide education on prevention and control of disease as well as provide treatments, and these are usually spatially uneven (Adewoyin, 2015; Okafor, 2007; 1987; 1982; Ikporuko, 1987 for instance) and skewed positively towards the elites. Lipton (1998; 1977) posits that as long as elites' interests, background and sympathies remain largely urban, resource allocation will always favour the elites. The elites live in the best part of a city (Harvey, 1975; Smith, 1979; 1994), characterized by low residential density and good environmental quality. Studies have also shown that health-care in particular is more accessible to people of higher socio-economic groups who live in the best parts of a city (Townsend, 1974; Knox, 1978) than to the relatively poor who live in high or medium density residential areas. This situation is known as the inverse care law (Hart, 1971) and the underclass hypothesis (Lineberry, 1976).

An individual's lifestyle is simply his behaviour. How the individual adapts to conditions in his habitat, the choices he makes to contain changes in his habitat and on his person is that individual's behaviour. In the disease triangle, behaviour includes the actions and inactions of an individual that expose him to or protect him from diseases as well as other interventions aimed at achieving a sound health. Behavior thus includes disease prevention and treatment strategies employed by an individual and these are also consequent on the individual's education, income, cultural perceptions and socio-economic status.

Socio-Economic Status and Malaria

Outside of changes in climatic parameters of temperature, rainfall and humidity as well as changes in land use and land cover which have been shown to promote the breeding of mosquito and increase the prevalence of malaria (Adeboyejo et al, 2012; Zacarias and Andersson, 2011, Krefis et al, 2011; Oluleye and Akinbobola, 2010; Uneke and Ibeh, 2008; Johnson et al, 2008; Munga et al, 2006; Vittor et al, 2006; Patz et al, 2005;), Yusuf, et al, (2010) investigated the effects of poverty on childhood malaria at regional levels using Nigeria as a case study. Their findings indicated that the prevalence of the disease was highest among children from the poorest households while it was minimal among children from wealthier households. The finding is not significantly different from those of regional studies in India (Sharma, 2003) and in several countries of the world (Teklehaimanot and Mejia, 2008; Worrall et al, 2003; Gwatkin and Guillot, 2000; Gwatkin et al, 2000) where it has been established that malaria is a disease of poverty. This is more so as only 0.2% of global malaria deaths are found in the world's richest population quintile while 57.9% of global malaria deaths are concentrated among the world's poorest population quintile (Gwatkin and Guillot, 2000).

Further, CHESTRAD (2000) observed that individuals earning less than $1.00 a day suffered more bouts of malaria per month than their counterparts with more income. The study was based on a sample from 4 states in Nigeria. Using occupation as a corollary of socio-economic status; greater risk occupations like agriculture and farming are associated with low socio-economic status (Worral et al, 2003), Ghebreyesus et al (2000) found out that highland migrant agricultural labourers in Ethiopia are more at risk of malaria than their counterparts in other forms of employment. Gemstone miners (Yapabandara and Curtis, 2002) and rice farmers (Mutero et al, 2000) were also found to have a greater risk of being infected with malaria. Tshikuka et al (1996) also showed that the prevalence of malaria parasite was higher among workers in the low socio-economic occupational category (low paid, industrial or unskilled workers) than among workers in a socio-economic category.

Location as a socio-economic factor influencing malaria prevalence is often described with respect to the rural-urban dichotomy while household facilities and age / condition of buildings are mostly implied by housing as a socio-economic factor affecting the prevalence of malaria. Rasheed et al (2000) for instance found out that annual episodes of fever were higher among children who lived in rural areas of Benin Republic in contrast to their counterparts in the urban areas. The same findings were recorded in studies in Malawi (Ndawala et al, 2000), Zaire (Coene, 1993) and South-Western Nigeria (Ademowo et al, 1995). Some other studies focused their locational analysis essentially on the spatial variation of the prevalence pattern within the urban milieu. Prathiba and Marshall (2012) for instance discovered that most breeding sites of mosquitoes in the urban areas are artificial (ditches, agricultural sites etc.) and are mostly found in the peri-urban where the socio-economic status of residents is usually lower than what obtains in the city centers.

The result is not significantly different from findings in studies by Byrne (2007), Wang et al (2005) and Robert et al (2003). In their own locational analysis within the context of urban environment, Kumar et al (2014) identified malaria hotspots in Chennai, India and associated these hotspots to local climatic factors in the affected areas. They however suggested that the socioeconomic status of the inhabitants of the hotspot areas may have an effect on their findings. As a generalization, Worrall et al (2003) argue that housing that places individuals at increased risk of malaria infection is used more frequently by those in the lower socio-economic strata than those in higher socioeconomic strata. These houses are agglomerated along residential district lines with distinct class boundaries. In other words, income and occupation, among other factors, influence choices of housing and housing standards, are spatially concentrated, and are all a reflection of socio-economic status.

Methodology

Population and Sampling

Ibadan the study area is the capital city of Oyo State in South-West Nigeria. It is located between latitudes 7°05'N and 7°25'N and longitudes 3°40'E and 3°55'E. Ibadan had a population of 2,550,593 according to the 2006 provisional census figures and covers an area of 3,080 km^2. The city's elevation ranges between 150m and 275m above sea level and is drained by rivers Ona, Ogbere, Ogunpa and Kudeti. Ibadan has a tropical wet and dry climate and is situated within the rain forest belt with rainfall between the months of March and October and a dry season between November and February. Mean annual rainfall in Ibadan is 1420mm while average annual temperature is 26°C. Relative humidity is 74.5%.

The city's population is spread across 11 Local Government Areas (LGAs) namely; Akinyele, Ido, Egbeda, Ona-Ara, Lagelu and Oluyole. Others are Ibadan North, North-West, North-East, South-West and Ibadan South-East local government areas. The latter set of 5 LGAs constitutes metropolitan Ibadan while the former set is sub-urban Ibadan. The focus of the study was on the 5 metropolitan LGAs. The metropolitan LGAs are more urbanized and possess more diversification in terms of social stratification, occupation, and residential characteristics. The 5 metropolitan LGAs comprised 168 localities (NPC, 1991; 2006) and accounted for about 53% of the population of the study area.

Using a stratified sampling technique, localities of contrasting housing residential densities, typifying high density, medium density and low density residential neighbourhoods in each LGA were selected for the study. With the background of an average of 4 persons per household in Ibadan (NBS, 2009), the selected localities were computed to have 43,377 households of which 1,084 (2.5%) were randomly selected in each locality for sampling. The selected localities, their residential density category, number of households and sample size from each of the localities are shown in Table 1.

Table 1: Distribution and Characteristics of Selected Localities

S/N	Local Government Area	No of Localities	Selected Localities	Residential Density	Population of Selected Localities	Computed Number of Households	Number of Questionnaire Administered
1	Ibadan North	41	Ikolaba	Low	6,575	1,644	41
			Basorun	Medium	4,156	1,039	26
			Yemetu	High	11,763	2,941	74
2	Ibadan NW	30	Idi-Isin	Low	2,398	600	15
			Eleyele	Medium	18,949	4,737	118
			Abebi	High	11,871	2,968	74
3	Ibadan NE	35	Agodi	Low	8,959	2,240	56
			Old Ife Road	Medium	11,903	2,976	74
			Elekuro	High	12,300	3,075	77
4	Ibadan SE	32	Felele	Low	22,136	5,534	138
			Challenge	Medium	10,675	2,669	67
			Idi-Aro	High	10,047	2,512	63
5	Ibadan SW	30	Oluyole Estate	Low	5,097	1,274	32
			Molete	Medium	5,293	1,323	33
			Foko	High	31,384	7,846	196
			Total			**43,377**	**1,084**

Source: NPC (1991), Author's Computation

Data Sources, Collection and Analyses

In measuring social well-being, a generic term for levels of living, quality of life, social satisfaction, and standard of living (Coates, Johnston and Knox, 1977; Smith, 1979), indicators such as access to healthcare, food and nutrition, education, shelter and clothing, conditions of work and nature of employment, as well as income and aggregate savings were employed. Other measures include quality of the living environment, recreation and leisure, security and social inclusion (UN, 1954; Smith, 1973; Drewnowski, 1974; Coates et al, 1977). An aggregation of these indicators (broken down into 26 variables) was measured in this study as primary data to determine the population's levels of social well-being. Data on the number of times each household treated episodes of malaria (for both the household heads and members of the households) was also sourced as primary data from the households to measure susceptibility to malaria and general wellness. The data on social well-being and frequency of being sick with malaria were collected using structured questionnaire administered on the 1,084 household heads in the selected localities.

The responses were coded to reflect numerical magnitude where 5 represented the best/highest rating and 1 represented the worst/least rating for social well-being measurement while for frequency of malaria treatment, 5 represented treatment frequency of 10 and more times annually and 1 represented treatment frequency of less than 5 times in a year. A simple addition of each respondent's feedback on all the 26 indicators measuring social well-being was thereafter carried out to determine each respondent's level of social well-being. Based on the computation, an individual with a perfect quality of life would have scored the highest 5 marks for each of the 26 variables and would have a maximum obtainable score of 130 (5 x 26). The scores were standardized to 100% for inter-locality comparison and establishment of quartile ranges.

The relationships between the indices of social well-being were analyzed using Chi Square Test while intra-urban variations in social well-being were analyzed using the One-Way Analysis of Variance (ANOVA). The Spearman Rank Correlation technique was used to establish the relationship between levels of social well-being and residential densities. The composite score derived for each respondent reflecting his/her level of social well-being was correlated with the respondent's frequency of household malaria treatment using the Pearson Product Moment Correlation technique.

Spatial Pattern of Social Well-Being

From the analysis of the social well-being scores of the 1,084 respondents, the mean of the entire data set is 57.71 while the quartile boundaries are 50.00%, 57.69% and 63.85%. The 1st quartile is the lowest social well-being class while the 4th quartile is the highest social well-being class. The minimum standard score for a respondent in the entire data set was 35.38% while the maximum was 87.69%. The scores were recorded in Foko and Idi-Isin respectively. Over 63% of the respondents in Foko lived within the 1st quartile of the standard of living scale whereas all the respondents from Idi-Isin were within the 4th quartile (Table 2.). Apart from Foko, other localities with the bulk of their population on the lowest rung of the standard of living scale were Idi-Aro and Elekuro. Over 90% of the population in Abebi lived within the first 2 quartiles. While Yemetu had a spread across each of the quartiles, the bulk of its population was found within the 2nd quartile whereas Idi-Isin, Oluyole and Agodi had no respondents within the 1st quartile just as Abebi and Elekuro had no respondents within the 4th quartile.

Table 2: Population Distribution of Localities on Social Well-Being Scale

S/N	Locality	% Pop in 1st Quartile	% Pop in 2nd Quartile	% Pop in 3rd Quartile	% Pop in 4th Quartile
1	Abebi	44.59	45.95	9.46	0.00
2	Agodi	0.00	19.64	37.50	42.86
3	Basorun	3.85	11.54	30.77	53.85
4	Challenge	4.48	34.33	40.30	20.90
5	Elekuro	48.05	38.96	12.99	0.00
6	Eleyele	1.69	17.80	41.53	38.98
7	Felele	5.07	11.59	44.20	39.13
8	Foko	63.78	31.12	5.10	0.00
9	Idi-Aro	50.79	44.44	4.76	0.00
10	Idi-Isin	0.00	0.00	0.00	100.00
11	Ikolaba	2.44	9.76	12.20	75.61
12	Molete	12.12	33.33	27.27	27.27
13	Old-Ife Rd	9.46	16.22	41.89	32.43
14	Oluyole	0.00	3.13	6.25	90.63
15	Yemetu	27.03	43.24	24.32	5.41

Source: Author's Computation

The lowest mean score for a locality was 48.29% for Foko while 78.97% for Idi-Isin was the highest mean score for a locality. Apart from Foko, the lowest locality mean scores were for the high density residential localities of Idi-Aro (49.61%), Elekuro (50.23%) and Abebi (50.41%). The Z-Scores of each locality's mean scores on the social well-being indices were used to map the ranks of the localities as illustrated in Figure 1. The population in Idi-Isin ranked best, followed by the population in Oluyole, Ikolaba, Basorun, Felele and Agodi. Foko, Idi-Aro, Elekuro, Abebi and Yemetu brought up the rear.

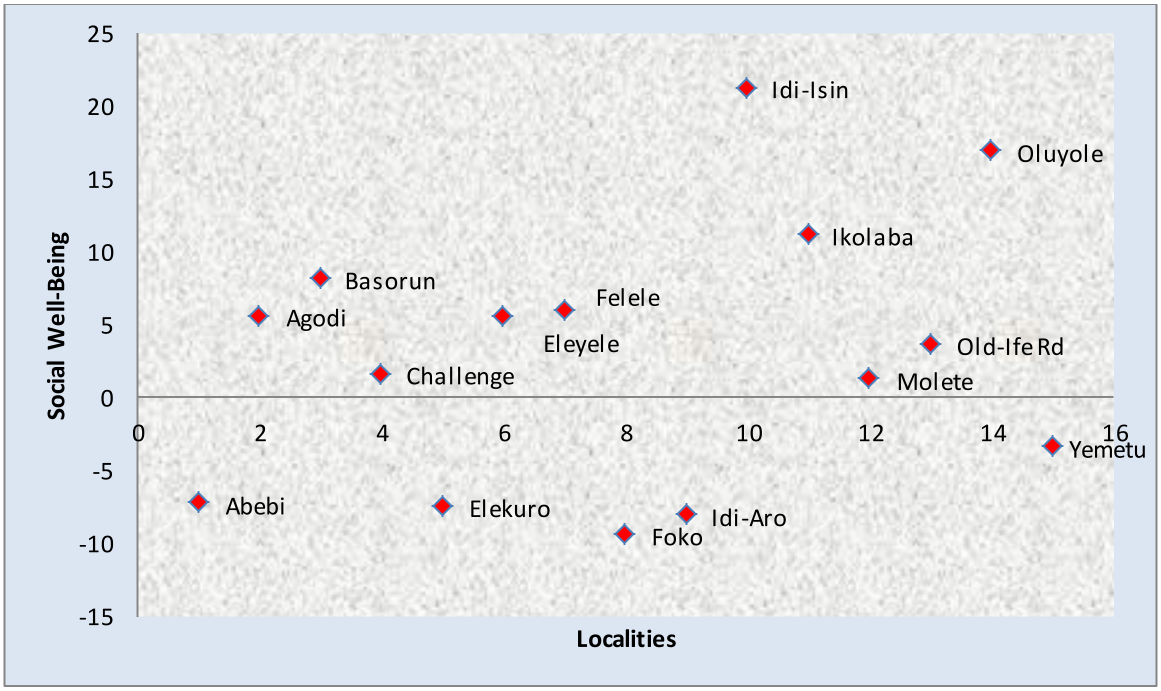

Figure 1: Spatial Pattern of Social Well-Being

Source: Author's Analysis

Social Well-Being and Residential Density Categories

The distribution of the respondents on the social well-being scale was further analyzed along residential density lines. The analyses followed three vistas; a comparison of social well-being scores of respondents resident in each of the residential density category, an investigation of the variations in levels of social well-being among the residential categories, and an assessment of the relationships between the two variables in the residential categories. Measures of Central Tendency were used for the first analysis while the One-Way Analysis of Variance (ANOVA) statistical technique was employed for the second analysis. The Spearman Rank Correlation technique was employed for the assessment of relationship.

A minimum social well-being score of 35.38 was recorded among the respondents from the high density residential area while the highest score was 66.92 (Table 3). In the medium density localities, the highest score was 79.23 while it was 87.69 in the low density residential areas. The average scores of respondents in each of the residential categories were 50.01, 61.73 and 66.38 for high, medium and low density residential areas respectively. The result shows that levels of social well-being were best in the low density localities and lowest in the high density localities. On the aggregate, residents of high density localities lived below the average level of social well-being in the study area as typified by a negative value of the residential category mean deviation from the total sample mean. On the average too, residents of both the medium and low density residential localities lived better than the sample average quality of life in the study area.

Table 3: Social Well-Being Performance in Residential Categories

S/N	Residential Category	Min Score	Max Score	Category Mean Score	Deviation from General Mean
1	High Density	35.38	66.92	50.01	-7.70
2	Medium Density	36.92	79.23	61.73	4.02
3	Low Density	42.31	87.69	66.38	8.67

Source: Author's Computation

This variation in quality of lives among the three residential categories was also tested and found to be statistically valid. The result of the One-Way ANOVA indicates that with an F-Value of 512.463 and a confidence level of 99.9% (P = 0.001), there is a spatial variation in levels of social well-being among the residential categories and that the variations are statistically significant (Table 4). This implies that people of different levels of social well-being populate different residential categories. The nature of the variations was further tested to determine the direction and level of relationship between the levels of social well-being and places of residence.

The residential categories were ranked 1 for high density, 2 for medium density and 3 for low density. The result of the correlation analysis (Table 5) shows that there is a strong positive relationship (r = 0.710) between levels of social well-being and residential categories. The result is also statistically significant (P = 0.001). The result implies that levels of social well-being are positively correlated with residential densities and that the best levels of social well-being are found in the low density residential areas. In other words, quality of lives is best in low density residential areas.

Table 4: Analysis of Variance of Levels of Social Well-Being in Residential Areas

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	55032.649	2	27516.324	512.463	.000
Within Groups	58043.522	1081	53.694		
Total	113076.171	1083			

Source: Author's Computation

Table 5: Relationship between Social Well-Being and Residential Areas

Correlations

			SWB SCORE	Density
Spearman's rho	SWB SCORE	Correlation Coefficient	1.000	.710**
		Sig. (2-tailed)	.	.000
		N	1084	1084
	Density	Correlation Coefficient	.710**	1.000
		Sig. (2-tailed)	.000	.
		N	1084	1084

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Author's Computation

Spatial Pattern of Household Incidence of Malaria

In Eleyele, 59.32% of the respondents treated malaria between 5 and 9 times in a year while in Felele, Molete, Old-Ife Road and Yemetu, the proportion of respondents who treated malaria between 5 and 9 times annually were 59.42%, 63.64%, 58.11% and 66.22% respectively. In Elekuro, 38 of the 77 respondents treated malaria at least 10 times in a year while in Foko, more than 57% of the respondents treated malaria at least 10 times annually. The proportion of respondents in Idi-Aro who treated malaria at least 10 times annually was 55.56% whereas only 9.38% and 13.33% of the population in Oluyole Estate and Idi-Isin respectively were in this category. Table 6 shows the distribution.

Table 6: Distribution of Malaria Treatment Frequency in Localities

		Frequency of Treating Malaria in Household in a Year			Total
		10 and Above	5 - 9	Less than 5	
Locality	Abebi	31	41	2	74
	Agodi	12	34	10	56
	Basorun	7	13	6	26
	Challenge	10	50	7	67
	Elekuro	38	37	2	77
	Eleyele	33	70	15	118
	Felele	38	82	18	138
	Foko	113	82	1	196
	Idi-Aro	35	27	1	63
	Idi-Isin	2	8	5	15
	Ikolaba	7	25	9	41
	Molete	8	21	4	33
	Old-Ife Rd	22	43	9	74
	Oluyole	3	19	10	32
	Yemetu	24	49	1	74
Total		383	601	100	1084

Source: Author's Field Survey

When the results are analyzed along residential density lines, respondents from the 5 high density residential localities accounted for 62.9% of those who treated malaria in their households 10 times and more annually while 20.9% and 16.2% of the respondents in this category were from the medium density and low density residential areas respectively. About 52% of the respondents who treated household malaria less than 5 times per annum were from the low density residential areas. A summary of the responses indicates that 601 respondents (55.4%) treated malaria in their households between 5 and 9 times annually. A total of 383 respondents representing 35.3% of the total respondents also treated malaria at least 10 times in a year in their individual households while only 9.2% of the total respondents treated malaria less than 5 times in a year. The distribution is illustrated in Figure 2.

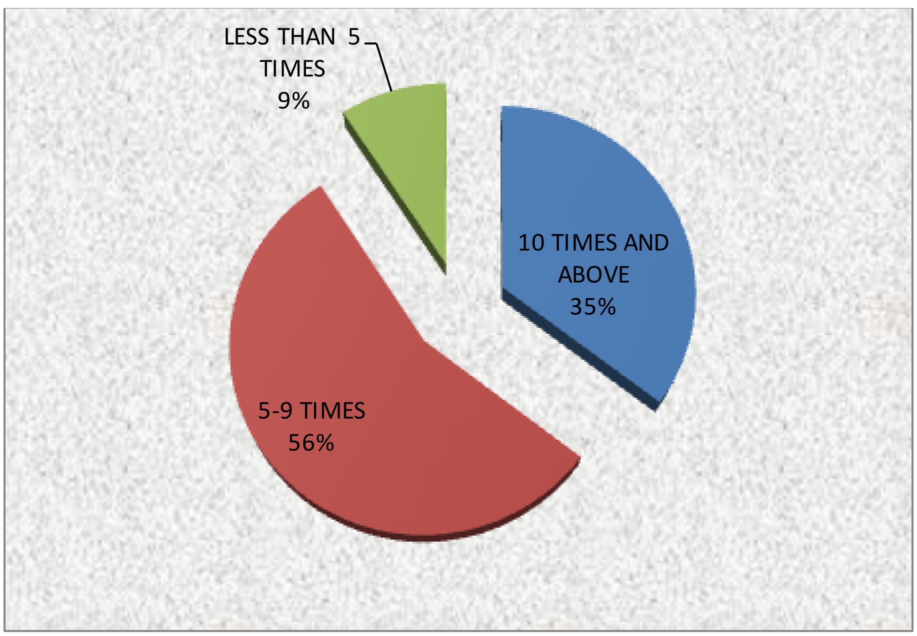

Figure 2: Malaria Treatment Frequency in Ibadan Households

Source: Author's Field Survey

In the households, grouped along residential density lines, the result of the Analysis of Variance (Table 7) in incidence of malaria indicates that the 'between groups' mean square was 88.774 while the 'within groups' mean square was 1.350. This resulted in an F-Value of 65.778 (P = 0.001). The results imply that at the household level in different residential density category, there is a significant spatial variation in the incidence of malaria. In other words, incidence of malaria in the study area varies from one household to another based on the residential density category the household belongs.

Table 7: Analysis of Variance of Malaria Prevalence in Households

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	177.548	2	88.774	65.778	.000
Within Groups	1458.921	1081	1.350		
Total	1636.469	1083			

Social Well-Being and Incidence of Malaria

The analyses of the correlation between levels of social well-being and incidence of malaria were carried out on two fronts; based on the household responses along locality lines and based on aggregated responses of the 1,084 respondents. The results at the household levels within each locality indicate that with the exception of Ikolaba and Idi-Isin, all the localities recorded significant negative correlations. The highest correlation coefficients were recorded in Elekuro, Foko, Idi-Aro and Abebi. The coefficients (r) were -0.700, -0.674, -0.664 and -0.657 for the afore-mentioned localities respectively. The correlation coefficients for the four localities were also statistically significant at P = 0.01 (2-tailed). Basorun, Oluyole Estate, Eleyele and Molete also recorded correlation coefficients greater than -0.5 and in all the cases too, the correlations were significant at P = 0.01 level. In Agodi, the correlation coefficient was -0.320 and significant at P = 0.05 level. At the aggregated level, the result shows a correlation coefficient r = -0.578 and a 99% confidence level (2-tailed).

These results confirm that at the household levels across the localities, there is a negative correlation between levels of social well-being and frequency of being sick with malaria. The results also imply that an individual household's frequency of being sick with malaria is inversely proportional to that household's levels of social well-being. The relationship between social well-being and incidence of malaria as shown by the results is also strong as indicated by the various correlation coefficients. The negative correlation coefficients in the results indicate that as the socio-economic status of the individual, measured by his social well-being scores increases, the individual becomes less prone to malaria. Stretched further, it means incidence of malaria is higher among individuals with low socio-economic status.

Conclusion

From the foregoing, it has been established that levels of social well-being vary significantly along residential density lines with residents of low density residential localities having a higher level of quality of lives than their counterparts in both the medium and high density residential neighbourhoods. The least levels of social well-being in the study area were observed in the high density residential areas. Also, the study showed that about 63% of the respondents who treated episodes of malaria at least 10 times in a year were resident in the high density residential districts, implying that incidence of household malaria was highest in the high density residential areas. The study also established that there is a strong inverse correlation between levels of social well-being and incidence of malaria in the study area.

It follows from these findings therefore, that there is an agglomeration of people of same (or almost same) socioeconomic status within the same clearly defined residential districts and that based on the residential differentiation, levels of social well-being vary directly with the quality of the residential categories. These results in a spatial variation in health outcomes such that the most affected, by virtue of their low socioeconomic status, are resident in high density residential neighbourhoods while the least affected are the more affluent and are resident in low density neighbourhoods. In other words, residents of low density residential areas ranked highest in social well-being and had the best health outcomes evidenced by the lowest incidence of malaria among the three residential classes. Instituting programmes to improve the quality of life of the average citizen and a deliberate locational bias in favour of 'other parts' of an urban center not inhabited by the affluent in the provision of public goods and services are clear steps a government interested in a 'just and egalitarian society' (Nigeria, 199) can pursue to ensure every citizen enjoys the product of the society irrespective of where s/he resides on the one hand, and to reduce the incidence of malaria on the other hand.

REFERENCES

Adeboyejo, A.T., Lirvhuwani, M and Shonisani, D.K. (2012) Impact of Climate Change on Children's Health in Limpopo Province, South-Africa. *International Journal of Environmental Research and Public Health*, 9.

Ademowo, O.G., Falusi, A.G. and Mewoyeka, O.O. (1995) Prevalence of Asymptomatic Parasitaemia in an Urban and Rural Community in South Western Nigeria. *Central African Journal of Medicine, 41 (1)*

Adewoyin, Y (2015) Urbanization and Health Inequalities in Ibadan, Nigeria. A paper at the International Conference on Cities and Informal Urbanization, Ogbomoso, Nigeria

Anderson, N.B and Armstead, C.A. (1995) Toward Understanding the Association of Socioeconomic Status and Health: A New Challenge for the Biopsychosocial Approach. *Psychosomatic Medicine*, 13.

Awake! (2003) When Insects Spread Disease. May 22

Barker, D. and Osmond, C. (1987) Inequalities in Health in Britain: Specific Explanations in Three Lancashire Towns. *British Medical Journal*, 294.

Ben-Shlomo, Y., White, I.R. and Marmot, M. (1996) Does the Variation in the Socioeconomic Characteristics of an Area Affect Mortality? *British Medical Journal 312*.

Byrne, N. (2007) Urban Malaria Risk in Sub-Saharan Africa: Where is the Evidence? *Travel Medicine and Infectious Disease, 5 (2).*

Center for Disease Control and Prevention (CDC) http://www.cdc.gov/malaria

CHESTRAD (2000). Malaria, Povery and Health, Center for Health Services Training. *Research and Development International.*

Coates, B.E., Johnston, R.J. and Knox, P.L. (1977) *Geography and Inequality*. London: OUP

Coene, J. (1993) Malaria in Urban and Rural Kinshasa: the Entomological Input. *Medical & Veterinary Entomology*, 7 (2)

Drewnowski, J. (1974) *On measuring and Planning the Quality of Life*. The Hague: Mouton

Ghebreyesus T. A., Witten K. H., Getachew A., Yohannes, A.M., Tesfay, W., Minass, M., Bosman, A. and Teklehaimanot, A. (2000) The Community Based Malaria Control Programme in Tigray, Northern Ethiopia. A Review of Programme Set-Up, Activities, Outcomes and Impact. *Parassitologia* 42.

Gwatkin, D.R., Rutstein, S., Johnson, K., Pande, R.P. and Wagstaff, A. (2000) Socio-Economic Differences on Health, Nutrition and Population. World Bank.

Gwatkin, D.R and Guillot, M. (2000) The Burden of Disease among the Global Poor. World Bank

Hart, J.T. (1971) The Inverse Care Law. *Lancet* 1.

Harvey, D. (1975) Class Structure in a Capitalist Society and the Theory of Residential Differentiation. In Peet, Chisolm and Haggett (eds.). *Processes in Physical and Human Geography*. London, Heineman.

Ikporukpo, C.O. (1987) An analysis of the Accessibility of Public Facilities in Nigeria. *Socio-Economic Planning Science*, 21 (1).

Johnson, M.F., Gomez, A. and Pinedo-Vasquez, M. (2008) Land Use and Mosquito Diversity in the Peruvian Amazon. *Journal of Medical Entomology*, 45

Kaplan, G. (1996) People and Places; Contrasting Perspectives on the Association between Social Class and Health. *International Journal of Health Services* 26.

Kaplan, G., Pamuk, E., Lynch, J.W., Cohen, R.D. and Balfour, J.L. (1996) Inequality in Income and Mortality in the United States: Analysis of Mortality and Pathways. *British Medical Journal, 312*

Kawachi, I and Kennedy, B.P. (1997) Socio-Economic Determinant of Health: Health and Social Cohesion, Why Care about Income Inequality? *British Medical Journal* 314

Kennedy, B.P., Kawachi, I. and Prothrow-Stith, D. (1996) Income Distribution and Mortality: Cross-Sectional Ecological Study of the Robin Hood Index in the United States. *British Medical Journal 312*

Knox, P.L. (1978) The Intra Urban Ecology of Primary Medical Care; Patterns of Accessibility and their Policy Implications. *Environment & Planning* A10

Krefis, A.C., Schwarz, N.G., Nkrumah, B., Acquah, S., Loag, W., Oldeland, J., Sarpong, N., Adu-Sarkodie, Y., Ranft, U. and May, J. (2011) Spatial Analysis of Land Cover Determinants of Malaria Incidence in the Ashanti Region, Ghana. *Plos One.*

Kumar, D.S., Andimuthu, R., Rajan, R. and Venkatesan, M.S. (2014) Spatial Trend, Environmental and Socioeconomic Factors Associated with Malaria Prevalence in Chennai. *Malaria Journal (13)*

Lineberry, R. (1976) Equality, Public Policy and Public Services: The Underclass Hypothesis and the Limits to Equality. *Policy and Politics* 4.

Lipton, M. (1977) *Why the Poor Stay Poor*. London: Temple Smith.

Lipton, M., 1998 Urban bias and inequality. In Seligson, M. and Passe-Smith, J.T.(eds.): *Development and Underdevelopment: The Political Economy Of Global Inequality*. London: Lynne- Reinne

Macintyre, S., Ellaway, A. and Cummins, S. (2002) Place Effects on Health; How can We Conceptualize, Operationalize and Measure Them? *Social Science and Medicine* 55.

Malaria Foundation International, (2013) HYPERLINK " http:// www.malaria.org''

Malaria Foundation International, (2010) www.malaria.org

Meade, M., Florin, J., Gesler, W. (1988) *Medical Geography*. New York: The Guilford Press

Munga, S., Minakawa, N, Zhou, G., Mushinzimana, E., Barak, O.O. (2006) Association between Landcover and Habitat Productivity of Malaria Vectors in Western Kenyan Highlands. *American Journal of Tropical Medicine and Hygiene*, 74

Mutero C. M., Blank H., Konradsen F. and van der Hoek W. (2000) Water Management for Controlling the Breeding of Anopheles Mosquitoes in Rice Irrigation Schemes in Kenya. *Acta Tropica* 76

National Bureau of Statistics, (2009) *Social Statistics in Nigeria*. Abuja; FG Press

National Malaria Elimination Programme, (2014) *National Malaria Strategic Plan 2014 – 2020*. Federal Ministry of Health, Abuja.

National Population Commission, (1991) 1991 Provisional Census Figures

National Population Commission, (2006) 2006 Provisional Census Figures

Ndawala J., Kalanda G. and Mahy M. (2000). Malawi MDHS Data Analysis, Malawi National Statistics Office.http://www.nso.malawi.net/

Nigeria (1999) Constitution of the Federal Republic of Nigeria. Abuja: Government Press

Nigeria, (2013) *President's Malaria Initiative; Malaria Operations Plan*. FG Press.

Njoku, G. (2005) Progress, Challenges of Roll Back efforts on Malaria. The Guardian, May 17.

Okafor, S.I. (1982) Policy and Practice: The case of Medical Facilities in Nigeria. *Social Science & Medicine,* Section D vol 16.

Okafor, S.I. (1987). Inequalities in the Distribution of Health-Care Facilities in Nigeria. In Akhtar,R. (ed.), *Health and Disease in Tropical Africa*. London: Gordon and Breach.

Okafor, S.I. (2007) *Location, Distribution, and Questions of Justice*. An Inaugural Lecture, University of Ibadan. Ibadan, IUP.

Oluleye, A. and Akinbobola A. (2010) Malaria and Pneumonia Occurrence in Lagos, Nigeria: Role of Temperature and Rainfall. *African Journal of Environmental Science and Technology*. Vol 47.

Patz, J.A., Campbell-Lendrum, D., Holloway T. and Foley J.A. (2005) Impact of Regional Climate Change on Human Health. *Nature*, Vol 438.

Prathiba, M. and Marshall, J. (2012) Factors Contributing to Urban Malaria Transmission in Sub-Saharan Africa: A Systematic Review. *Journal of Tropical Medicine, 2012*

Rashed S., Johnson H., Dongier P., Moreau, R., Lee, C., Lambert, J. and Schaffer, C. (2000) Economic Impact of Febrile Morbidity and Use of Permethrin-Impregnated Bednets in a Malarious area II. Determinants of Febrile Episodes and the Cost of their Treatment and Malaria Prevention. *American Journal of Tropical Medicine and Hygiene* 62

Reiter, P. (2000) From Shakespeare to Defoe; Malaria in England in the Little Ice Age. *Emerging Infectious Diseases* 6 (1).

Robert, V., Macintyre, K., Keating, J., Trape, J.F., Duchemin, J.B., Warren, M. and Beier, J.C. (2003) Malaria Transmission in Urban Sub-Saharan Africa. *American Journal of Tropical Medicine and Hygiene, 68 (2)*

Sharma, V.P. (2003) Malaria and Poverty in India. *Current Science*, 84.

Smith, D.M. (1973) *The Geography of Social Well Being in the U.S*. New York: McGraw Hill

Smith, D.M. (1979) *Where the Grass is Greener. Living in an Unequal World*. Harmondsworth: Penguin Books.

Smith, D.M. (1994) *Geography and Social Justice*. Oxford, Blackwell

Teklehaimanot, A. and Meija, P. (2008) Malaria and Poverty. New York Academy of Science

Townsend, P. (1974) Inequality and Health Services. *Lancet* 1

Tshikuka J. G., Scott M. E., Gray-Donald K. and Kalumba O. N. (1996) Multiple Infection with Plasmodium and Helminths in Communities of Low and Relatively High Socio-Economic Status. *Annals of Tropical Medical Parasitology* 90.

Uneke, C and Ibeh, L. (2008) Impacts of Deforestation on Malaria in South-Eastern Nigeria; the Epidemiological, Socio-Economic and Ecological Implications. *Internet Journal of Third World Medicine*, 8.

United Nations, (1954) Economic Survey of Europe. Quoted in Smith, D.M., 1979 ibid.

United States, (2011) Malaria Fact Sheet. A publication of the Economic Section, United States Embassy in Nigeria, Abuja

Vittor, A.Y., Gilman, R.H., Tielsch, J., Glass, G., Shields, T., Lozano, W.S., Pinedo-Cancino, V and Patz, J.A. (2006) The Effect of Deforestation on the Human-Biting Rate of Anopheles Darlingi; The Primary Vector of Falciparum Malaria in the Peruvian Amazon. *American Journal of Tropical Medicine and Hygiene*, 74

Wang, S.J., Lengeler, C., Smith, T.A., Vounatsou, P., Diadie, D.A., Pritroipa, X., Convelbo, N., Kientga, M. and Tanner, M. (2005) Rapid Urban Malaria Appraisal (RUMA) I: Epidemiology of Urban Malaria in Ouagadougou," Malaria Journal, 4

Wilkinson, R.G. (1992) Income Distribution and Life Expectancy. *British Medical Journal, 304*

Wilkinson, R.G. (1996) *Unhealthy Societies: The Afflictions of Inequality*. London: Routeledge

Worrall, E., Basu, S. and Hanson, K. (2003) The Relationship between Socioeconomic Status and Malaria: A review of the Literature, SES and Malaria, January 2003

World Health Organization, (2005) World Malaria Report.

World Health organization, (2006) World Malaria Report

Yapabandara, A. M. and Curtis C. F. (2002) Laboratory and Field Comparisons of Pyriproxyfen Polystyrene Beads and other Larvicidal Methods against Malaria Vectors in Sri Lanka. *Acta Tropica* 81.

Yusuf, O.B., Adeoye, B.W., Oladepo, O.O., Peters, D.H. and Bishai, D. (2010) Poverty and Fever Vulnerability in Nigeria; A Multi-Level Analysis. *Malaria Journal*, 9.

Zacarias, O.P. and Andersson, M. (2011) Spatial and Temporal Patterns of Malaria Incidence in Mozambique. *Malaria Journal*, 10 (189).