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Effect of Urbanization on Malaria Transmission and Its Impact on Women in Four Districts in the Ashanti Region of Ghana

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1.0 INTRODUCTION

Malaria threatens the lives of 3.2 billion people globally and leads to over one million death annually [31].

Malaria is hyper endemic in Ghana and accounts for 44% out-patients attendance in hospitals. It continues to be a major public health problem in Ghana. Despite efforts to control the disease, reports from various health centers reveal that it is still the major causes of mortality of children under 5 years. It is also the most frequently reported disease in all hospitals. Parasite rate in children varies from 47%-97% in various regions of the country. Malaria accounts for 13% of all deaths in the hospitals and is considered the major cause for loss of economic productivity [27].

Malaria is a major cause of absenteeism in endemic areas, the adverse impact of the disease on household production and gross domestic product can be substantial [33; 22].

In Ghana as in most part of sub Saharan Africa, malaria transmission is very intense in the rural areas [32]. This situation arises due to low human population density in close proximity to a large

number of potential mosquito breeding sites. In urban areas, malaria is expected to be in significantly lower levels even though population density is high, the breeding sites are expected to be fewer and more easily identified and can be assessed for vector control [17].

Ashanti Region where this study was conducted is in the tropical forest belt of Ghana. Women form about 50% of the population in the region [9]. Women here are very hard working, industrious and resilient. When malaria infection is not treated properly especially in pregnant women it can cause anaemia and also lead to miscarriage, still births, under weight babies and maternal deaths [7].

However, as a result of human migration and rapid growth of human population, more people are now living in urban areas [12]. It has been predicted that, the number of urban dwellers will exceed the rural population for the first time in 2008 [12].

This increasing urbanization will have significant impact on the population dynamics in many cities and towns. Most cities are heterogeneous and the risks factors that enhanced the spread of disease will vary significantly from one urban setting to another and indeed within a particular city/town [29], Ghana is no exception.

In this present study, urban areas are denoted as areas that have a built up central hub with economic activities that show a less dense periphery mainly based on administrative definition where boundaries are specified by municipal / government authority and on functional characteristics, e.g. amount of non-agricultural economic activities. Peri urban areas are the

peripheral areas that are poorly planned in land use, involving housing, agriculture and industry. Rural areas are less built up towns where agriculture is the main stay of the residents [14].

In Ghana, urban population growth rate of about 4.3% outstrips the overall national population growth rate of 2.7%. The proportion of the population residing in urban areas rose from 32% in 1984 to 43.8% in 2000 [8]. Kumasi, one of the study areas is the most urbanized and commercialized metropolis in the Ashanti region with a daily influx of traders, civil workers and migrants from neighboring districts.

The research question that this study addresses is whether there are differences in the intensity of malaria due to urban and rural differences in the Ashanti Region. It also aims to investigate if there are significant intra-urban / town difference. In most African societies, women are the main care givers and are the most affected by their environment. This current study also aims to investigate through a series of questionnaires, the knowledge, attitude and practices of women in these selected towns and to find out malaria prevention behaviours/practices that would help eradicate the disease. This data would help plan proper focused intervention procedures where they are needed most.

2.0 METHODOLOGY

2.1 Study Areas

The Ashanti region with Kumasi as its capital is located longitude 00151-200251 west and latitude $5^{o}50^{l}$-$7^{o}40^{l}$ north. It lies approximately at the center of the country and is accessible to many other regions. It has the highest number of administrative districts (36) in the country and is

the most heavily populated region (3.5 million) in Ghana [9]. The region experiences two seasons (wet and dry seasons).

Four towns were studied for this research;

1. **KUMASI, AN URBAN CITY** with rapid state of urbanization that has depleted most of its natural reserves. It has a population of approximately-1625246 people [9]. About 32.4% of the inhabitants are self employed, 69% are in the services and 8% in agriculture. Migrant workers are attracted in search of jobs; in some households there may be 22-26 residents per house. Almost 80% of arable land has been displaced by construction and physical infrastructure; however backyard farms are common. The water bodies are greatly polluted from human activity.

2. **MANKRANSO –** Mankranso is a RURAL town in the Ahafo Ano district with a population of 88,648 [9]. It is a highly forested area with 20 large settlements. Housing delivery is poor with only 17% having pipe borne water, 7% have proper toilet facilities, 85% homes in the district were built with mud. Many households use kerosene, averagely 7 persons per house.

3. **JUABEN** – Juaben is a RURAL town in the Ejisu –Juaben District with a population of 124,176 [9]. It is highly deforested area due to ecologically unfriendly farming and forestry management practice giving way to savannah bush fires. Averagely 7.1 persons per house. Rural urban split is 75.5 rural and 24.5 urban. Majority of the populates (60%) are into Agriculture, 27.9% into services whiles 13.1% are into industry.

4. **BEKWAI** – Bekwai is a SEMI-URBAN town in the Amansie East district with a population of 197,364 [9]. 70.5% of houses were built with mud. The prominent occupation is agriculture. Averagely 7.5 persons per house. Current population growth rate is 3.0%. About 30% of the community has access to safe drinking water (mostly boreholes and dug out wells).

2.1.1 Parasitological Studies

Study 1 – Inter-City/Town investigations

Subjects; This was Hospital / Health center based study. Any patient who was diagnosed to have malaria by the Doctors and was sent to the laboratory were included in the study with their consent. This study was carried out in October 2015.

Study 2 – Intra-City investigations. Six communities were investigated within the city of Kumasi. Study population was chosen at random from the communities that were investigated. A total of 500 women were screened for malaria. These participants were also required to complete the questionnaire. Ethical clearance was obtained from the school of medical sciences ethics committee. This study was carried out from July 2014 to December, 2015

2.1.2 Entomological studies

2.1.2.1 Indoor Resting collection:-

Indoor resting Anopheline mosquitoes in the four study areas were estimated by standard WHO sampling methods using Pyrethrum Spray Collection (PSC) [34] once a month.

2.1.2.2 Hourly Biting Collection:-

Two trained collectors carried out hourly biting collections from 6pm to 6am using an aspirator once a month from the four study areas. Mosquitoes collected each hour were stored separately and taken to the laboratory each morning. The number of mosquitoes was recorded and species identified using the appropriate keys.

2.2 Knowledge, Attitude and Practice Study (KAP):-

A structured Questionnaire was administered to women to gather information about their households, their house design, biodata and other demographic information about the communities in which they live. It also sought to find out their knowledge on malaria, its' treatment and control.

2.3 Results

2.3.1 Parasitological Study:-

In Kumasi (an urban area), a total of 2477 patients were suspected of having malaria during the study period at the Kumasi South Hospital. Parasitological confirmed cases ranged from 18% in February to 54% cases in July. There were higher rates of parasitological diagnosis usually after peaks of rainfall which approximately lag off about a month.

A total of 1012 and 2478 patients were diagnosed of having malaria in Mankranso and Juaben (both rural areas) respectively.

In Juaben, confirmed cases of malaria ranged from 40% in March to a high of 69.8% in June. This was the town considered most rural with the inhabitants having the least education. Bekwai (peri urban setting) had 1274 patients suspected of having malaria. Confirmed cases range from a low of 12.7% in March to 37.5% in September.

Table 2.1: Monthly Mean Parasite Rates in Four Districts in the Ashanti Region

MONTH	KUMASI (%)	BEKWAI (%)	JUABEN (%)	MANKRANSO (%)
January	21.3	20.8	54.6	30.8
February	18.0	27.8	43.8	26.2
March	29.0	12.7	40.9	13.8
April	21.3	26.8	60.7	7.7
May	39.7	28.6	61.7	27.6
June	44.8	26.3	69.8	19.8
July	54.0	34.5	64.6	27.8
August	50.0	33.9	62.0	31.7
September	43.7	37.5	56.8	25.0
October	45.7	33.1	60.9	12.5
November	35.0	27.5	62.9	7.5
December	30.0	24.1	61.2	5.0
OVERALL	33.8	30.6	60.0	22.2

Comparatively, Juaben recorded the highest overall parasite rate of 60.0% (Table 2.1).

Table 2.2: Age specific prevalence of parasitaemia

AGE GROUP	KUMASI		BEKWAI		JAUBEN		MANKRANSO	
	#	+VE	#	+VE	#	+VE	#	+VE
<2	125	51.2	104	32.7	240	75	195	20.5
2-4	228	40.3	111	46.8	137	78.8	187	39.6
5-9	184	57.3	98	53.1	57	73.7	140	10.7
10-14	90	36.5	60	36.7	42	59.5	94	20.2
15-19	75	33.3	152	23.7	52	46.2	51	41.2
20-29	52	28.1	43	25.6	175	50.9	106	16
30-39	64	28.8	51	21.6	110	42.7	63	15.9
40+	114	19.8	188	14.4	231	51.1	93	11.1

Age specific rates (Table 2.2) indicate that infections still occur in all age groups. In the two most rural areas, the peak age is still 2-4 years. In the most urban town Kumasi, the peak age was between 5 and 9 years, whilst in Bekwai the distribution throughout the different age groups was more even.

2.3 Entomological Study

Throughout the study period, 17,888 mosquitoes were collected using night landing and spray sheets from the study areas. Of this number, 25.1% were *Anopheles* mosquitoes. Out of the 4490 *Anopheles* mosquitoes collected, 96.9% were *Anopheles gambiae* and 3.1% were *Anopheles funestsus.* 33.9% of the *Anopheles mosquitoes* were caught in Juaben, 27.6% in Kumasi, 18.5% in Mankranso and 21.0% in Bekwai.

The man biting rates of the two *Anopheles* species were higher outdoors in all the study areas.

Table 2.3: Man Biting Rates of *Anopheles* Species Collected by Spray Sheet and Night Biting Methods

TOWNS	Spray sheet collection		Night biting Collection			
	A.g.s.1	A.f	A.g.s.1	A.f	A.g.s.1	A.f
Kumasi	6.09	0.39	5.35	0.52	12.98	0.52
Mankranso	5.70	0.27	4.06	0.21	8.52	0.40
Bekwai	5.16	0.15	4.56	0.13	9.56	0.10
Juaben	6.99	0.09	6.50	0.04	15.20	0.08

2.4 Entomological Inoculation Rates (E/R) For *A. gambiae S.L.* In Four Districts In The Ashanti Region

MONTH	KUMASI (%)	MANKRANSO (%)	BEKWAI (%)	JUABEN (%)
January				
February				
March				
April				02
May	0.08	0.04	0.11	
June	0.16	0.09	0.07	0.05
July	0.17			0.34
August		0.05	0.1	0.19
September	0.16			0.19
October				0.22
November		0.14	0.04	
December				
Overall	0.14	0.08	0.08	0.22

Hourly biting rates of *Anopheles gambiae* in the four districts (the biting cycle) shows that intense biting occurs between 23.00hrs to 02.00hrs. However enough biting activity occurs around 21.00hrs to 23.00hrs so people who stay up late would be bitten.

2.4 KAP Study

A total of 500 women were chosen randomly to take part in the intra city study. The main aim was to investigate the effect of urbanization on women with regard to their knowledge on malaria transmission, treatment and prevention. Participants were categorized into two groups;

Group 1 High KAP: these were women who have in-depth knowledge on malaria either from school, radio or television, and **Group 2 Low KAP**: representing the vice versa.

The average age of women who participated in this research was 34.92 years. Their occupational levels were as follows; traders (36.5%), seamstress (11.4%), pensioners (2.6%), farmers (7.4%), teachers (9.0%), services (4.8%).

The level of education of participants ranged from primary school, Junior High, Senior High and few Tertiary.

From Table 2.5, 467 of the participants had good knowledge of malaria, its transmission and control methods. The most common control methods used by participants are ITNs (135/467) and mosquito coil (54/467).

Table 2.5: Assessment of Participants Knowledge, Attitude and Practices (KAP) on Malaria and Percentage Parasitaemia

NUMBER OF RESPONDENTS	**HIGH KAP**		**LOW KAP**
	467		33
Preventive Measure	Method Use	Number	None
	Aerosol	28	
	Repellent	23	
	ITN	135	
	Anti-malaria drug	5	
	Pyjamas	15	
	Coil	54	
	None	207	
Parasitaemia	Observation	Number	
	Seen	60	11
	Not Seen	407	12

A study of malaria parasite density within the most urban city (Kumasi) showed that the residents in the suburbs of Kentinkrono and Ayigya had the highest prevalence of malaria parasites. The two areas could be considered as peri urban as they were the furthest away from the city center. Table 2.6 also showed that areas that had better housing facilities especially rooms having ceiling had fewer cases of malaria. The highest parasites density rates were seen in Ayigya. (Table 2.7)

Table 2.6: Description of Dwelling Places within the City of Kumasi

Location	Compound Houses (%)	Private Houses (%)	Houses With Ceiling (%)	Corrugated Roofing (%)
Ayeduase	84.20	14.80	90.11	98.60
Ayigya	87.10	10.00	68.20	99.20

Table 2.7: Prevalence of Malaria and Parasite Density in the City of Kumasi

STUDY AREA	TOTAL NO. SCREENED	NO. INFECTED	PREVALENCE	PARASITE DENSITY(pd/µl)
KNUST	400	40	10	270
Ayeduase	490	90	18.4	281
Ayigya	640	170	26.6	2012
Bomso	710	112	15.8	312
Kotei	550	70	70	280
Kentinkrono	210	75	35.7	380

3.0 DISCUSSION

3.1 Parasitological Survey

The results of this hospital based study showed that malaria is a significant health problem all year round in all the districts studied and is endemic in Ghana [11]. Parasite rates between 11% and 50% of an area signify that the area is mesoendemic. A rate of 51.0% means the area is hyperendemic. Kumasi (38.8%), Bekwai (30.6%) and Mankranso (22.2%) were mesodemic whilst Juaben (60.0%) was the only hyperendemic area. Epidemiological distribution is seasonal and that the intensity of transmission varies from year to year [26]. The lowest parasite rate of 5.0% occurred in Mankranso and the highest occurred in Juaben (69.8%). Juaben is a highly deforested rural district with a high degree of deforestation resulting in the creation of open spaces for mosquitoes to breed. This result is similar to [6] who recorded an overall prevalence of malaria parasitaemia of 50.72% in the forest areas, followed by coastal regions and then the north which had a very dry savannah like climate.

Malariometric indices showed marked heterogeneity between the towns and the city. In this current study the urban city of Kumasi reported a higher parasitaemia rate than the towns that were peri-urban (Bekwai and Mankranso). Juaben which was the most rural had the highest levels of parasitaemia reported.

The patterns of annual rainfall as well as average daily temperature have not changed drastically for many years. It appears that the difference in parasitaemia levels in the various towns is influenced by slight variations in rainfall in each community.

The poor types of houses lived in did not confer any protection at night as such people are exposed to Anopheles mosquitoes all throughout the night (Table 2.6) [18].

Mankranso is in a rural forest which has suffered little deforestation and therefore there are few open spaces for mosquito breeding.

Kumasi is a popular city with an ever increasing population. It is a rapidly growing unplanned urban city with several slum areas on its periphery where construction and other activities create many pools of water.

In such communities, migrants resort to urban agriculture with backyard farms thereby increasing breeding sites through irrigation [16; 2]. People in urban slums frequently come into contact with mosquitoes as a result of their behaviour. In many communities the residents stay up till after 10:00pm in open social areas to eat, drink and trade. This finding conforms to [28] who observed that alongside life style, housing conditions play a role in modulating exposure of populations to mosquitoes. Housing types determine indoor temperatures, a parameter that is associated with malaria transmission [19]. Insect behaviour can be exploited when designing control strategies for control of malaria vectors because *Anopheles Gambia* the main malaria vector is well adapted to entering houses [15].

The overall parasite rate of 42.6% recorded for the four study areas is lower than similar studies for rain forests and savannah areas in the Ashanti region but higher than some reported areas in West Africa. A research in year 2000 reported overall parasite rates of 50.725 in forest areas and

49.72% in savannah areas [6]. Climates, particularly temperature and rainfall affect the ability of malaria parasites and anopheline vector to coexist long enough to ensure transmission.

Age specific rates (Table 2.2) indicate that infection still occurs in all age groups. In the two most rural areas, the peak age was 2-4 years. In the most urban town Kumasi, the peak age was between 5 and 9 years. WHO reported a peak age group of 5-9 years in two southern cities in Southern Ghana [37]. Changes in life style cause older children to have more cases of malaria in endemic areas. Frequent episodes of severe malaria may negatively impact on their learning ability and cause frequent episodes of absenteeism in schools [1]. In this current research, a significant portion of adults still harbour parasites as seen in all the towns. This brings about morbidity and loss of working days to illness.

3.2 Entomological survey

The presence of *Anopheles gambiae,* the notorious vector in Ghana is well documented [36]. The man biting rate (indoor and outdoor) of *A. gambiae s.I.* was significantly higher ($p<0.05$) in Juaben than in all the other places (Table 2.3). Residents in urban areas were exposed to 10.83 bites per person per night which is far higher than that recorded by [21] in coastal areas. This higher man biting rate is attributed to differences in rainfall, the forest zones having more rain. The man biting cycles of *A. gambia* during the house and night collections suggested that malaria transmission occurs throughout the night in the study areas. The peak of biting occurred around mid night. Biting activity started before 10.00pm so residents who were active after 10.00pm were therefore exposed to the mosquitoes. Higher entomological inoculation rates were recorded in districts where ecologically unfriendly farming practices and uncontrolled urbanization have

rendered the virgin forests into secondary forests. It is also a reflection of the abundance of breeding sites. In this region the *Anopheles* mosquitoes were found to be highly exophagic in all the study areas. Research by [21] showed that the behaviour of *Anopheles* was contrary as they were endophagic. An earliar research stressed that the abundance of vector mosquitoes varies with season and available habitats [24]. The abundance was also affected by the motility of human hosts between regions there by affecting the malaria transmission process.

3.3 Knowledge, Attitude and Practice Survey

The rapid growth of cities and towns is characterized by a distinctive mix of different social, economic and cultural conditions which cannot be overlooked [23]. This present study sought to study intra-city variation to find out factors that affected malaria transmission the most. Result showed that people with or without in depth knowledge about the causes, symptoms and prevention of malaria were less infected with malaria parasites as few participants tested positive to the parasite. Observation by [25] found out that greater knowledge about malaria does not always translate into improved bed net use. Many of the participants had some level of formal education and were aware of malaria through radio and television. The study shows that knowledge in the causation, symptoms and prevention of malaria is important in controlling malaria infection.

Most houses (90.11% in Ayeduase and 68.20% in Ayigya) in the Kumasi metropolis had ceilings. A research has revealed that adding ceilings in mud huts reduced the number of *Anopheles mosquitoes* and other vectors entering the room and may be an effective way to reduce malaria [20].

Women are the primary care givers in any community and their knowledge, decisions and malaria preventive behaviours will definitely affect malaria transmission and epidemiology. Also, community perceptions, beliefs and attitudes about causes of malaria, prevention and cure influence efforts to address malaria but are often overlooked in control efforts [25]. Gender therefore plays an important part in malaria control. The Department of Gender Women and Health [35] recognized that gender norms and values influence the division of labour, leisure patterns and sleeping arrangements that may lead to different patterns of exposure to mosquitoes for males and females.

Self medication was preferred amongst the residents in Kumasi because pharmaceutical shops were easily available and attending to hospital was seen as a waste of time contrary to residents in other study areas.

4.0 CONCLUSION

It is commonly assumed that urbanization leads to decrease in malaria prevalence due to the presence of fewer breeding sites, better access to treatment, better housing and even better education. This study revealed that *Anopheles* mosquitoes are with us all year round, parasitaemia is found in all age groups and urban malaria is greatly enhanced in slum areas. Heterogeneity exists in intracity and intercity due to factors that characterize urban and peri-urban rural and slum areas and all control measures should be tailored to meet the specific characteristics of a particular area.

This research revealed that people are very aware of malaria and that social and cultural needs should be considered so that the right interventions be applied in each setting. The local residents should be consulted each time a control programme is planned because it has been observed that greater knowledge does not always translate into practice. Education has really improved the lives of most residents but more awareness campaign must be organized.

A gender approach to understanding and combating malaria should be included in every control programme as women are the primary care givers.

Since factors like age, education, employment, numbers of people in house, health seeking behaviour, compliance to treatment, knowledge about the disease and standard of living all have an impact on the incidence of the disease.

In creating higher level of awareness and compliance to safety practices, a legislature should be designed to compel landlords and government agencies to provide better houses with ceilings and mosquito proofing. Also, local government should liaise with the community nurses in all district hospitals or other volunteer groups to act as “supervisors of malaria awareness committees” that will go round each community at regular periods to educate and mentor the residents on good practice to reduce malaria. This may be funded by the local government. There should be a reward scheme for households that conform to prescribed control practices from their local government.

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