Quantifying Weather and Climate Impacts on Health in Developing Countries (QWeCI)

Science Talk

QWeCI is funded by the European Commission's Seventh Framework Research Programme under the grant agreement 243964

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EFFECT OF CLIMATE VARIABILITY ON THE INCIDENCE AND TRANSMISSION PATTERNS OF MALARIA IN KUMASI, GHANA

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Introduction

- Changes in temperature, rainfall and relative humidity are expected to influence malaria by modifying the behavior and geographical distribution of malaria vectors and by increasing or decreasing the length of the life cycle of the parasite.

- Mosquito vectors, are very diverse in their biology, with some species preferring extremely wet climates and others preferring extremely dry climates. Increased climatic variability could potentially lead to increased variability in mosquito communities and thus in diseases transmitted by these different species.

- Areas exist where the malaria vector exists but malaria transmission is limited because of temperature. Models of malaria risk indicate that these areas, are areas in which increased malaria transmission may occur in the future with increased temperatures due to climate change

Introduction Cont.

- Climate plays an important role in the transmission of many infectious diseases which are among the most important causes of morbidity and mortality in developing countries.

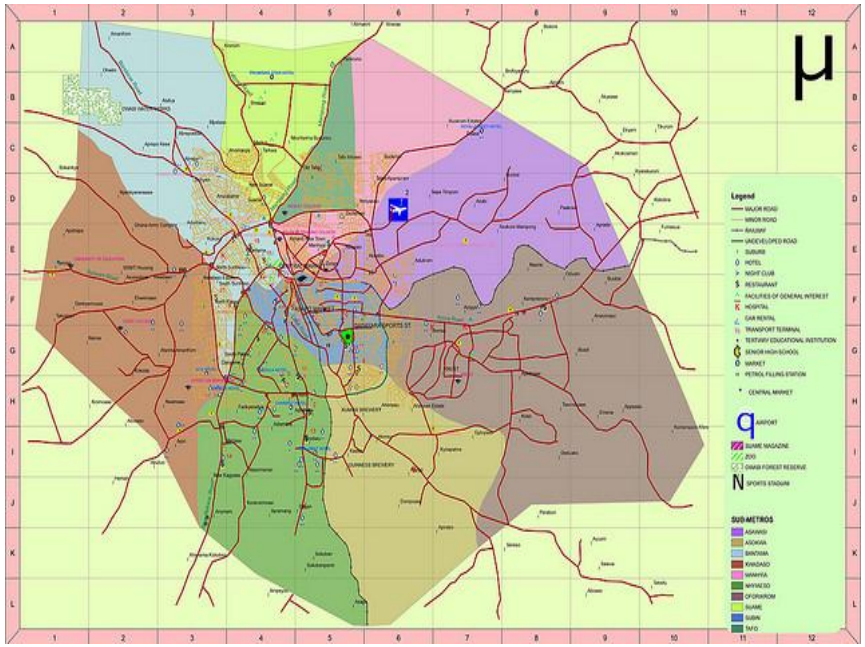
- Several factors have been identified as direct drivers of disease risk among these are climatic factors such as rainfall, temperature and relative humidity.

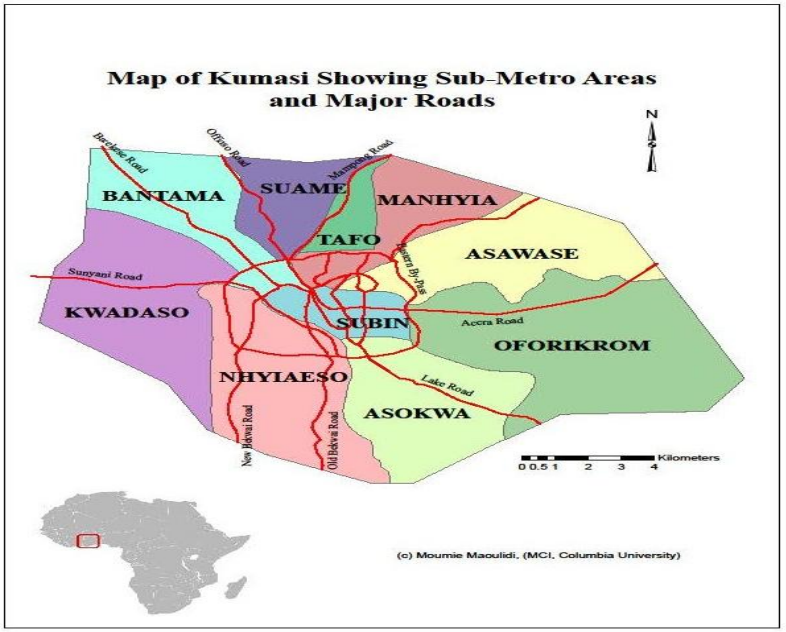
- By understanding the factors (including weather conditions, and vector populations) that drive mosquito abundance and the occurrence of malaria, future patterns of disease maintenance and transmission can be predicted.

Aim

- This study was aimed at investigating the impact of temperature, rainfall and relative humidity on malaria incidence in Kumasi, Ghana

Study Area





- Kumasi is located in the transitional forest zone and is about 270km north of the national capital, Accra with a population of 1,889,934. It is between latitude 6.35o – 6.40o and longitude 1.30o – 1.35o, an elevation which ranges between 250 – 300 metres above sea level with an area of about 254 square kilometres.

Methods

- Data on climatic variables from December 2009- November 2011 were obtained from the Owabi, Emena and Airport weather stations.

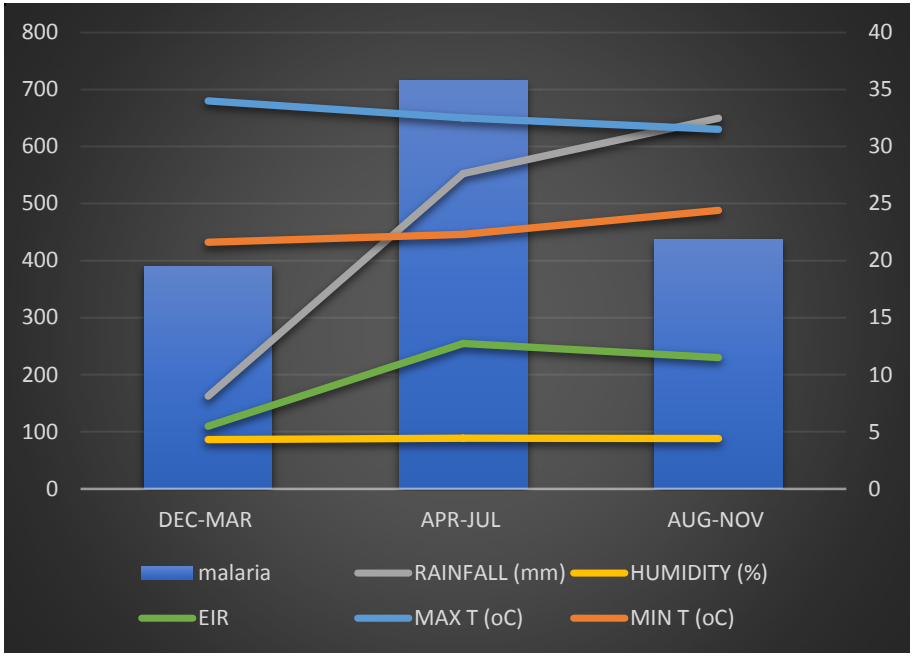
- Data on malaria cases from December 2009- November 2011 were obtained from Nkawie hospital (near Owabi weather station), Emena hospital (near the KNUST Weather station) and Manhyia hospital (near Airport weather station) from December 2009- November 2011.

- Based on malaria morbidity data, three communities were selected and sprayed for mosquitoes using the pyrethrum spray catch method.

- Questionnaire administered to household heads to collect data on socio economic and environmental factors

- Data analysis was conducted with Microsoft Excel and Statistical Software Package, SPSS version (16.0). Pearson's correlation analysis was done to establish the relationship between climatic variables and malaria transmission.

Results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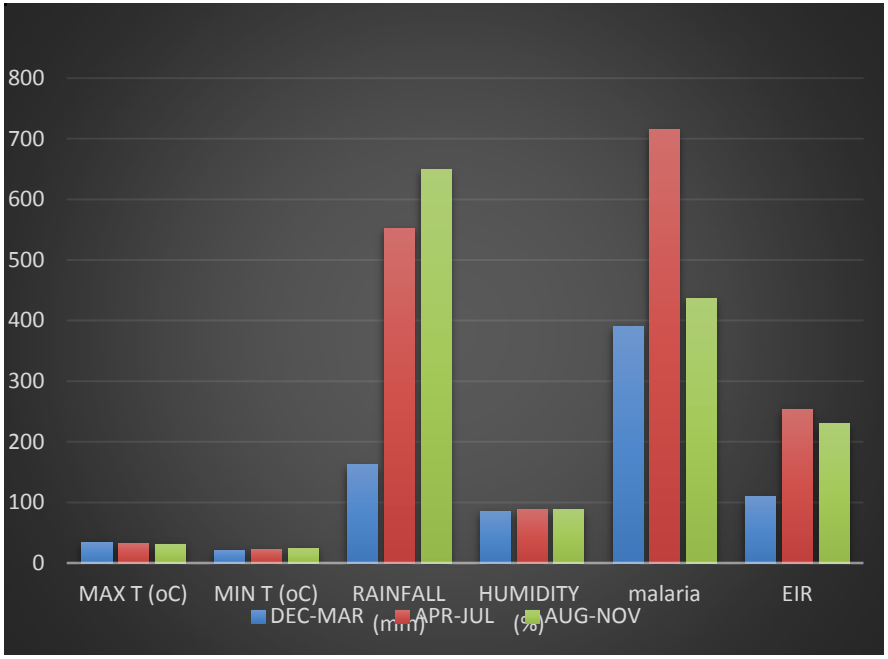
DEC-MAR
APR-JUL
AUG-NOV
malaria
RAINFALL (mm)
HUMIDITY (%)
EIR
MAX T (oC)
MIN T (oC)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MAX T (oC)
MIN T (oC)
RAINFALL (mm)
HUMIDITY (%)
malaria
EIR
DEC-MAR
APR-JUL
AUG-NOV

Results cont.

		APR-JUL	%		AUG-NOV	%		DEC-MAR	%		Total	%
Mosquito Species	A. gambaie	59	54.6%		72	56.3%		26	31.3%		157	49.2%
	A. funestus	0	0.0%		6	4.7%		0	0.0%		6	1.9%
	Mansonella	13	12.0%		10	7.8%		9	10.9%		32	10.0%
	Culex	36	33.4%		40	31.2%		48	57.8%		124	38.9%
Blood Digestion	Un-fed	21	31.0%		31	39.7%		16	47.1%		65	38.2%
	Fresh fed	22	41.4%		28	35.9%		10	29.4%		62	36.5%
	Half gravid	8	15.5%		8	10.3%		3	8.8%		20	11.8%
	Gravid	8	12.1%		11	14.1%		5	14.7%		23	13.5%
Host Preference	HUMANS	35	92.1%		37	92.5%		16	88.9%		88	91.7%
	OTHERS	3	7.9%		3	7.5%		2	11.1%		8	8.3%

Results cont.

		Correlation	Sig.
Pair 1	Min Temp & Human bite rate	.996	.001
Pair 2	Max Temp & Number of mosquitoes	-.984	.011
Pair 3	Max Temp & Circumsporosoite proteins	.858	.017
Pair 4	Humidity & Human bite rate	.878	.018
Pair 5	Rainfall & Number of mosquitoes	.863	.035
Pair 6	Malaria incidence & EIR	.987	.006
Pair 7	Malaria incidence & Humidity	.939	.039

Conclusion

- Correlation analysis of climate variables against number of mosquitoes showed a direct relationship between rainfall and number of mosquitoes caught.
- There was also an indirect relationship between maximum temperature and number of mosquitoes.
- Maximum temperature had a strong direct relationship to circumsporozoite proteins
- There was a direct correlation between minimum temperature and human bite rate. Relative humidity was also found to be directly proportional to human bite rate.
- There was also a direct correlation between incidence and Entomological inoculation rate
- This study finds a strong correlation between relative humidity and malaria incidence.

Conclusion cont

- Malaria transmission was highest in Asawasi which is an urban community with rural features with an Entomological Inoculation rate of 187.1infectious bites/person/ year.
- In Asawasi, basic social amenities are lacking, rooms are crowded with three or more people sleeping in one room, housing is of poor quality and the rooms are small.
- The rooms are poorly ventilated and the sanitation is inadequate. Residents store water in drums because there are no public water supply for individual households
- These create numerous breeding grounds for mosquitoes leading to explosive growth of mosquito vectors, increased exposure of residents to vectors due to poor housing and the potential for disease outbreaks.
- The result of this study indicates that climatic variables are relevant for malaria forecasting and control in Kumasi; it also shows that malaria transmission is caused by a multiplicity of factors including climatic, environmental and socioeconomic factors.