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ASSESSMENT OF DYNAMICS OF INFECTIOUS DISEASE ECOLOGY AND EVALUATION OF HUMAN-MOSQUITO INTERACTIONS IN GWAGWALADA TOWN, FCT-ABUJA.

***GIMBA, U.N.**

Department of Biological Sciences, University of Abuja, Nigeria

P.M.B 117, Gwagwalada Abuja, Nigeria

***Corresponding Author: usnaji@yahoo.com**

Tel: 08036381509

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Abstract

Gwagwalada-FCT climate is suitable for several mosquito species capable of transmitting pathogens to humans. The objective of this research, as a theoretical framework, is to assess knowledge of mosquito-borne disease in Gwagwalada-Abuja, as well as perceptions and practices of mosquito prevention. Five demographic and socioeconomic variables. Knowledge of mosquito-borne diseases within the area was generally low, with only few individual correctly identifying Malaria as a threat in the area. These results can enhance existing public health programs by increasing knowledge, addressing public uncertainty and addressing ways to make recommended practices more effective with the knowledge of how different aspects are perceived by the varying groups within the community.

Introduction

Disease agents with much of their life cycle occurring external to the human host, such as water- and vector-borne diseases, are subjected to environmental conditions, and it is these diseases for which most linkages to ecosystem conditions have been found (Patz *et al*. 2004).

Infectious diseases are a product of the pathogen, vector, host, and environment. Thus, understanding the nature of epidemic and endemic diseases and emerging pathogens is essentially a study of the population biology of these three types of organisms, as well as of environmental factors. In addition to ecologically mediated influences on disease, changes in the level of infectious diseases can themselves disrupt ecosystems. (such as bird populations or predator-prey relationships altered by West Nile virus) (Daszak *et al*. 2001; Epstein *et al*. 2003). Female mosquitoes lay their eggs in water only; some species lay their eggs in running water, others in woodland pools, marshes, swamps, estuaries, or in containers such as rain barrels (Leung, *et al*, 2003). The majority of mosquito larvae live in standing fresh-water. Only a minority of species utilize brackish water or certain situations in flowing streams. Mosquito larvae require some protection from wind or waves at the water surface and so do not occur in such places as the open waters of lakes and rivers. The favoured habitats are themselves extremely varied, although most are characterized by small size and relative impermanence.

Mosquito distribution and feeding habits

Mosquitoes are distributed worldwide except in areas that are permanently frozen. They have a terrestrial adult stage but require a diversity of water bodies for the development of their immature stages i.e., the egg, larva and pupa (Hardin, *et al*, 2003). Mosquito population dynamics are dependent on a number of biotic factors such as predation by larvivorous fish, competition for resources with other mosquito species in the habitat, aquatic plant species/ hydrophytes, host choice and feeding preference, and abiotic factors including availability of suitable oviposition sites, physicochemical qualities of the breeding site water like; dissolved substances, pH, conductivity and water temperature (Gesler, 2004).

Mosquitoes and Disease Transmission in Man

Both male and female mosquitoes are primarily fluid feeders, naturally consuming plant nectars, other exudates and water (Gaines, 2008). In both anopheline and culicine mosquito families, males feed exclusively on plant juices and water, and hence do not vector agents of human diseases (Gaines, 2008). However, anautogenous females of both mosquito subfamilies in addition to their plant juice and water diet, require vertebrate blood meals which provide the necessary proteins for the process of öogenesis before the initial and for subsequent ovipositions (CDC, 2008).

When in search of a blood meal, female mosquitoes bite their vertebrate hosts including man. They inject some of their saliva into the wounds they create, causing swelling and irritation. Further, they may inject infectious agents into the hosts including viruses and protozoa, and thus transmit such diseases as malaria (anopheline mosquitoes), yellow fever (culicine mosquitoes; *Aedes aegypti*, *Haemagogus* sp. and *Sabethes* sp.), dengue fever (*Aedes aegypti)*, Japanese encephalitis (*Culex tritaeniorhynchus*, *Culex pseudovishnui* or *Culex gelidus)* and filariasis (*Culex quinquefasciatus*- found primarily in urban and suburban areas) (Barker, 2003). *Anopheles*, *Mansonia* and *Aedes* species can also vector filariasis (WHO, 2003; ARC, 2003; Aquino, *et al*, 2004).

Mosquito Vector Control

Mosquito control maybe undertaken either to avert the transmission of mosquito-borne diseases or to protect man and his livestock from the vicious bites of the insects by minimizing the man-mosquito contact. Control is targeted at the two ecologically distinct life stages of the insect, namely; the immature (egg, larva and pupa) and the adult mosquito. Gimba and Idris, 2014).

Physical Methods of Mosquito Control

Physical methods of mosquito control utilize mechanical barriers to prevent the entry of host seeking mosquitoes into the human dwellings or access to human host. These barriers include; window screens, sealing of heaves and openings in the roof, doorways, and windows (WHO, 2003). These mosquito control methods target adult mosquito and will additionally work as deterrent entry measures for other arthropods and non-arthropod household pests e.g. rats and bats. These physical methods are also advantageous in that they do not use chemical insecticides, and are thus environmentally friendly. The barriers are however limited in the sense that they are only effective in the protection of man against endophilic/endophagic inside the dwellings and will not affect outdoor feeding vector species.

Another physical control measure against mosquito is source reduction which is a component of a broader category of larval source management.

Larval Source Management, a strategy that utilizes methods such as larviciding (i.e. the use of mosquito larvicides to prevent the emergence of adult mosquito vectors) and source reduction (i.e. environmental manipulation, modification and elimination of aquatic habitats for mosquito larval control) has historically been used as a measure for malaria control in many parts of the tropical world (Kramer, 2005).

Chemical Methods of Mosquito Control

Chemical insecticides are an important armory in the control of mosquitoes, which are employed in IRS, LLINs and Larviciding mosquito vector control strategies.

The main thrust interventions presently being applied in Zambia to control mosquito vectors include the IRS intervention with insecticides and the use of LLINs, in an integrated vector management fashion (WHO, 2003; WHO, 2010). Throughout Africa, national malaria control programmes have recently embarked on emphasizing vector control as an essential component in the fight against malaria disease (Okafor, 2000). Most programmes are using ITNs and/or IRS incentives. When optimally employed, these vector control measures can reduce malaria parasite transmission by 90% (WHO, 2003; VDH., 2008a) or more and can correspondingly reduce malaria disease incidence, malaria disease prevalence, parasite density, and clinical malaria (WHO, 2003;VDH., 2005b).

Biological Methods of Mosquito Control

Biological control methods include but are not limited to the following;

Sterile Male Technique (SMT) - This involves the release of genetically modified males of a mosquito species into the environment to competitively mate with the wild female mosquitoes, and in the process, limiting the reproductivity of a vector population.

Release of other organisms that predate on mosquito larvae in the aquatic environment; e.g. larvivorous fish species of *Minnows* sp and *Gambusia affinis* (Rogerson, *et al*., 2007; Newman, *et al*., 2003) and is less likely to be avoided by adult mosquitoes (Belay and Deressa, 2008). The integration of LSM into malaria vector control programmes offers the potential to considerably augment the protection afforded by existing strategies (Enato, *et al*, 2007).

Mosquito-Borne Disease in Gwagwalada

Abuja climate is suitable for mosquitoes; the humidity and warm temperatures make for ideal breeding sites. Thus, mosquito-borne illness is nothing new to the area. Until 1989, malaria was present in large portions in Nigeria, including Abuja and was considered a major public health problem. The disease is gradually being eradicated only through a massive public health effort (CDC, 2004). This past disease history indicates that Gwagwalada-FCT climate can sustain both the vector and pathogen of what is thought of today as a tropical disease (Gimba & Idris, 2014). Consequentially, it is important to ensure public health prevention programs continue to work as planned.

Natural Habitats

Climate is one of many factors that influences vector-borne diseases. Vectors have biological constraints that act within climatological thresholds. Climatological and meteorological shifts can therefore alter disease activity within a given place. Increases in temperature and rainfall correlate directly with an increase in mosquito population because mosquitoes breed in standing water and warmer water temperatures increase the breeding cycle (CDC, 2008).

Built Habitats

The built environment, or areas of human settlement, can change the dynamics of natural systems. Mosquitoes may use artificial containers in urban or residential areas as breeding sites (Gimba & Idris, 2014) if they are more suitable or accessible than traditional breeding sites. These containers include items such as gutters, water vases, abandoned tires, trash, water storage containers, and any other item that can hold a very small amount of water.

Perceptions and Mosquito-Borne Illness

To address the threats of mosquito borne diseases, it is important to look beyond just the behavior of the vector. The behavior of susceptible populations also plays an important role in the ecology of infectious diseases. The way in which diseases are conceptualized by individuals influences how they respond to this threat. A review of literatures suggests that there are many misconceptions about mosquito-borne diseases. By first understanding these misconceptions, it is then possible to develop solutions to the problem.

Regarding likely breeding sites of *Aedes aegypti*, many people believe that mosquitoes are more likely to breed in dirty water (Kramer, 2005). In fact, this particular type of mosquito prefers to breed in clean water (Kumar *et al*., 2003). In the Philippines, Aquino, *et al*, (2004) found that most individuals believed malaria was contracted via water with mosquitoes or larvae in it, not through the bite of the mosquito. Residents believe that drinking this water is the ultimate source of infection. Thus, even if people understand that mosquitoes are involved, there is a gap in the knowledge of the transmission cycle involving the bite of an infected mosquito (Gimba and Idris, 2014). By applying the framework of the Health Belief Model to these existing studies, issues related to perceived susceptibility are highlighted. If mosquito-borne diseases are attributed to anything other than the bite of an actual mosquito, then people will not feel they are susceptible to contracting the disease through a mosquito bite. Therefore, if any action is taken to prevent against disease contraction it will be ineffective because it will not be protecting against the actual pathway of transmission (CDC, 2006).

Some community members in Gwagwalada reported that they do not believe that mosquitoes cause the disease because they have tried to control the mosquitoes and nevertheless people still fell ill, leading to the belief that they cannot prevent the disease because previous attempts to do so failed (Gimba and Idris, 2014). This reasoning jeopardizes public health programs because people will not comply if they do not believe in the goals or do not trust the effectiveness of these programs. While it is understandable that individuals who have spent their whole lives getting bitten while never contracting a disease may feel that the threat is not real, it is important to remember that many of these diseases have been introduced to the United Sates within the last decade.

METHODS

The Study Area

Gwagwalada Area Council is located about 55km away from Federal Capital City [FCT], Abuja. It lies on latitude 8°.55' and 9°.00'North and longitude 7°.00' and 7°.05'East (Ishaya, 2013). The area covers a total of 65sq kilometer located at center of very fertile area with abundance of grasses (Ishaya, 2013).

The rainy season comes between the months of April to October with temperature range of 23^{oC} and 36^{oC}. It is pertinent to observe that, this area has a higher temperature than any other Area Council in the Federal Capital Territory throughout the year (Ishaya, 2013).

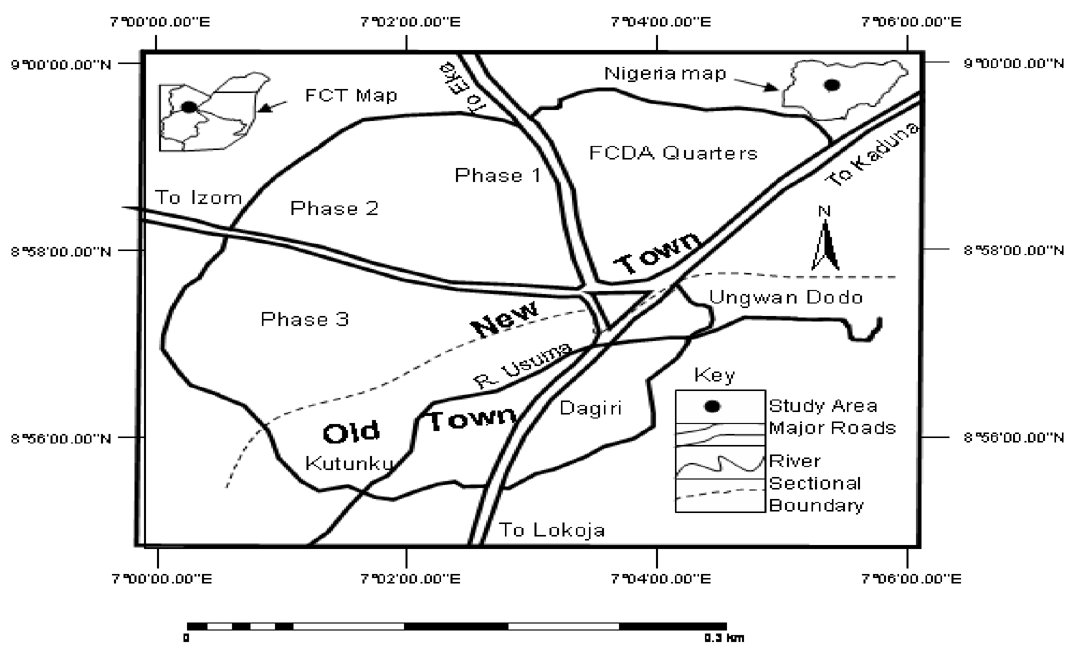

Fig. 1 Gwagwalada Town

Figure 1: Map of Gwagwalada Area Council, FCT-Abuja showing the Study Site.

Source: Ideal Cartographic Services, Bwari-Abuja [2002].

RESULTS

Table 1: Socio-Demographic Characteristics of Respondents in Selected Households in Gwagwalada, FCT-Abuja.

Characteristics	*n*	%
Gender		
Male	154	42.1
Female	212	57.9

Survey, 2015.

A total of 366 households heads were interviewed, including 58% females and 42% males (Table 1). Symptoms of malaria such as intermittent fever and headache, fever/high body temperature and general body weakness, and fever with rigors were most frequently mentioned. Other symptoms mentioned were dizziness, abdominal pain, loss of appetite, diarrhea, body pains, and cramps.

Table 2: Mode of Transmission of the Respondents

Mode of Transmission	***n***	**%**
By bites of any mosquito	180	49.1
By bites of mosquito which has bitten a malaria patient	63	17.2
Others	31	8.5
Do not know	92	25.1

Survey, 2015.

Table 3: Causes of Malaria of the Respondents

Causes of Malaria	***n***	**%**
Germs	30	8.2
Dirt stagnant water	16	4.4
Mosquito bites	174	47.5
Plasmodium organisms	22	6
Does not know	124	33.9

Survey, 2015.

Table 4: Mosquito Breeding Areas of the Respondents

Mosquito Breeding Areas	***n***	**%**
Stagnant water	199	63.4
Tall grasses	81	25.8
Bushes	29	9.2
Others	5	1.6

Survey, 2015.

Table 5: Respondent's Knowledge and Practices about Malaria Preventive Measures in Gwagwalada, FCT-Abuja.

Variable	*n*	%
Preventive Measures		
Using insecticidal bed nets	234	63.9
Using insecticides sprays	13	3.6
Preventing breeding of mosquitoes and resting places	18	4.9
Using mosquito coil/repellents	15	4.1
Treatment	22	6
Others	29	7.9
Does not know	35	9.5

Survey, 2015.

The data show that, even the rural people have demonstrated a better understanding of malaria causes, symptoms, treatment and, preventive measures as observed in other reports from different parts of the world Menandez, *et al*, 2007; FMH, 2004; 2008]. However, the findings revealed a poor or superficial knowledge on malaria transmission, treatment, preventions, and etiology among illiterate respondents in Gwagwalada.

However, in this study only few respondents mentioned a correct transmission route ("the bites of mosquito which has bitten a malarial patient"). About half of the respondents demonstrated a gap of knowledge on malaria transmission by stating that the bite of any mosquito could cause malaria and a quarter of respondents did not knew the mode of transmission. This observation was similar to the findings of Isah and Nwobodo, (2009) in Bangladesh. Public health education interventions should always be designed to cover the existing knowledge and should be implemented for a sufficient length of time for it to be effective (Newman, *et al*, 2003).

In this study, health facilities were the most common sources of malaria treatment in the study population. This observation was similar with other studies in Tanzania (WHO, 2005). Self-treatment was also practiced by the study participants for treatment of malaria. This was consistent with findings of other studies in India and Bangladesh (WHO, 2004). Informal allopathic providers such as drug store sales people and traditional healer were also consulted by respondents [CDC, 2006].

Bed nets are among the most recognized methods of personal protections against mosquitoes and many studies have reported the benefits of ITNs (Adedotun, *et al*, 2010). The majority mentioned the use of insecticidal bed nets (ITNs) in the study, and most of them reported to sleep under bed nets a night before the survey.

Similar observations have been reported in Mexico (WHO, 2003). Acceptability of the spraying, in terms of house-spraying coverage, is sufficient to prevent human-vector contact and to control malaria in the study area. Malaria control based on indoor house spraying heavily depends on this acceptance (WHO, 2005). The causes of refusal of accepting IRS were bad smell of the insecticides, poisoning of domestic animals, poisoning of children, and the insecticides may cause infertility to family members. The responses corroborate another report from Mexico (Njoroge, *et al*, 2009). A study in Abuja concluded that there is a significant relationship between people’s knowledge of the causes of malaria and preventive measures taken against it, and that a household's level of understanding of the purpose of an insecticides spraying program is directly correlated with their compliance with having their house sprayed (FMH, 2005).

In this study, the majority of respondents reported to have heard of the combination therapy, artemether+lumefantrine (ALU) for treatment of malaria. Health facilities were the main sources of information about ALU. This has also been reported from Nigeria (FMH, 2008).

Gender was the only variable that was significantly predictive of knowledge. Although men and women were equally likely to be aware of mosquito-borne diseases in the area and in FCT, Abuja, men were more likely to correctly identify the specific diseases. Results of previous studies suggest that there is a correlation between income/education and knowledge; however, neither of these were found to be significant predictors of knowledge in the study area. The results of this portion of the study suggest that knowledge of the vectors of mosquito-borne disease is low in Gwagwalada. Therefore, it is of critical importance for local health departments to raise awareness of the threat, as the Health Belief Model demonstrates that awareness of a threat is a critical input to following through with recommended actions.

Women were significantly more likely than men to report being concerned about being bitten by mosquitoes and contracting a disease if bitten. They were also more likely to feel that a disease contracted by a mosquito would require medical attention. Therefore, it is important to ensure that men are also educated about the potential threat of mosquito-borne disease to both themselves and their children.

The removal of standing water was perceieved to be the most effective form of preventing mosquito bites, yet only 40% of individuals reported actually emptying standing water around their homes. The two most frequent reasons cited for not emptying water was that standing water did not collect around the home and that it was time-consuming. This is an important barrier, particularly because mosquitoes require only a small amount of water for oviposition, and there are likely potential breeding sites around all homes. However, if the perception is that standing water does not collect, people will not take action to clear potential breeding sites nor take additional protective measures when outdoors around the home. Again this ties back to knowledge of disease threat and perceieved susceptibility and seriousness of the problem. If people are not aware of mosquito-borne diseases or not concerned about their potential threat, the hassle of removing standing water will outweigh any perceived potential benefits.

The vast majority of participants (81.1%) reported that using insect repellent was somewhat to very effective in protecting against mosquito bites. However, only 17% of participants said they always use it outdoors when mosquitoes are present. A barrier to using insect repellent appears to be the perception of its danger. Thus, it appears that the safety of insect repellent should be stressed in local public health campaigns, rather than simply outlining its effectiveness for preventing bites.

Conclusion

The results of this research extend beyond Gwagwalada. Various socioeconomic variables were predictive of specific perceptions or behaviors, demonstrating that this place based approach can be used to target certain demographic groups or to adjust health campaigns as necessary. These results can also help public health programs in strained financial economic times because they emphasize individual preventative action around the homes rather than emergency reactionary plants that would ultimately fall on shoulders of local and state governments.

Recommendations

The components of environmental sanitation should be carried out to the latter in the Area Council. Estimates on the needs of each area councils and the components as it applies to should be prepared and submitted to the appropriate authority for proper attention, approval and prompt release of fund to avoid preventable deaths.

REFERENCES

Adedotun AA, Morenikeji OA, Odaibo AB. (2010). Knowledge, attitude and practice about malaria in an urban community in South western Nigeria. *Journal of Vector Borne Dis*;47:155-9.

Ajayi IO, Jegede AS, Falade CO, Sommerfeld J: (2013). Assessing resources for implementing a community directed intervention (CDI) strategy in delivering multiple health interventions in urban poor communities in Southwestern Nigeria: a qualitative study. Infect Dis Poverty, 2:25.

Aquino, M., Fyfe, M., MacDougall, L., Remple, V. (2004). West Nile Virus in British Columbia. *Journal of Emerging Infectious Diseases* 10 (8): 1499-1501.

ARC, (2003). Subregions of Appalachia. Compiled by Appalachain Regional Commission, October 2003. Source: U.S. Department of Commerce, Census Bureau, Census of Population, and Housing, 2000 Summary File 3.

Bharti PK, Chand SK, Singh MP, Mishra S, Shukla MM, 6. Singh R. (2013). Emergence of a new focus of *Plasmodium malariae* in forest villages of district Balaghat, Central India: implications for the diagnosis of malaria and its control. *Trop Med Int Health*; *18* : 12-7.

Center for Disease Control (2008). *Vector Control.* Online. http://www.cdc.gov/malaria/control_prevention/vector_control.htm. Retrieved 24 April 2008.

Dysoley L, Kaneko A, Eto H, Mita T, Socheat D, Börkman A, (2008). Changing patterns of forest malaria among the mobile adult male population in Chumkiri District, Cambodia. *Acta Trop*; *106* : 207-12.

Enato EF, Okhamafe AO, Okpere E. (2007). A survey of knowledge, attitude and practice of malaria management among pregnant women from two health care facilities in Nigeria. *Acta Obstet Gynecol Scand*; 86:33-6.

FMOH. (2008). National Malaria control Programme, Abuja-Nigeria. Strategic plan 2009-2013; *A Road Map for malaria control in Nigeria*; p. 23-4.

Gimba, U.N. and Idris, H.S. (2014). Morphological Identification and Distribution of *Anopheles* Species in Gwagwalada Town, F.C.T, Nigeria. International Journal of Environmental Science and Toxicology (ISSN: 2315-9927) Vol. 2(10) pp. 210-216,

Lowassa A, Mazigo HD, Mahande AM, Mwang'onde BJ, Msangi S, Mahande MJ, Kimaro EE, Kweka Elisante E, Kweka EJ (2012): Social economic factors and malaria transmission in Lower Moshi, Northern Tanzania. Parasit Vectors, 5:129.

Singh R, Jain V, Singh PP, Bharti PK, Thomas T, Basak S. (2013). First report of detection and molecular confirmation of *Plasmodium ovale* from severe malaria cases in Central India. *Trop Med Int Health*; *18* : 1416-20.

WHO. *World Malaria Report 2013*. Geneva: World Health Organization, 2013. Available from: *www.who.int/iris/bitstream/10665/97008/1/9789241564694_eng.pdf*, accessed on March 11, 2014.