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Environmental Sanitation Practice Affecting Malaria Prevalence And Transmission In Awka Metropolis Of Anambra State, South Eastern Nigeria

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ABSTRACT

This study focused on the implication of poor environmental sanitation on malaria parasite prevalence and transmission in Awka metropolis of Anambra State South Eastern Nigeria. The studied population comprised of 301657 persons of which 728 subjects were randomly selected from 364 households. The overall malarial prevalence of the study was 44.50%. The prevalence was higher in the rainy season (57.77%) than in the dry season (42. 28%).The mean parasite density was significant (p = 0.001). Subjects 0 – 5 years and 6 – 15 years recorded highest prevalence in this study (62.00%) and (50.00%) respectively with (p = 0.001) the odd ratio (OR = 1.7, CI = 6.41 – 70.41). Malaria Parasite prevalence (p = 0.001) and parasite density (p =0.001) were higher in individuals that live in poor environmental sanitation than those that live in environmentally clean surroundings without heaps of refuse dumps. Inhabitants of houses surrounded by dumpsites, bushes, block gutters, garbage and stagnant water recorded highest female An. gambiae (52.24%) An. funestus (29.39%), An. bancroftii (10.33%) and An. Stephensi (8.03%) were associated with perennial transmission of malaria. Our finding showed that poor environmental sanitation is a major risk factor for transmission.

Keywords: Environmental sanitation, Malarial, Parasite, Prevalence, Transmission, Seasonality, Awka, Nigeria

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1. INTRODUCTION

Malaria, a major public health concerned disease, is prevalent in Nigeria. Incidence of the parasitic disease in Nigeria both urban and rural area have led to millions of morbidity and death each year. It is a common knowledge that poor environmental sanitation, poorly drained rain water and stagnant pool provides breeding sites for malaria's parasite vector and other vectors (WHO, 1997). The problem of environmental sanitation is essentially that of the individuals or family, but without government interference, there is bound to be indiscriminate dumping of refuses in streets, roads, open spaces and water drainage channels, thereby contributing immensely to the rapid breed of parasitic diseases and its vectors (WHO, 1997). Malaria transmission is perennial in Nigeria with increases prevalence during the wet season, and varies with levels of urbanization. (Adeleke et al., 2008). Malaria is a major contributor of anemia and may have profound consequences on learning and educational achievement of school age children (Lalloo et al., 2006). Environment factors such as the presence of bushes and stagnant water around homes, dumpsites, rainfall, low attitude and high temperatures favour the breeding of malaria vectors, as well as parasite reproduction within the vector (Messina, 2011).

Evidence of the adaptation of malaria vectors to the African urban environment has been reported (Awolola et al., 2007). Indiscriminate farming activities, uncompleted house construction works in major cities in Nigeria, unclear bushes as well as varieties of poor environmental factors provides additional breeding sites for malaria vectors (Adeleke et al., 2008). Malaria transmissions are higher during wet season coinciding with increase mosquito abundance, though in some areas malaria infestation rate (the proportion of people with positive blood smears) are relatively constant throughout the year but majority of cases occur during the wet season (Graham et al., 2002). The four major species of human malaria parasite (Plasmodium) are transmitted by many species of a female Anopheles mosquitoes; *Plasmodium vivax* is transmitted by *An. maculipennis* and *An. darlingi; P. ovale* is transmitted in the tropics by *An. gambiae* and *An. funestus; Plasmodium malaria* is transmitted by *An. gambiae, An. Funestus* and *An. darling; Plasmodium falciparum* is transmitted by wide range of Anopheles mostly *An. Funestus; An. gambiae, An. bancroftii* and *An. stephensi* (Beebe et al.,2001; Beebe et al.,2013) *Plasmodium knowlesi* is found throughout Southeast Asia, where it primarily infects long-tailed macaques, and banded-leaf monkeys, the vectors are *An. hackeri, An. latens, An. cracens, An. balabacensis, An. dirus,* and *An. introlatus* (Milla & Cox Singh,2015).

An integrative approach has been recommended to mitigate the spread of malaria parasites. Top on such strategy or approach is the integrated vector management (IVM) through a combination of biological and chemical methods aimed at improving ecological soundness, improve efficiency cost effectiveness and sustainability towards the control of vector-borne diseases (WHO, 2012). Components of IVM include those of preventive (e.g. use of mosquito repellants, long lasting insecticide-treated nets (LLINs) and wearing of protective clothing) and chemical control methods (e.g. environmental and biological control measures, outdoor spraying, larviciding and indoor spraying (WHO, 2012). Not enough information exist on malaria transmission associated with poor environmental sanitation in Awka metropolis. Understanding the full economic burden of malaria to the populace helps to identify the potential benefits of effective prevention and control from reducing the incidence of malaria infection in Anambra state and Nigeria. Hence this study was set to assess the effect of poor environmental sanitation practice on malaria prevalence and transmission in Awka metropolis.

2. MATERIALS AND METHODS

Awka is the capital of Anambra state located in south Eastern Nigeria at 6^{0}-12'25'N and 7004'04'E has an estimated population of 301,657(FRNOG, 2007). Awka is in the tropical rainforest zone of Nigeria and experience two distinct seasons six months of heavy tropical rains, which occur between April and July, followed by a short dry period in August lasting two to three weeks with the rain resuming in September and October. This is followed by five months of dryness (November – March) marked by Harmattan wind characterized by dry and dusty wind which enters Nigeria in late December to early part of January dissipating and leading to extreme dry heat in the latter months of February and March(FRNOG, 2007).

The temperature of Awka is generally 27 – 30^{o}C between June and December but rises to 32 – 34^{o}C between January and April. The last few months of the dry season is marked by intensive heat (Weather in Africa, 2014).Stagnant waters and slow flooring streams are formed around Awka with heavy deposits of dumpsites seen around the metropolis. This allows for the continuous breading of anopheline mosquito all year round. The inhabitants of Awka metropolis are predominantly farmers, traders, civil servant and students. There are different types of houses;– cement built house, batchers and uncompleted buildings. **Parasitology:** This study was carried out between April 2017 to August 2018. Out of 301657, seven hundred and twenty eight (728) subjects were randomly selected from 364 households for malaria parasite studies. The subjects were of both sexes and age range between < 1 – 85 years. Informed consent was obtained from the subjects before recruitment into the study. For the infants and minors' informed consent was obtained from the parent, guidance and care givers.

Ethical clearance was obtained from Anambra state Ministry of health. In July to August (Peak transmission period) 364 subjects were selected to assess the impact of environmental sanitation malaria prevalence and parasite density. Both thick and thin blood fitness were prepared from the blood samples from each selected subjects and observed under ×100 objectives of Olimpus microscope. Slides were reported negative for parasites only after observing at least 100 fields (WHO 2014).

Parasite densities were calculated using the formula:

$$\frac{\text{Parasite count / Ml x Estimated WBC/ml/ (8000)}}{\text{WBC Count.}}$$ (Cheesbrough, 2009) ……………..(1)

Mosquitoes were collected by indoor residual spraying techniques in dry and wet seasons (WHO, 2006). Six trained assistants served as mosquito collector. Spray catches were done in at least 3 rooms per location in the six locations of the randomly selected areas of the metropolis. Rooms were spray of with Baygon mosquito flit, within 6 minutes after spraying, adult mosquitoes were collected from all the floors and corners of the room. Adult mosquitoes were identified using Yssouf et al. (2016) morphological identification. Human biting rate (HBR) per person per night was calculated from the human landing catches and the hourly night biting pattern determined.

2.1 Statistical Analysis
Analysis of data was done with the statistical package for social sciences (SPSS) version. 10. Data were analyzed using percentages, Chi-Square and Odd Ratio.

3. RESULTS

The overall prevalence of malaria parasites in the current study was 44.50%. There was prevalence through the year but the prevalence was higher during wet season (187/324 = 57.72%) than in the dry season (137 / 324 = 42.28%). Malaria parasite prevalence was higher among the age group < 1 – 5 years and 6-15 years 67 years and above 50.0% respectively.

Table 1: Malaria Parasite prevalence and geometric Mean parasite Density (GMPD) by age group in Awka Metropolis Anambra State South Eastern Nigeria

Age group (Yrs)	**No. (Exm)**	**No. (Ifectd)**	**Prevalence (%)**	**GMPD (Parasites/ml Blood** ISD)
0-5	148	92	62.0	3484±121
6 – 15	132	66	50.0	1446±53
16 – 25	109	48	44.0	2986±89
26 – 64	101	40	39.6	1184±58
65 – 85	238	78	32.8	332±78
Total	728	324		

Malaria parasite density begins to decline after the 15 years of age (Table 1) prevalence in Children from the age of < 1 – 15 years. From aged 16 – 25, 26- 64 and 65 – 85 years had a continuous decline as 44.2, 39.6, and 32.8% respectively

Table 2: Anopheline abundance (%) in both seasons in Awka Metropolis Anambra State South Eastern Nigeria		
	Seasons	
	Number Caught Wet (%)	**Number Caught Dry (%)**
Female *Anopheline gambiae*	1040 (53.30)	528 (48.70)
Female *An. funestus*	486 (25.40)	296 (36.53)
Female *An. bankcroftii*	207 (10.86)	103 (9.50)
Female *An. staphensi*	184 (9.60)	57 (5.25)
Total	1917 100	1084 100

An. gambiae and *An. funestus* recorded the highest abundance both in dry and wet seasons 640 (40.10%) and 385 (44.20%) respectively (Table2) *An. stephensi* was the least in abundance while *An. bancroftii* was the 3rd highest in abundance in this study. The abundance was highly season dependent though female anopheles mosquito species occurs in the entire metropolis at all time (Table 2). The biting incidence of female anopheles species indicates peak biting hours occurring between 12 - 3am irrespective of the season. Biting rates were higher for *An. gambiae* followed *An. funestus* while *An. stephensi* had the lowest biting rate. Higher populations of female Anopheles Mosquito species were caught owing to poor environmental sanitation practice with higher biting rate which corresponds with higher malaria parasite prevalence and parasite density (Table 3). A positive correlation was recorded between female Anopheles mosquito population and malaria parasite prevalence (r=0.51; P=0.001; OR = 1.7)

Table 3: Association of Poor Environmental Sanitation with Malaria Parasite Prevalent Environmental/Condition in Awka Metropolis Anambra State South Eastern Nigeria							
	Present	**Prevalent**	**Absent**	**Prevalent**	**X2**	**P.**	**OR**
Dumpsite garbage	86/117	67.7	57/172	31	10.12	0.001	1.7
Bushes / Stagnant pool Water	69 / 100	69.0	71/ 183	38.0	11.89	0.000	
Dumpsite garbage potholes	24/64	50.0	12/50	24.0	6.12	0.05	

4. DISCUSSION

Malaria is a very important parasitic infectious disease transmitted by female Anopheles mosquitoes occurs mostly in tropical and subtropical countries particularly Sub-Saharan Africa South-East Asia and South America. The ecology of the disease is closely associated with the availability of water as the larval stages of mosquitoes develop in different kinds of water bodies (De Silva & Marshall, 2012). A high female Anopheles mosquito species population was recorded in this study and the high abundance corresponded with higher malaria parasite prevalence and parasite density due to poor environmental sanitation. The finding was in agreement with the report of (Wang et al., 2005) in the epidemiology of urban malaria in Ouagadougou; Fournet et al., (2010) for anopheline larval habitat and adult composition during the dry and wet seasons in Ouagadougou and; Drakely et al. (2003) in a semi- urban area in a region of intense malaria transmission in Tanzania. These studies observed that higher mosquito densities naturally lead to elevated levels of malaria transmission for people who either work or on hire near urban agricultural fields. Awka metropolis is a well-established urban area. The study reveals that *An. gambiae* and *An. Funestus* were the most abundant species responsible for malaria transmission in Awka metropolis. This finding was in line with most observations made by some studies in Sub-Saharan Africa (De Silva & Marshall, 2012).

The majority of malaria deaths are caused by *P. falciparum* and transmitted by *An. gambiae*s in Cameroon and Libreville respectively (Antonio –Nkondji et al., 2011; Mourou et al., 2012). *An.Funestus* also contributes to malaria transmission on the continent of Africa and they thrive in dry and peri-urban environment throughout Uganda (Okello et al., 2006). *An stephensi* population was recorded in this study. This anopheles species was reported under malaria transmission vector alert by World Health Organization (WHO) in 2018 and may affect transmission among vectors (WHO, 2018). Malaria parasite prevalence had significant difference in children between 10-15 years in Mvomero district, Tanzania (Rumisha et al., 2019). Lower mean parasite densities were recorded in adult than is children 322±78 and 3484±121 respectively. This finding was in agreement with report of a study carried out in Bamanda, Duala, Yaoundé and Bolifamba allin Cameroon (Nkuo –Akenji, 2006) which attributed low prevalence in adults to protective immunity acquired over a long period of exposure to malaria. Odd ration (OR = 1.7) was observed in this study which confirmed that inhabitants exposed to poor environmental sanitation condition were 1.7 times likely to have malaria parasitic infection. This was in accord with studies carried out by Amoran et al., (2014) which observed significant association of environmental sanitation with prevalence of malaria in the households in a rural town in South-Western Nigeria.

Poor environmental sanitation encourages higher mosquito densities naturally and it leads to elevated levels of malaria transmission in that environment (Fournet et al., 2010). The impact of poor environmental sanitations on malaria prevalence and transmission was potentially high in Awka metropolis and highest malaria prevalence was recorded in children living in houses surrounded by dumpsites, block gutters, uncompleted houses, bushes and slumps. High Anopheles species populations were recorded in this study from the above mentioned environments studied. A reduction of malaria prevalence and transmission in Awka metropolis could be achieved by control interventions involving clean environmental sanitation practice this will prevent exposure to mosquito bites and risk of malaria parasite infection all year round.

The current approach of the WHO to control malaria in Sub-Sahara and Africa has been a combination of vector control, (in the form of LLINS and indoor residual spraying with insecticides (IRS)) and the distribution of ACT drugs for treatment (WHO, 2012). Site known to be conducive for vector breeding such as agricultural fields, tyre tracks, ditches swimming pools, construction sites dumpsite and blocked gutters should be targets for control vector control. These sites are common in areas with slum-like conditions (Mourou et al., 2012). Larviciding should be priorities since larvae contained within aquatic sites are easier to control than free flying adults (Matthys et al., 2006), and its annual cost per individual is less than two-third that of ITNS (Fillinger et al., 2008) integrated vector management (IVM) provides the WHO's decision-making framework for vector control, and its emphasis on local evidence and participation makes it an ideal framework for effectively utilizing a community resources to control the ever evolving urban malaria (WHO, 2012).

5. CONCLUSION

Emphasis should be on eliminating vector breeding sites through larviciding and other measures. Although LLNS and IRS are the gold standard for vector control in rural areas, there are much greater potential vector control measures such as identifying and eliminating breeding sites in urban settings. Attention should be paid to both natural and artificial breeding sites, as suggested in this study.

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