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Prevalence of Vectors of Public Health Importance in Major Dumpsites in Port Harcourt Metropolis, Rivers State, Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author CNII designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author LBBG managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Vectors are important factors in the transmission of many parasitic diseases. The determination of the prevalence of vectors of public health importance in major dumpsites in Port Harcourt metropolis was investigated. Eight major dumpsites within the metropolis were randomly selected and the study was conducted within August 2018 and June 2019. Record on age of the dumpsites were obtained from the regulating agency and composition of dumpsites was made by physical observation. The composition of the dumpsites ranged from plastic cans, decomposing food, metals, cartons, bottles, faecal matters to plant materials. Vectors were collected using Sweep nets, sticky traps, water traps and manual hand picking with gloves and forceps. Vectors of public health importance collected from the dumpsites included *Chrysomya megacephala* (Family: Calliphoridae), *Musca domestica* (Family: Muscidae), *Anopheles spp*. (Family: Culicidae) *Aedes spp* (Family: Culicidae), Periplanata Americana (Family: Culicidae) and *Blatta orientalis* (Family: Culicidae). Out of the 360 vectors collected, 12.5%, 49.4%, 5.3%, 18.9%, 10.5% and 3.1% were *C. megacephala, M. domestica, Anopheles spp, Aedes spp, P. americanus* and *B. orientalis*

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repectively. There was no statistically significant difference (P > 0.05) in the prevalence of vectors in relation to the dumpsites investigated. *M. domestica* was the most prevalent vector. High prevalence of vectors of public health importance was recorded in all the eight dumpsites investigated. Hence, there is a possibility of a potential high risk of transmission of gastrointestinal helminths and malaria among residence within the dumpsites, scavengers and sanitation workers of the waste management agency. Proper waste management strategy, regular fumigation exercise and health education for sanitation workers and scavengers will curb the breeding of vectors.

Keywords: Dumpsites; vectors; public health; Port Harcourt metropolis.

1. INTRODUCTION

A vector is an organism which carries or transmits diseases. It is an organism (usually an arthropod) which transfers infective forms of a parasite from one host to another [1]. Vectors can also be defined as arthropods and other invertebrates which transmit infection by inoculation into or through the skin or mucous membrane by biting or by deposit of pathogens on food or on skin or other objects. Vector borne diseases are responsible for over 17% of all infectious diseases, accounting for over 700,000 deaths annually [2].

There are several vectors that transmit communicable diseases. For instance, mosquitoes and ticks have been implicated in the transmission of malaria and lyme disease respectively. Traditionally, vectors do not cause diseases themselves but are known to spread infections by serving as a vehicle through which pathogens are transported from one host to another. Vector-borne diseases have a debilitating effect on health and hamper economic growth, hence, a person with repeated bouts of malaria will definitely need healthcare and lose productive days at work. Malaria alone, is responsible for over 400,000 death every year globally and affects mostly children under the ages of 5years [2]. Diseases like onchocerciasis (river blindness) also have a devastating health impact on health and if an infected person is left untreated, it could result to blind, rendering the person useless to production in relation to economic worth. Additionally, other vectors like rats destroy food and household materials, causing enormous economic loses.

The relevance of vectors in the transmission of some of these diseases cannot be overemphasised. Most of these vectors breed in areas laden with human and animal excrement, waste water ditches, tin cans, car tyres and organic domestic waste such as vegetable matter found in urban areas [3]. These waste materials and more are mostly found in dumpsites [4]. Wastes generated from industrial, commercial and domestic sources are collectively gathered and dumped in specific locations generally referred to as dumpsites. The contents of dumpsites create favourable breeding ground for vectors of diseases. This increases the risk of spreading pathogens of infectious diseases to the public [5]. Record shows that about 43.2 million tonnes of waste is generated in Nigeria annually [6]. These wastes are generated in major cities like Lagos, Port Harcourt, aba etc.

Refuse generation in Port Harcourt comes from industrial, domestic, and commercial sources. Refuse generation rate has been increasing steadily and will likely continue to do so in future due to the rapid growth of population in Port Harcourt metropolis [7]. Ikebude [5] reported that the conventional waste management system is still being used in Port Harcourt metropolis by the waste management authorities, instead of the Integrated Solid waste management system (ISWMS), and that about 75% of the storage facilities in the city are sub-standard and insanitary with no colour coded containers for different corresponding kinds of wastes.

This shows that the waste management system in Port Harcourt is inefficient and lags in coordination. Although the activities of the agency (Rivers State Waste Management Agency) saddled with the responsibly of waste management in Rivers state cannot be completely undermined, its policy and effort in management of generated waste especially within Port Harcourt metropolis has yielded no positive impact on both vector control and aesthetics of the city. The dumpsites are mostly located around human residence, enhancing possible availability of the three key components (a favorable environment, a susceptible host and

the disease causing organism) that ensure the striving of infectious diseases [8].

In view of the above, it becomes scientifically relevance to conduct a research that will investigate the prevalence and species of vectors of public health importance associated with dumpsites in Port Harcourt metropolis.

2. MATERIALS AND METHODS

2.1 Study Area

This study was conducted in Port Harcourt metropolis (Fig. 1), a city in the Niger Delta region of Nigeria. The city lies on latitude 4°49′27″ N longitude 7°2′1″ E. It covers an area of about 369 km² with a temperature of about 22°C and 90% Humidity. Port Harcourt metropolis consists of Port Harcourt Local Government Area and some parts of Obio-Akpor Local Government Area [9]. The population of the city is estimated to be 2,060,000 inhabitants [10] but in 2016, it was projected to be 756, 600 [11]. The city is characterised by tropical wet climate with lengthy and heavy rain fall. Only the months of December and January could truly be considered as dry season months. This research was carried out within August 2018 and February 2019.

2.2 Sampling Sites

There are several major dumpsites in Port Harcourt metropolis, however eight dumpsites were randomly selected for this study. Data collected from Rivers State Waste Management Agency (RIWAMA) and residence within dumpsites indicated that all the selected dumpsites have been in use for the at least 3-5 years and are still functional. The dumpsites selected are located at various areas within Port Harcourt metropolis (Table 1).

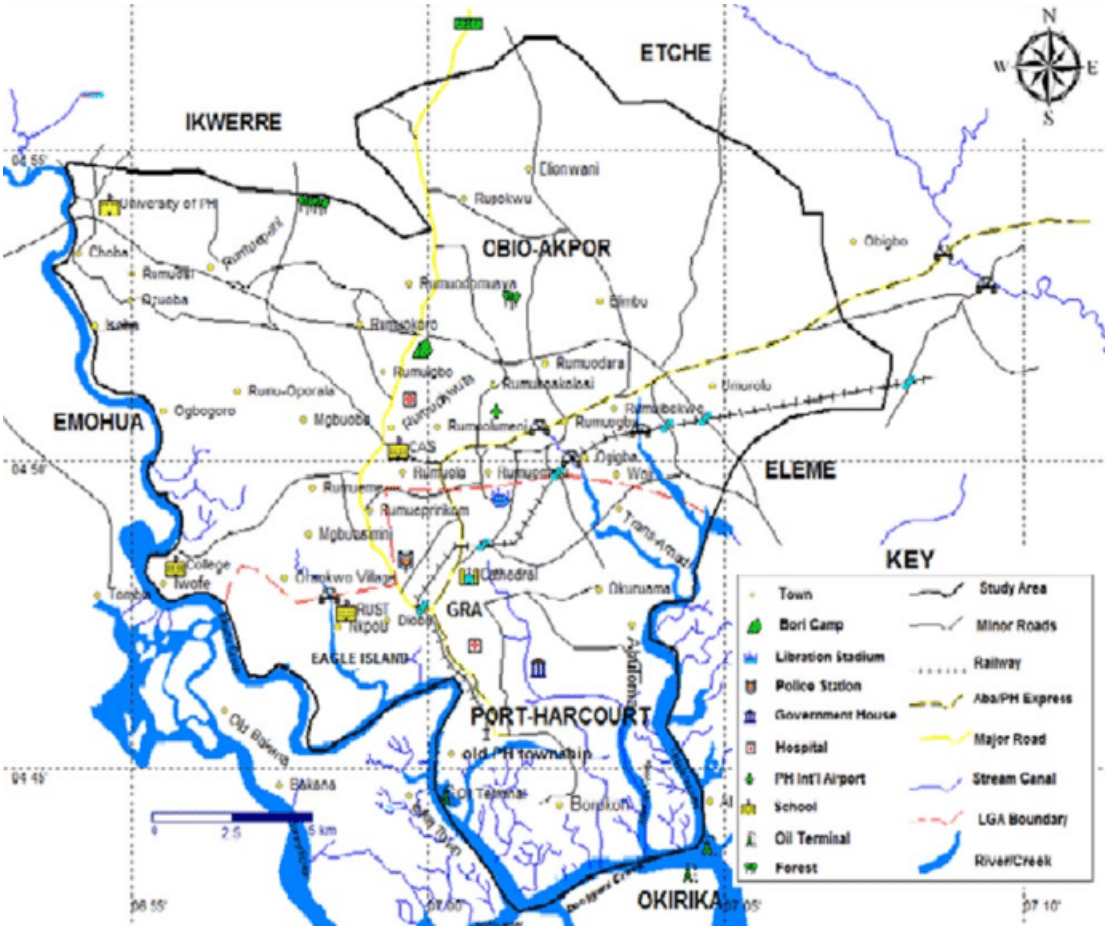

Fig. 1. Map of Port Harcourt metropolis
Source: The Achives, Port Harcourt City Local Government Area

2.3 Collection of Vectors

There was physical observation of the dumpsites for possible vector composition and other material components, the methods of [12] was adopted for the collection of vectors. The methods included the use of self-made sweep nets, sticky traps, water traps and hand picking, wearing disposable gloves and picking with forceps. Vectors collected were preserved in well labelled ventilated specimen bottles and transported to the research laboratory, Department of biology, Ignatius Ajuru University, Rivers state for identification and examination for presence of parasites. Samples that could not be examined were preserved in well labelled specimen bottles containing 10% formalin.

2.4 Statistical Analysis

Data generated were analysed using simple percentages and SPSS version 23. One way Analysis of Variance (ANOVA) was used to determine the significant difference between variables at 0.05 significant level. The prevalence (VP) and relative abundance of vectors (RVA) were determined using the formulae below:

Vector prevalence (VP) = (No. of specific vector / Total number of vectors) x 100

Relative abundance of vectors (RVA) = (No. of specific species of vectors / Total No. of vectors) x 100

3. RESULTS

3.1 Description of Dumpsite

The location, composition and age of the dumpsites are presented in Table 1. Plastic cans, polythene bags, decomposing food particles, chemical sludge, rusted metals, biochemical waste, cartons, cloths, bottles, faecal matter, plants materials were common materials seen in virtually all the dumpsites. Again, all the dumpsites are in high density areas (Table 1).

Table 1. Composition and location of dumpsites

Site No.	Location	GPS	Composition	Age range
1	Timothy Nsirim Road, Mile 4 PH	4˚49' 12" N 6˚58' 48" E	Food particles, hair, foil, plates, Polythene bags, orange peel, faeces, cans etc	Above 5 years
2	Obiri Ikwerre Airport Road Sorting dumpsite site	4˚ 54' 19" N 6˚ 57' 55" E	Plastic cans, decomposed food particles, vegetable, fabric materials, hair, peels, Nylon, metal cans, Plastic water bottles, faeces	About 3 years
3	Obiri Ikwerre Airport Road Major dump site	4˚ 54' 4" N 6˚ 57' 49" E	Plastic cans, decomposed food particles, vegetable peels, Nylon, metal cans, Plastic water bottles, faeces	About 3 years
4	Alakahia Uniport East West road	4˚ 53' 12" N 6˚ 55' 22" E	Papers, Polythene bags, food wastes, glass bottles, baskets, plastic bottles, faeces, etc	Above 5 years
5	Aprikom Road, off Chinda Road, Ada George, PH	4˚ 49' 14" N 6˚ 58' 15" E	Plastic, papers, Dirty water logs, nylon, fruit peels, faeces, decomposed food particles, etc	Above 5years
6	Eagles cement	4˚ 48' 21" N 6˚ 56' 37" E	Polythene bags, Plastic cans and bottles, foil plates, faeces, etc	About 3years
7	Timothy lane, Olara community, Rumuola	4˚ 50' 7" N 7˚ 0' 1" E	Nylon bags, banana peels, orange peels, paw paw peels, decomposed food, Faecesetc	Above 5years
8	Opp Naval Medical Centre, Borikiri, Port Harcourt	4˚ 45' 8" N 7˚ 2' 26" E	Faeces, polythene bag, garbage, decomposed food particles, plastic cans and bottles, etc	Above 3years

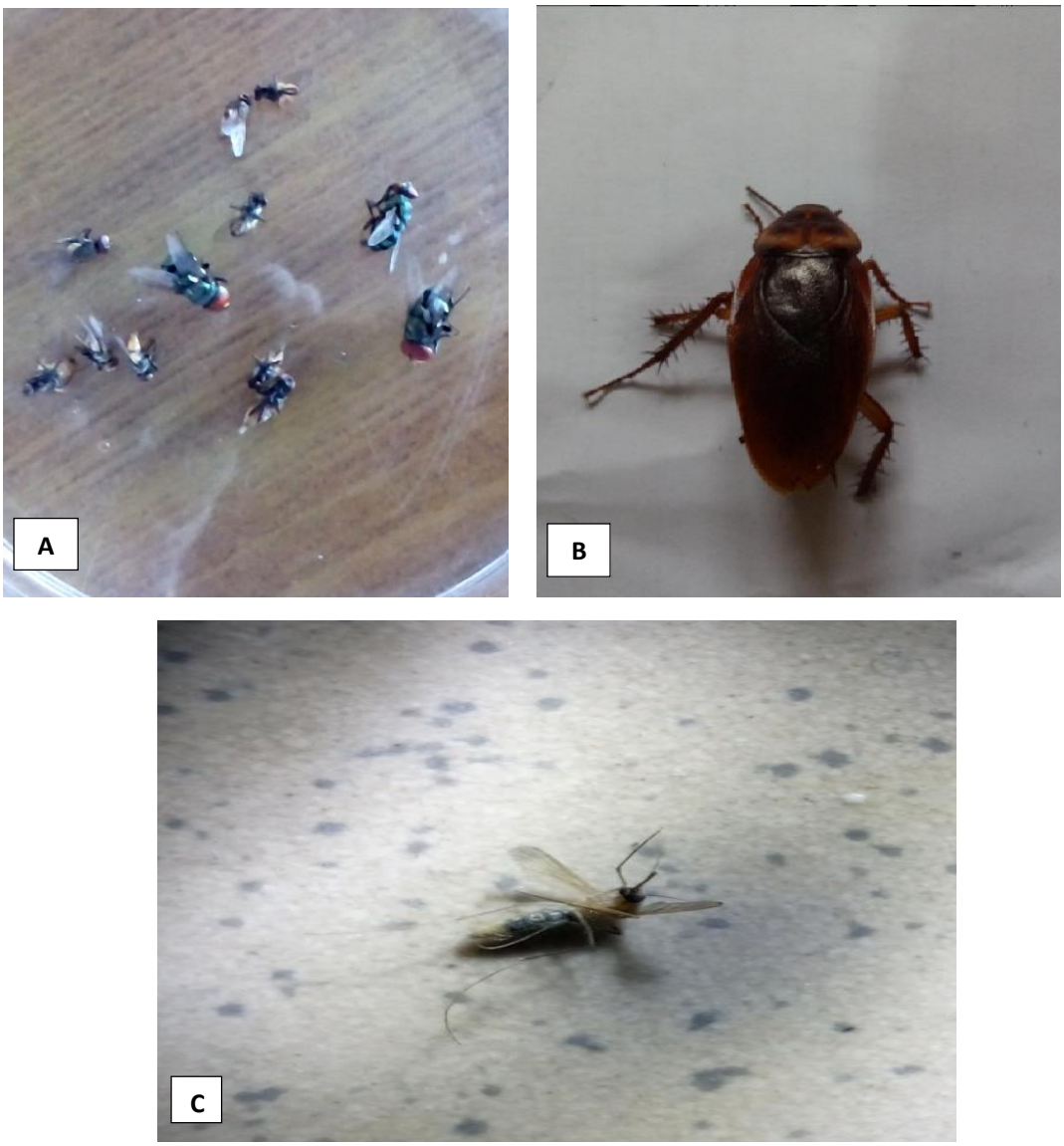

Plate 1. A: Housefly (Green arrow) and Blow fly (Black arrow) B: American cockroach C: Anopheles mosquito

Vector abundance: A total of 360 vectors of public health importance were collected from the eight dumpsites investigated (Table 2). The vectors collected and identified included *Chrysomya megacephala* (Family: calliphoridae), *Musca domestica* (Family: Muscidae), *Anopheles spp* (Family: Culicidae), *Aedes* (Family: Culicidae), *Periplanata americanus* (Family: Culicidae) and *Blatta orientalis* (Family: Blattidae) (Plate 1). Out of 360 vectors collected, 12.5%, 49.4%, 5.3%, 18.9%, 10.5% and 3.1% were *Chrysomya megacephale, M. domestica, Anopheles, Aedes, Periplanata americanus* and *Blatta orientalis* repectively (Table 1). The results also showed that dumpsite 4 (Alakahia Uniport) had the highest relative abundant number of vectors (20.6%), followed by dumpsite 1 (Timothy Nsirim road-18.9%), dumpsites 8 (Opp. Naval Medical centre, Borokiri-13.3%), dumpsite 2 (Obiri Ikwere airport road-13.1%), dumpsite 7(Timothy lane, Olara-11.1%), and dumpsite 5(Aprikom road-10.8%) (Fig. 2). There was no statistically significant difference ($P > 0.05$) in the prevalence of vectors in relation to the location of dumpsites investigated.

Table 2. Abundance of vectors in dumpsites

Vectors	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Total	%
Blow Fly (*Chrysomya megacephala*)	7	-	2	9	12	3	5	7	45	12.5%
Housefly (*Musca domestica*)	27	18	12	31	22	16	23	29	178	49.4%
Mosquito (*Anopheles*)	5	3	-	9	-	-	-	2	19	5.3%
Mosquito (*Aedes*)	16	17	6	11	5	-	6	7	68	18.9%
American Cockroach (*Periplaneta americana)*	4	9	3	14	-	-	6	3	39	10.8%
Oriental Cockroach (*Blatta orientalis*)	9	-	2	-	-	-	-	-	11	3.1%
Total vectors collected	68	47	25	74	39	19	40	48	360	
Relative abundance of vector collected per dumpsite %	18.9%	13.1%	6.9%	20.6%	10.8%	5.3%	11.1%	13.3%		100%

P > 0.05

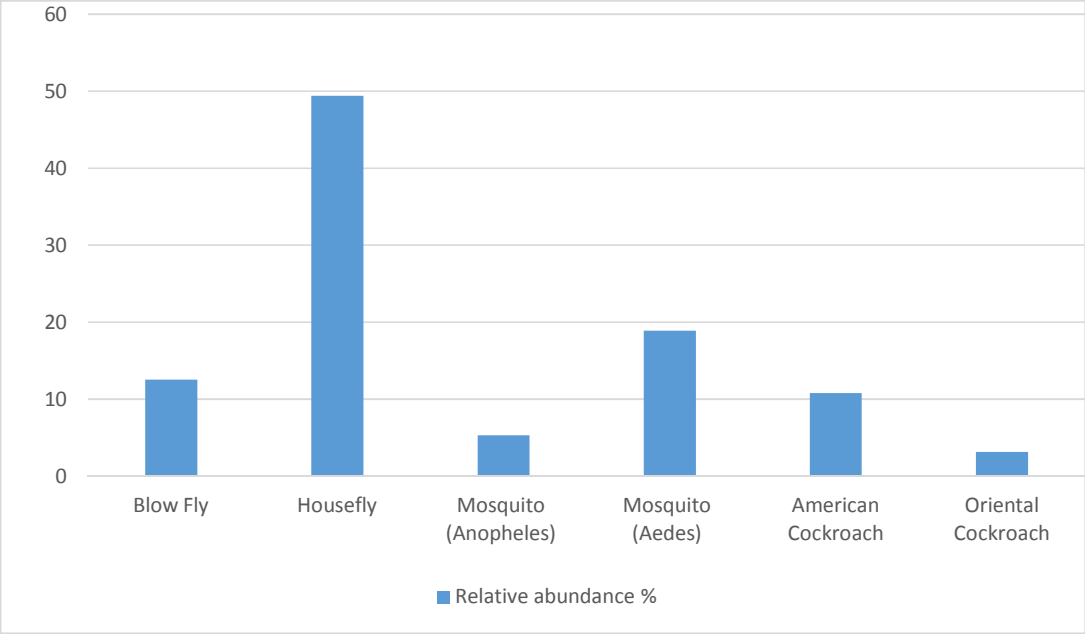

Fig. 2. Relative abundance of vectors

4. DISCUSSION

Vectors play very important role in the transmission of disease-causing microorganisms and in the absence of these vectors, the transmission of several diseases could be easily managed. The results of this study indicated that waste management strategies adopted by the Rivers State Waste Management and Sanitation Authority is faulty and has resulted in the indiscriminate breeding of disease vectors in non-evacuated refuse dumps and major dumpsites across Port Harcourt metropolis. Refuse dumps are observably visible on the median of virtually every major street in the metropolis.

All the dumpsites investigated had mixed composition ranging from household biodegradable waste, polythene bags and other plastic material, hospital/biomedical wastes, automobile and industrial waste to plant materials. This observation agreed with [13] that listed waste composition of dumpsites in Nigeria include the above materials.

In our study, a total of 360 vectors belonging to six genera were collected and identified (Table 2). *Musca domestica* (Plate. 1A) and *Chyssoma megacephala* occurred in all the eight dumpsites investigated. The abundance of *M. domestica* in all the dumpsites (Table 2) could be attributed to the fact that the insect is always linked with filthy places and decomposing substances [14]. Similar observation was recorded by Ahmed [15] in Kaduna town, Northern Nigeria. *M. domestica* (Family: Muscidae) was also the most prevalence vector in all the dumpsites and the insect has been implicated in the transmission of helminthic infections [16], protozoa infections such as *Gardia spp* [17,18], *Crystosporidium spp* [19] including bacteria such as *Escherichia spp, Salmonella Spp* and *Chlamydia spp* [20,21].

Chrysomya was also found in all the dumpsites visited. The prevalence of this vector could be as a result of the capacity of oviposition on dead organisms, a sure sight at all the dumpsite investigated [15]. Species of *Chrysomya* have been implicated in the transmission of myiasis.

Anopheles spp and *Aedes spp* (Plate. 1C) were the two genera of mosquitoes encountered in the dumpsites (Table 2). Similar results were obtained by Onyido et al. [12] and Ahmed [15] in Onitsha metropolis and Kaduna town respectively. The high prevalence of these mosquitoes in the area could be as a result of the presence of cans containing water and stagnant water within the dumpsite.

Other arthropods of public health importance collected from the dumpsites included *Perplanata Americana* (Plate. 1B) and *Blatta orientalis*

(Table 2). Similar result was obtained by Onyido et al. [12] at dumpsites in Onitsha. These species of cockroach have record of transmission of various disease-causing organisms including protozoa, viruses, helminthes and bacteria [21].

Generally, the results our study lends credence to [22] which placed Nigeria among countries without clear cut and workable frame work on sanitation, The report also pointed out that sanitation in Nigeria is at the house level which is not comprehensive enough to address the sanitation in Nigeria. Again, [23] recorded that although there is an increase in water supply and sanitation in other African countries like Ethiopia and Congo Democratic Republic, a substantial decline in water supply and sanitation from 32% in 1990 to 7% in 2015.

5. CONCLUSION

The results of our study indicated a high abundance of vectors that transmit parasitic diseases in dumpsites investigated. Considering the public health concern posed by refuse dumps especially when not evacuated and/ or treated, it becomes necessary for the government at all levels to initiate policies that will stimulate public awareness on the dangers of indiscriminate dumping of refuse and separation of waste materials.

It is also appropriate for the government through its relevant agencies to establish dumpsites with modern treatment facilities. Again, it is observably clear that the monthly sanitation exercise is not enough to keep Port Harcourt hence the introduction and empowerment of sanitation inspectors and health officers for regulation of the sanitary habit of Port Harcourt residence will go a long way to curb indiscriminate dumping of refuse on the median of the roads and other places not designated for refuse dump. Again, regular fumigation exercise of dumpsites will reduce the breeding of vectors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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