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Survey of Insect Vectors in Some Selected Dumpsites in Gombe Metropolis, Nigeria, Western Africa

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Authors' contributions

This work was carried out in collaboration among all the authors. Authors EA and MA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors YL, AR, AJ and KPY managed the analyses of the study and the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This study was conducted to determine the insect vectors living in refuse dumps at Gombe Metropolis in Gombe State of Nigeria.
Study Design: The metropolis were divided into four longitudinal zones, and in each zone three dumpsites were randomly selected. Visual observations were used to estimate the composition of the refuse dumps.
Place and Duration of Study: The study was conducted in Gombe metropolis of Gombe state between the months of May and August, 2018.
Methodology: Sweep nets, sticky traps, water traps and handpicking were used to collect different vector species. Specimen collected were preserved and transported to the laboratory for identification. Standard Identification keys were used for the identification of the vectors.
Results: The compositions of the refuse dumps varied from vegetable matter and animal remains to assorted materials including used tyres, electronic parts, cartons, faecal matter, broken bottles, polythene bags. A total of 464 insect vectors belonging to 9 species were collected. *Musca*

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domestica 282(60.8%) was the dominant species, followed by *Anopheles spp* 55(11.9%) and *Aedes species* 44(9.4%). *Periplaneta americana* accounts 37(8.0%) of the collections.
Conclusion: The thriving population of these vector species and the abundance of putrefying refuse dumps are risk factors of the endemic diseases transmitted by such vectors in the city. The present work therefore recommends the proper disposal of refuses to avert an epidemic status.

Keywords: Refuse dumps; nets; Musca domestica; Anopheles spp. Aedes spp; Periplaneta americana.

1. INTRODUCTION

Insects belong to kingdom Animalia and phylum Arthropoda. They are extremely diverse and play an important role in the ecosystem [1]. They have permeated the diverse and essential natural processes that uphold biological systems, making up over *75%* of known species of animals. Indeed, the present ecosystem may not function without insect [2]. Insect vectors are those playing a role in the transmission of a pathogen between humans or from animals to humans [3]. The pervasive ecological importance of this great variety of insect makes them valuable to assess disturbance or environmental impacts of various kinds [4]. Mosquitoes are responsible for transmission of pathogens causing some of the most life-threatening fever and filariasis [5]. Cockroaches are found in nearly all habitats: tropical and temperate forests, grassland, heath, steppe, salt marshes, coastal communities, and deserts [6]. The house fly is very common and is a cosmopolitan species which transmit diseases to humans. House flies often live among filth and garbage, and can carry the pathogens for dysentery, typhoid, fever and cholera [7,8]. Female flies deposit their eggs on decayed, fermenting or rotting organic material of their animal or vegetable origin. Garbage provide the main medium for breeding. The house fly *Musca domestica* is usually associated with decomposing substrate of solid urban wastes [9]. *Musca domestica* are also implicated in the transmission of bacteria such as S*almonella, Shigella, Campylobacter, Escherichia, Enterococus, Chlamydia* and many other species that caused illness [7]. Pokkala and Ponka [10] reported that *Musca domestica* visit human homes, crawl over food and household utensils, and deposit there pathogens. Their survival and capacity to transmit diseases are directly linked to putrefying solid wastes. The *Stomoxys calcitrans* have been reported to harbour a variety of pathogens that cause diseases in man and animals such as viruses, bacteria, protozoan, fungi, larvae and eggs of helminthes [11,12]. The cockroaches (family Balttidae) are known to feed on human faeces and transmit such diseases as *amoebiasis* caused by *Entamoeba histolytica* [13]. A study by Cotton et al. [14] showed that exposure to cockroach antigens may play an important role in asthma-related health problems.

Miller [15] defines waste as man's unwanted materials that need to be discarded. Waste has also been described as substances and materials which are disposed off or are required to be disposed off according to the provision of national law [16]. Dumpsites have been the most organized common methods of waste disposed and remain so in many places in the world [17]. Reported by Sarojini [18] every household produces certain amount of waste or refuse daily. If this refuse is thrown outside the house, the breeding of animals vectors becomes possible and this affects the health of community. Jung et al. [19] established that open dumping can reduce environmental quality, and pose a threat to public health. On the other hand, Babayemi and Dauda [20] reported that many countries in Africa do not have efficient waste collection and disposed service, what leads to both environment and health problems.

In Nigeria the sources of solid waste are commercial, industrial, agricultural and educational establishment. The consequences resulting from improperly managed waste include its serving as reservoir of pathogens, habitat for pest such as rats, flies and mosquitoes, reduction of usable land area of the society, obstruction of motorable roads and general nuisance and societal problems in residential areas [21]. Open dump of solid waste is a common practice in Nigeria while some employ the service of stream to transport their solid waste out of sight, sometimes directly dumping their solid waste by the roadsides. However, in some part of Nigeria, refuse is generally buried, though some heedless burning is sometime observed [22]. Ahmed [23] reported that Kaduna metropolis is littered with refuse dumps. The predominance of houseflies, mosquitoes and

cockroaches in Ijebu-ode points to the possible mechanical transmission of disease [24].

All the eleven species of insects encountered in this study are closely associated with humans and human generated waste. Despite the significant role that insect play in transmission of disease and their abundance in the environment, only limited information about the species of insect commonly found in dumpsites in Gombe metropolis is available. Consequently, it is required to survey insect vectors in some selected dumpsites in Gombe. The present study identified insect vectors inhabiting dumpsites in Gombe metropolis, Northeastern Nigeria.

2. MATERIALS AND METHODS

2.1 Study Design

The study was conducted in Gombe metropolis, Gombe State Nigeria. The metropolis is located between latitude 12°8' and 10°24' N longitude 11°22 and 11°24' E. Altitude 500 meters above sea level. Gombe city has over one hundred refuse dumps scattered all over the metropolis. The studied sites were selected based on random selection. The metropolis were divided into four longitudinal zone and in each zone three dumpsite were randomly selected. The location were Jekadafari, Orji Quarters, Tumfure, Herwagana, Bolari, Madaki, Tudunwada, Arawa, Kagarawal, Kanayel, Nassarawo and Usman Farouk Quarters.

The locations and composition of the refuse dumps studied are shown in Table 1. The refuse varied in their compositions according to human activities in the area.

The following methods were used for vector collection: Sticky traps, water traps, sweep nets and handpicking method as prescribed by Onyido et al. [25].

Sticky traps: The sticky traps were used for trapping smaller insects and cockroaches. The sticky trap was designed with plywood of about 60cm length, 40 cm breadth and 2 cm thickness. The surface of the plywood was coated with grease and was placed on the surface of the refuse so that the insects were caught when they crept into or were blown onto the sticky surfaces by wind.

Water traps: The water traps were made using plastic buckets of five liters, which were almost filled with water. Detergent was added to the water to reduce surface tension and enhance wetting of the insects.

Sweep net: This was used for catching mosquitoes, houseflies and other flying insects. The sweep nets were made with mosquito net and metal rods to form the rim and a wooden handle.

An average of about 20 sweeps were carried out at a dump between 8.00am and l0.00am in the morning for a better catch.

Hand picking: This was used for catching cockroaches.

Samples were collected in the morning between 8-10 am.

Preservation and Identification: Cockroaches, houseflies and other animals were kept in specimen bottles containing 70% ethanol, while mosquitoes were kept in a Petridish containing filter paper placed over moist cotton wool. And were taken to Zoology Laboratory, Gombe State University for Identification using insect atlas and Identification Keys [26,27].

3. RESULTS AND DISCUSSION

3.1 Results

The locations and composition of the refuse dumps studied are shows in Table 1.

Figs. 1-5 highlight the cross-section of some selected dumpsites where the insects vectors were collected.

Table 2 shows the different species of insect which were collected from different refuse dumps. Nine different species were collected from different refuse dumps and also the species of insect varied in the different refuse dumps *M. domestica*, *Anopheles spp and P. americana* are collected in all the study sites.

Table 3 shows the different insect species collected using different method. Mosquitoes and some flies were collected using sweep nets, while cockroaches were collected using sticky trap and hand picking. Most of the flies were collected using water trap. Most of the insects were collected using water trap which has (59.9%), followed by sticky trap (30%), and then, sweep net (9.3%). Handpicking has the least percentage (0.8%) which shows that only few insects were collected using this method.

Table 1. Location and composition of different refuse dumps at Gombe metropolis

Locations	Descriptions	Composition of refuse dump
Jekadafari	High density area, poor planning and poor drainages inhabited by traders, top and low civil servants.	Used cans, vegetable matters, disposable cups, pots and plates, broken dishes, polythene bags, plastics, papers, old tyres etc.
Orji quarters	Residential homes, mostly civil servant and student with good drainage system.	Household garbage, pieces of clothing, broken bottles, and polythene bags etc.
Tumfure	High density area, better planned and blocked drainage with both commercial and residential buildings.	Used can, household garbage, polythene bags, plastics, broken bottles, empty tins and old tyers etc.
Herwagana	High density area with poor drainage and poor planning, mostly inhabited by traders, schools and residential houses.	Household garbage, empty cartons, pieces of clothing, vegetable matters, polythene bags, and old tyers.
Bolari	High density area with poor drainage and poor planning, inhabited by traders and low civil servant.	Faecal matter, vegetable matter disposable pots and plates, broken dishes, polythene bags and plates, broken dishes, polythene bags etc.
Madaki	High density area with poor drainage and poor planning, mostly inhabited by low civil servant and some traders	Faecal matter, household garbage, disposable pots plates and cups, polythene bags, plastics metals, used tyers, pieces of clothing, broken bottles etc.
Tudunwada	High density area with poor drainage and poor planning, inhabited by both low and top civil servant and traders	Vegetable matters, polythene bags, used tyres, faecal matter, disposable pots, cups and plates broken dishes.
Arawa	High density area with poor drainage and poor planning, inhabited by both top and low civil servant and some traders	Faecal matter, household garbage, polythene bags, broken wooden furniture's, disposable cup sand plates, used tyers, broken bottles, pieces of clothing etc
Kagarawal	High density area with poor drainage and poor planning, open defecation, inhabited by traders and low civil servant	Faecal matter, household garbage, old tyers, Polythene bags, plastics, broken bottles, broken dishes, disposable cups, plates and ports etc.
Nassarawo	High density area, poor planning and poor drainage inhabited by both low and top civil servant and traders	Used tyers, faecal matter, food waste, polythene bags, plastics, household garbage vegetable matters etc.
Usman faruk quarters	High density area poor planning and poor drainage inhabited by traders and civil servant	used can, vegetable matters, disposable cups, pots and plates, broken dishes, polythene bags, plastics, papers, old tyres, faecal matters etc.
Kanoyel	High density area with poor drainage and poor planning, inhabited by both low and top civil servant and traders	Vegetable matters, polythene bags, used tyres, faecal matter, disposable pots, cups and plates broken dishes.

Table 2. Insects collected from different refuse dumps

Locations	Vector species								
	Anopheles spp.	***Aedes spp.***	***Culex spp.***	***M. domestica***	***F. scalaris***	***S. alcitrans***	***O. lencostoma***	***P. americana***	***S. longipalpa***
Kagarawal	5	4	2	16	4	-	-	6	2
Herwagana	4	4	-	13	-	1	-	3	-
Orji Quarters	3	1	1	12	-	1	-	2	-
Bolari	3	7	1	36	2	1	-	4	4
Usman Faruq Q.	5	3	2	17	1	-	-	4	-
Arawa	7	2	1	22	-	-	-	2	-
Tudunwada	8	4	2	18	1	-	-	2	-
Tumfure	3	4	3	16	-	-	-	2	-
Madaki	6	2	2	48	2	-	-	4	3
Nassarawo	2	7	1	6	-	-	-	2	2
Jeka fari	3	4	2	14	-	3	1	2	-
Kanoyel	6	2	-	64	-	-	1	4	-
Total	55	44	17	282	10	6	2	37	11
Percentage	11.9	9.4	3.7	60.8	2.1	1.3	0.4	8.0	2.4

Fig. 1. Madaki dumpsite

Fig. 2. Nassarawo dumpsite

Fig. 3. Jekadafari dumpsite

Fig. 4. Arawa dumpsite

Fig. 5. Herwagana dumpsite

Table 3. Insect collected using different method

Vectors species	Hand picking	Water trap	Sticky trap	Sweep net	Total	Percentage
Anopheles spp.	-	-	-	55	55	11.9
Aedes spp.	-	-	-	44	44	9.4
Culex spp.	-	-	-	17	17	3.7
M. domestica	-	259	-	23	282	60.8
F. scalaris	-	10	-	-	10	2.1
S. calcitrans	-	6	-	-	6	1.3
O. lencostoma	-	2	-	-	2	0.4
P. Americana	4	-	33	-	37	8.0
S.longipalpa	-	-	11	-	11	2.4
Total	4	277	34	139	464	
Percentage	0.8	59.9.	9.3	30.0		100%

3.2 Discussion

The identified dumpsites in this study are at varying decomposing stages. This is perhaps an indication of poor sanitary condition in the town. [28] noted that the greatest challenge to the environmental health are those of municipal solid waste and human excreta. The negative effect of uncontrolled dumping of wastes in developing countries has been a great threat to public health [29,25]. The composition of the dumpsites in this study agrees with that of Onyido *et al.,* (2009). Reports of [30] from Bangalore highlighted the danger of waste disposal sites in the spread of diseases to people living in the immediate vicinity. [10] observed that waste increase the incidence of cancer and asthma in houses built in sites that have been previously used as refuse dumps. Moreso, [31] highlighted that refuse dumpsites constitute a habitat for vectors and nuisance organisms that are capable of acting as transmitters of diseases. Nine (9) insect species including *M.domestica, P. americanus, Aedes spp, Culex spp, Anopheles spp, F. scalaris, S. calcitrans, O. lencostoma and S. longipalpa* were collected from the dumpsites. *M. domestica*, was the most abundant species collected. This finding agree with that of [32], where they reported the high frequency of *M. domestica*. This indicates the probable endemicity of diseases transmitted by these vectors in the city as the environmental conditions (warm humid climate), etiological sources of infection (faecal materials in the refuse) and human population for the maintenance of infections abound. Out of the nine species collected *M. domestica* and *P. Americana* were encountered in all the study sites, this also agree with that of [24]. The predominance of houseflies and *P. americana* revealed possible mechanical transmission of diseases. Apart from *M. domestica, Anopheles species* are the most abundant species of insect collected in the survey sites; this also corresponds with the finding of [24], where they reported the relative abundance of mosquitoes breeding in the water holding containers found in the refuse dumps as an indicative that malaria and other mosquitoes borne diseases will be prevalent in the area. On the other hand, this disagree with the result of [23], where they stated that *Aedes* mosquitoes, the vector of yellow fever were the only species encountered in their study. A possible reason for their absence could be the absence of water holding containers for the female to lay eggs.

4. CONCLUSION

This study revealed that the undisposed dumpsites in the metropolis house numerous insect vectors. Abundance of these insect vectors in the different dumpsites is worrisome. There is a need of intense public health education in Gombe metropolis especially concerning the numerous common insect vectors and their role in the transmission of pathogens to humans. Proper management of waste is particularly necessary. Waste recycling is a good alternative of waste management. Households should be encouraged to dispose their dumps appropriately to minimize incidence of epidemics of diseases.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Ethical approval was obtained from the Ethical Committee, Department of Biological Sciences, Gombe State University.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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