Original Research Article

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

ABSTRACT

Aim: This study was conducted to determine the insect vectors found in refuse dumps at Gombe Metropolis in Gombe State of Nigeria.
Study Design: Visual observations were used to estimate the composition of the refuse dumps. Twelve refuse dumps were randomly selected based on the longitudinal zone. The metropolis were divided in to four longitudinal zone and in each zone three dumpsites were randomly selected.
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.
Result: 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 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 endemicity of diseases transmitted by the vectors in the city. This work therefore recommend the proper disposal of refuse to avert an epidemic status.

Keywords: Insect; refuse dumps; nets; Musca domestica; Anopheles spp. Aedes spp; Periplaneta americana; Gombe.

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 understood to be insect that play 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 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 on their feed and mouth parts. [7, 8]. Female flies deposit their eggs on decayed, fermenting or rotting organic material of

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their animal or vegetable origin. Garbage provide the main medium for breeding. The house fly *Musca domestica* are usually associated with decomposing substrate of solid urban wastes [9]. *Musca domestica* are also implicated in the transmission of bacteria such as *salmonella, shigella, campylobacter, Escherichia, Enterococus, Chlamydia* and many other species that caused illness [7]. [10] reported that *Musca domestica* breed and frequently visit human homes where they crawl over food and household utensils depositing the pathogens as they do. 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, protozon, fugi, 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 [14] showed that exposure to cockroach antigens may play an important role in asthma-related health problems.

[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 [18] every household produces certain amount of waste or refuse daily. If this refuse is thrown outside the house, it encourage the breading of animals vectors spread many disease, there by affecting the health of community. [19] established that open dumping has potential to reduce environmental quality in neighborhood and can also pose a threat to public health, the environment and even scavengers that depends on scavenging materials for their livelihood. On the other hand, [20] reported many countries in Africa do not have efficient waste collection and disposed service, which often result in both environment and health problems for the people.

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, some directly dump their solid waste by the roadsides. However, in some part of Nigeria, refuse is generally buried, though some heedless burning is sometime observed [22]. [23] reported that investigation reaffirmed 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. This necessitate the need to survey insect vectors in some selected dumpsites in Gombe. This study identied insect vectors inhabiting dumpsites in Gombe metropolis, Northeastern Nigeria.

2. MATERIAL 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 11^0 22 and 11^0 24'E. Altitude 500 meters above sea level. Gombe city has over one hundred refuse dumps scattered all over the metropolis. The study site 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 below. The refuse varied in their compositions to human activities in the area.

Methods of Vector Collection: The following methods were used for vector collection: sticky traps, water traps, sweep nets and handpicking method as prescribed by [25].

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Sticky traps**:** The sticky traps were used for trapping smaller insects and cockroaches. The sticky trap was designed with plywood of about 60cm length, 40cm breadth and 2cm 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 8-10am.

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].

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3. RESULTS AND DISCUSSION

3.1 Results

The locations and composition of the refuse dumps studied are shows in the table one (1). The refuse varied in their compositions to human activities in the area.

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	Used can, household garbage, polythene bags, plastics, broken

	with both commercial and residential buildings.	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.

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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	Faecal matter, household garbage, polythene bags, broken wooden furniture's, disposable cup sand

	civil servant and some traders	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	High density area poor planning	used can, vegetable matters,

QUARTERS	and poor drainage inhabited by traders and civil servant	disposable cups, pots and plates, broken dishes, polythene bags, plastics, papers, old tyres, faecal matters etc.

The table below show different species of insect that are 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 2: Insects collected from different refuse dumps

LOCATIONS	**VECTOR SPECIES**								
	Anopheles spp.	*Aedes spp.*	*Culex spp.*	*M. domestica*	*F. scalaris*	*S. calcitrans*	*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	-

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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

The table (Table 3) below show 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 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

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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

Many indiscriminate refuse disposals at varying decomposing stages were observed within Gombe metropolis. This is perhaps an indication of poor sanitary condition in the town. [28] noted that the greatest challenge to the environmental health in Anambra State and indeed Nigeria 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). Worth mentioning are the reports of [30] from Bangalore who 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; [31] who highlighted a high frequencies of toxic mathemoglobinemias in people living in the vicinity of refuse dump sites 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 that *M. domestica,* as a notorious mechanical transmitter of filth disease especially cholera, amoebiasis, typhoid and helminthiases was the most abundant species collected. This indicates the probable endemicity of such diseases 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 disease. Apart from *M. domestica, Anopheles species* are the most abundant species of insect collected in the survey site this also agree 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 disagree, 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

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on the role of the common insect vectors in the transmission of pathogens to humans. Proper management of waste is critical. 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.

COMPETING INTERESTS

All Authors have declared that no competing interests exist.

ETHICAL APPROVAL

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

CONSENT

It is not applicable.

REFERENCES

1. Finnamore, A.T. (1996). The Advantages of Using Arthropods In Ecosystem Management A Brief From The Biological Survey Of Canada (Terrestrial Arthropods) Upp. Http://Www.Wikepedia.Org/Spread.
2. Wiggins, G.B, S.A. marshal, and J.A Duwnes. (1991). The Importance of Research Collections of Terrestrial Arthropods. A Brief. *Bulletin of the Entomological Society of Canada* 23 (2) Supplement. 16pp.
3. WHO. (2001). Weekly Epidemiological Reachrd, Vol. 76, No 25, Zool.
4. Lehmkuhl, D.M., H .V Danks, V.M behanapelletier, D.Y Larson, D.M Rosenbergi and I.M Rosembergi and I.M Smith. (1984). Accommodations for the Appraisal of Environmental Disturbance: Some General Guide Lines and the Value and Feasibility of Insect Studies. A Brief. Bulleting of the Entomological Society of Canada 16(3), Supplement 8pp.
5. Larissa, E. Collins and Alison Blackweel (2000). The biology of Toxorhyn chites Mosquitoes and Their Protential as Bio Control agents. Departments of Biological Sciences, University of Dundee, UK Vol. Uno 4. 105 N – 116N.
6. Roth, L. M. (2003). Blattodea (Cockroaches). In Grzimek is Animal Life Encyclopedia. Vol. 3.M Hytchins, D.A Thoney, and M.C. Mc Dade, Editors. Gale, Detroit. 147-159.
7. Service, M. (2012). Medical Entomology for Students. Fifth Edition. Cambridge University Press. The Eidinburge Building Cambridge, UK p. 303.
8. Sarwa, M. (2014). Defeating Malaria with Preventative Treatment of Disease and Deterrent Measures against Anopheline Vectors (Diptera: culiadge). *Journal of Pharmacology and Toxicological Studies, 2(4): 1-6.*
9. Morales, G.M & Wolf, M. (2010) Insect Associated With Composting Process of Solid Urban Waste Seperates at the Source. Revista Brasileira de Entomological 54 (4): 645-653.
10. Pokkala, E. and A. Ponka, (2001). Increase Incidence of Cancer and Asthma in House Built on a Former Dump Area. Source. Environmental Health Perpect; 109 (11): 1121-1125.
11. Philpoot, M. Ezeh, A.O. (1978). The Experimental transmission by Musca and Stomokeys Species of D. Congolensis Infection between Cattle. British *Veterinary Journal 1*34 (6): 515 – 520.

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12. Ogbonna, D. N., I. Ekwezor and F.U. Igwe, (2002). Waste Management: A Tool for Environmental Protection in Nigeria. Ambio, 31 (1): 55-57.
13. Rao, C.K.A.: Krishnaswani, K.: Gupta, S.R.: Biswass, H. &Raghavan I.N.G. (1971) Prevalence of Amoebiasis and other Intestinal Parasitic Infections in a Selected Community. *Indian Journal of Medical Research 59: 1365-1373.*
14. Cotton, M.F; Wasserman, E; pieper, C.H.; C.H.; Theron, D.C.; Van Tubbergh, D.J Campheli, a.i Fang, F.C & Barnes, J. (2000). Invasive Diseases Due to Extended Spectrumbeta-la Ctamase Producing Klebsiella pneumoniae in Neonatal Unit: The Possible Role of Cockroaches. *Journal of hospital infections* 44 (1): 13-7.
15. Miller, G.T. (1994). Living in the Environment: Beement, California Wads Worth Publishing Company: 78-83.
16. Adegoke, (1990). Wastea Management within the Context of Sustainable Development. In Aina and adedipe (eds). The Making of the Nigerian Environmental Policy, FEPA Monograph. Pp 103-117
17. El-fadel. M., Findikakis. A.N.and Leckie. J.O. (1995). Environmental Impacts of Solid Waste Land Filling, *Journal of Environmental Management*.
18. Sarojini, T.R., (2005) Refuse Disposal. 3rd Edn., ATP Africana First Publishers Ltd., Owerri, Nigeria, pp: 1-528
19. Jung. H; Mastuto.T. and Tanakaim (2005). Behavior of Metals in ash Melting and Gasification- Melting of Municipal Solid Waste (MSW). Waste Management 25.pp.301-310.
20. Babayemi. J.O. and Dauda. Kit. (2009). Evaluation of Solid Waste Generation Categories and Disposal Options in Developing Countries, A case study of Nigeria. *Journal of applied science and environmental management* 14-(1):83-88.
21. Oyedele, O. (2009). Solid Waste Management as Engine for Industrial Development in Nigeria.
22. Igoni, A.H., M.J Ayotamuno, S.O.T. Ogaji and S.O. Probert, (2007). Municipal solid waste Management in Pathercout. *Nigeria Appl. Energy. Elservier*, 84(6): 664-670.
23. Ahmed, A. B. (2011) Insect Vectors of Pathogens in Selected Undis posed Refuse Dumps in Kaduna town *Northern Nigeria J. Sc.* Vol. 6 (No. 4).
24. Banjo, F.M., Banjo, A.D., and Fasunwon, 'B.T., (2012). Survey of Arthropod Associated with Refuse Disposal Sites in Ijebu-Ode, Ogun State. *Journal of Science* 4 (4); 381-384.
25. Onyido, A.E. Okolo, P.O., Obiukwu, M.O and Amadi, E.s (2009) A Survey of Vectors of Public Health Disease in Undisposal Refuse Dumps in Awka, Anambra State South Eastern Nigeria *Research Journal of Parasilogy*;; 4 (1): 22-27.
26. Folsom, Justus Watson. 1922. Entomology with Special References to its Ecological Aspects. 3rd Edition. P. Blakiston's Son & Co, Philadelphia.
27. Borror, Donald J., Charles A. Triplehorn, and Norman F. Johnson. 1989. An Introduction to the Study of Insects. Harcourt Brace College Publishers, New York.
28. Obionu, C. N. (2004) Sustainable Health Environment: The Challenge of our time. Proceeding of the Annual Conference of EHOAN, Nov. 8-10 Anambra State Chapter held at Ikenga Hotels Awka.
29. Siboe. G.M; Kimetti and C. Bii, (1996). The Role of Air-borne Fungal Shoves from Garbage Dump in Respiratory Disease. *Afriy Health Sci; 3:* 74-76.
30. Lakshmikantha, H. (2006). Report on waste dump sites around Bangalore. *Waste Management 26:*640-650.
31. Pach, J.; Kamenczak, A. & Panas, M. (1996). The frequency of toxic metnemoglobinemias in people living in the vicinity of refuse dumps in Barycz. *Przegl Lek, 53:* 348-350.
32. Onyido, A.E., Azubuike, J., Amadi, E.S., Obiukwu, M.O., Ozumba, N.A and Ikpeze, O.O. (2011) A Survey of Public Health Disease vectors Breeding in Refuse Dumps

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in Onitsha Metropolis, Anambra State Nigeria. *New York Science Journal*: 4(9): 34-39.

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