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## Research Article

# Prevalence and Health Implication of Macro-faunae in Selected Refuse Dump Sites in Umuahia Metropolis, Abia State, South-East Nigeria

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## Abstract

**Background and Objectives:** Refuse dump site (RDS) are considered refugia for a myriad of medical and ecological important micro-faunae. A survey of selected refuse dump sites was conducted in Umuahia metropolis to determine the prevalence and effect of macro-faunae. **Materials and Methods:** Two RDS were selected from Ibeku and Umuahia main in Umuahia North and from Olokoru and Aba road in Umuahia South Local Government Areas (LGAs) of Abia State, South east Nigeria. Different methods were adopted to collect samples namely: handpicking, water and net traps. Collected samples were identified in the Laboratory of Zoology and Environmental Biology, Michael Okpara University of Agriculture, Umudike after sorting by means of a hand lens, pictures and a taxonomic key and their abundance determined. Paired sample t-test was used to compare species population of the two LGAs. **Results:** Six families (Muscidae, Culicidae, Blattidae, Lumbricidae, Blattellidae and Chironomidae) were recorded. *Musca domestica* (50.8%) was the most abundant species of the total (81) organisms caught while the least was *Lumbriscus terrestris* (2.4%). Water traps captured the highest (55.5%) number of the organisms irrespective of species and location whereas handpicking caught 2.4%. More macrofaunae were caught in Umuahia North (45) compared to Umuahia South (36) but were not significantly ( $p > 0.05$ ) different. To elicit data on public health and methods of waste disposal, 100 copies of structured questionnaires (i.e., 25 copies/LGA) were distributed to the residents around the dumpsites visited. Statistical descriptive method was applied to generate data on frequency, percentages and means. **Conclusion:** The predominance of houseflies and mosquitoes in the RDS appear to be the reasons for high prevalence of vector-borne diseases in the metropolis.

**Key words:** Arthropods, dump sites, environment, macro-faunae, prevalence, Umuahia metropolis

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**Competing Interest:** The authors have declared that no competing interest exists.

**Data Availability:** All relevant data are within the paper and its supporting information files.

## **INTRODUCTION**

Approximately 2 million tonnes of the 7-10 Mt of waste generated globally are categorized as municipal solid waste<sup>1</sup>. ISWA<sup>1</sup> also reported that the world's 50 biggest dumpsites affect the daily lives of 64 million people, therefore, there is no gain saying the fact that wastes and by extension dump sites have become a global problem<sup>1</sup>. According to UNEP<sup>2</sup> report, poorly managed waste like excreta, household solid and liquid wastes pose serious health risks that may lead to spreading of diseases.

In Nigeria, the quantity of the solid wastes generated is enormous, with an average household rate<sup>3,4</sup> of 0.44-0.66 kg/capita. Previous studies provide evidence that macro-fauna act on the wastes thereby putrefying it to the extent that they begin to constitute nuisance such as, offensive and malodorous odour, transmission of diseases and pollution of the environment<sup>5,6</sup>. So many diseases such as, malaria, typhoid, cholera, diarrhea, trypanosomiasis, paratyphoid fever, hepatitis B, dysentery, onchocerciasis etc. can be attributed to their infestation or presence in dumpsites<sup>7</sup>. According to Adegoke<sup>8</sup>, most industries in Nigeria do not treat their liquid effluents before discharging them into open gutters, drains etc. Most industries dump their solid wastes in heaps within their premises and discharge gaseous emissions and particulate matter freely into the atmosphere.

In municipal areas such as Umuahia, refuse disposal is the responsibility of the public health authorities, which comes under the Ministry of Health<sup>9</sup>. All these wastes are then collected by the agency using waste compression trucks which reduces the volume of the waste by compaction before moving them to the landfill at Umuahia-Aba high way near Ubakala.

Residential homes purchase plastic bins of about 250 L while shops are expected to have bins of sizes ranging from 15-50 L depending on the volume of waste generation. In the municipal waste generated in Umuahia, 2% of wastes are from individuals, 6% from households, 12% from corporate bodies and 80% from markets<sup>10</sup>.

Given the high consumption rate in Nigeria and with a population of over 170 million, the amount of waste generated daily can only be imagined. Umuahia, which is a miniature Nigeria, is challenged with the control and management of solid waste. First, due to population surges giving rise to overcrowding and pressure on available facility and infrastructure, second, the indigenes of Umuahia

metropolis are mindful of the quality of food they eat and the water they drink but they think less of their waste and how it should be properly disposed.

The disposal of wastes is irregular and inefficient in Umuahia metropolis. Litters and wastes often accumulate along roads and public places creating breeding grounds for some arthropods and rodents responsible for the spread of many diseases. Statistics have shown that nearly 25% of all deaths and disease burden can be attributed to these organisms which underscore their importance to public and environmental health. Furthermore, information on the composition and quality of solid waste from this location is critical in designing and implementing a sustainable waste management program. This has spurred the need to examine the incidence of commonly found macro-fauna in dump sites and their impacts on the residents. A survey was therefore, conducted on selected dumpsites in Umuahia to characterize the macro-fauna present with a view to providing baseline information on the impact of their activities on public health in Umuahia.

## **MATERIALS AND METHODS**

An assessment of selected dumpsites was conducted between February and June, 2016 to determine the identity, incidence and health issues attributable to the activities of macro-fauna inhabiting them in Umuahia metropolis of Abia State.

**Research Location and population:** Umuahia metropolis of Abia State on the latitude (5°31'29.68"N) and longitude (7°29'40.60"E) comprise of Aba road, Umuahia main, Olokoru and Ibeku with a population of 359,230 persons according to the 2006 National Population Census<sup>11</sup>.

### **Research instrument**

**Questionnaires:** Two methods were adopted to collect data in this research, a structured questionnaire and personal observations/interviews were used to determine the impact on the public health.

Four locations within the study area were demarcated and 100 copies of questionnaire were distributed thus: Aba road (25 copies), Umuahia main (25 copies), Olokoru (25 copies) and Ibeku (25 copies). Officers of Abia State Environmental Protection Agency (ASEPA) and Department of Pollution Control, Ministry of Environment, Abia State and people living around the study area were interviewed.

**Trapping:** The traps were buckets half-filled with water to capture crawling insects while net traps were nailed to sticks which was spread on the dumpsites to catch flying insects. Ten sweeps were made every week. The macrofaunae were preserved in a jar containing 70% ethanol. Hand gloves were used to protect hands and forceps were used to collect other organisms like earthworm.

**Data collection and statistical analysis:** The dumpsites were visited weekly to collect data of trapped arthropods. The samples were collected and taken to the laboratory for sorting, identification using pictures (including marching samples with referenced works from the internet) and taxonomic keys to their genera. Data collected were analyzed using descriptive statistics (frequency, percentage and means) to generate summaries and tables. Student's t-test was used to compare species populations of the two LGAs using Analysis TolPac (MSEXcel, 2010 version).

## RESULTS

The distribution of macrofaunae at different locations in Umuahia North and South is presented in Fig. 1. Higher number of houseflies (8 and 6) and midges (7 and 5) were trapped at Umuhia main and Aba road, respectively. In Ibeku, higher number of mosquitoes (6) were trapped and Olokoro trapped higher number of cockroaches (7). However, there were no significant ( $p \leq 0.05$ ) differences between their means.

Characterization and prevalence of macro-fauna collected from the dumpsites visited in Umuahia metropolis are presented in Table 1. The total number of macro-fauna collected from all the sites during sampling was 81 in 4 families (Culicidae, Blattidae, Chironomidae and Muscidae) and six different species. Diptera were the most abundant group, most of which were trapped while foraging for mate, oviposition site, or were accidentally caught. The least abundant group was earthworms.

Table 2 shows the efficiency of methods of trapping. A total of 81 macrofaunae were trapped irrespective of the method used. Proportion of macrofaunae caught was water trap (55.6%), net trap (41.9%) and hand picking (2.5%).

Irrespective of trap used, houseflies were the most prevalent (41.0), followed by mosquito (22.0) and the least was earthworm (2.0). The correlation coefficient for the association between means number of macrofaunae trapped in surveyed sites in Umuahia north and Umuahia south was positive, but not significant.

Table 3 presents the socio-economic characteristics of respondents residing around surveyed RDS in Umuahia metropolis. Most of the respondents are male (63%) and 55% of them are between 26 and 45 years. Educational background of the respondents was also high with 70% with WAEC certificate and higher qualifications.

Table 4 shows the handling and management of solid waste in surveyed communities in Umuahia. Most of the respondents burn (21%), their waste, or take to designated sites (47%) or await collection by ASEPA (10%). However, collection of solid waste is poor in the survey communities since 78% of the respondents reported that dumped waste are not collected or the frequency is very poor resulting in the poor and very poor assessment of their sanitary condition (67%).

Table 5 shows the macro-fauna associated with residence and their health status around dump sites in Umuahia metropolis. Houseflies and mosquitoes (61%) were the predominate species caught in the communities, followed by cockroaches (20%). Of the other invertebrates, earth worms and leeches (72%) were most prevalent.

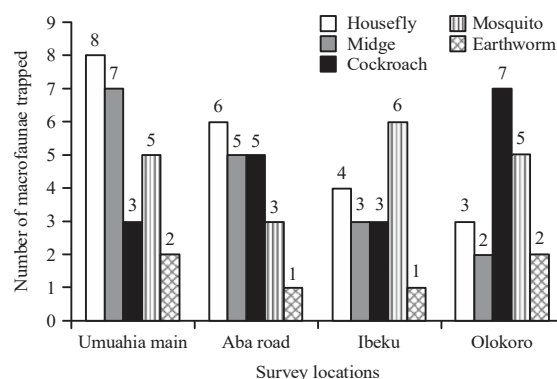


Fig. 1: Distribution of macrofaunae at different locations in Umuahia (February to June, 2016)

Table 1: Characterization and prevalence of macrofaunae collected from the surveyed refuse dumpsites

Species of macrofaunae	Family name	Ordinal name	Common name	Prevalence (%)
<i>Aedes</i> spp.	Culicidae	Diptera	Mosquito	27.1
<i>Lumbriscus terrestris</i> (Linnaeus, 1758)	Lumbricidae	Haplotaxida	Common earthworm	2.4
<i>Periplaneta americana</i> (Linnaeus, 1758)	Blattidae	Blattodea	Common cockroach	3.7
<i>Blattella germanica</i> (Linnaeus, 1767)	Blattidae	Blattodea	German cockroach	
<i>Chironomus plumosus</i> (Linnaeus, 1758)	Chironomidae	Diptera	Buzzer midge	16.0
<i>Musca domestica</i> (Linnaeus, 1758)	Muscidae	Diptera	Housefly	50.8

Table 2: Efficiency of methods of trapping macrofaunae at surveyed refuse dumpsites

Macro-faunae	Water trap	Net trap	Hand picking	Total	Percentage
Houseflies	20.0	21.0	0.0	41.0	50.6
Mosquito	12.0	10.0	0.0	22.0	27.2
Midges	10.0	3.0	0.0	13.0	16.1
Cockroaches	3.0	0.0	0.0	3.0	3.6
Earthworm	0.0	0.0	2.0	2.0	2.5
Total	45.0	34.0	2.0		
Percentage	55.6	41.9	2.5		

Table 3: Socio-economic characteristics of respondents residing around surveyed refuse dumpsites

Residence in Umuahia	Frequency
Yes	100
<b>Community of residence</b>	
Olokoro	25
Ibeku	25
Aba road	25
Umuahia main	25
Total	100
<b>Gender</b>	
Male	63
Female	37
Total	100
<b>Range of age</b>	
18-25	16
26-35	40
36-45	18
46-55	9
56-65	10
>66	7
Total	100
<b>Occupation</b>	
Trader	28
Civil servant	20
Student	16
Laborer	12
Farmer	14
Artisan	4
Unemployed	6
Total	100
<b>Level of education</b>	
No formal education	14
FSLC	16
WAEC	30
OND	13
BSC/BA/HND	22
PG	5
Total	100

FSLC: First school leaving certificate, WAEC: West Africa Examination Council, OND: Ordinary national diploma, BSc: Bachelor of science, BA: Bachelor of art, HND: Higher national diploma, PG: Postgraduate

Of the 100 respondents interviewed, 59% were infected with malaria due to the mosquitoes found around their locality but only few had cholera (4%), which also might be attributed to their proximity to the dumpsite (Table 5).

Table 4: Handling and management of solid waste in surveyed communities

Disposing solid waste	Frequency
Burn it	21
Leave it on the street	15
Throw it into the river	7
Take it to a central designated site	47
ASEPA collects it from my house	10
Total	100
<b>Collection of solid waste</b>	
Daily	1
Once a week	5
Twice a week	7
Now and then	9
No collection	78
Total	100
<b>Sanitary condition of the locality</b>	
Excellent	3
Very good	4
Good	7
Fair	19
Poor	38
Very poor	29
Total	100
<b>What you do with recyclable products</b>	
Dispose them with other solid waste	70
Separate them for selling to scavengers	20
Separate them for reuse	10
Total	100
<b>What you do with organic waste</b>	
Use as compost	17
Feed the animals	20
Dispose in the street	63
Total	100

Table 5: Macro-fauna associated with residence and their health status around dump sites

Macro-fauna	Frequency
<b>Insects</b>	
Centipede	9
Flies/mosquitoes	61
Millipede	6
Cockroach	20
Tsetse fly	3
Maggot	1
Total	100
<b>Other invertebrates</b>	
Earth worms/leeches	72
Flat worms	15
Snails	11
No response	2
Total	100
<b>Health status</b>	
Malaria	59
Diarrhoea	7
Typhoid	15
Sleeping sickness	9
Cholera	4
No response	6
Total	100

## DISCUSSION

Species of macro-fauna encountered in this study are all closely associated with humans and human-generated waste as reported by Ahmed<sup>6</sup>, Onyido *et al.*<sup>12</sup> and Banjo *et al.*<sup>13</sup> and corroborated by Banjo *et al.*<sup>13</sup> studies on arthropods found in five refuse dumps in Ijebu-Ode Town in Ogun State but contradicts vertebrate organisms such as rodents and snakes which were found in two refuse dumps in Awka Town, Anambra State reported by Onyido *et al.*<sup>12</sup>.

Waste produced is a function of resident population, socio-economic status and level of urbanization<sup>14-16</sup>.

Trapped arthropods in Umuahia metropolis particularly houseflies and mosquitoes are important in forensic studies<sup>17</sup>, animal<sup>18</sup> and human<sup>19</sup> health and hygiene. Studies by Slesak *et al.*<sup>20</sup>, reported leeches as a potential vector for Rickettsial infections.

A study by Fotedar<sup>21</sup> implicated houseflies (*Musca domestica*) as vector of *Vibrio cholera* which is the causative agent of cholera. Similarly, Osei and Duker<sup>22</sup> postulated that flies are able to carry *V. cholera* from dumpsites to surrounding areas within a critical buffer distance of 500 m within which transmission can occur. Data from the UNEP<sup>2</sup> study conducted at Dandora waste dump in Kenya, established a linkage between waste dumpsites infested with macro-fauna and public health. Soil and water around the dumpsites was compared with samples from other sites as well as medical tests carried out on humans living around the dumpsites and the results show evidence of infections from water, land and air pollution attributable to these macro fauna. The leachates generated in the landfills and open dump sites are sources of pollution which is inimical to public health.

Dumpsites in Umuahia metropolis consist mostly of organic solid wastes such as; maize peel, rotten tomatoes, vegetable stem, rotten meat and fish etc. This might be attributed to the proximity of the dumpsite to the market thereby attracting houseflies, midges and cockroaches, whereas dumpsites in Ibeku and Olokoro consisted mainly of scraps such as plastics, papers, metals, bottles, etc. which trapped predominantly mosquitoes, cockroaches, midges and few houseflies. The nature of these wastes generated and their proximity to markets or residential areas determine the type of arthropod they attract. It is logical to find diptera such as mosquitoes and houseflies nurturing in organic wastes. The non-degradable solid wastes serve as refugia for macrofauna especially in the class insecta. Cotton *et al.*<sup>23</sup> report showed that cockroach antigens cause asthma-related health problems.

Siboe *et al.*<sup>24</sup> also reported the potential human danger resulting from molds growing on crude garbage dumps in the vicinity of human habitation. A similar report from Bangalore by Lakshmikantha<sup>25</sup> highlighted the danger of waste disposal sites in the spread of diseases to people living in the immediate vicinity. Report by Cotton *et al.*<sup>23</sup> showed that cockroach antigen cause asthma-related health problems. Pukkala and Ponka,<sup>26</sup> also reported that wastes increase the incidence of cancer and asthma in houses built on sites that have been previously used as refuse dumps.

## CONCLUSION

The results of this study showed that mosquitoes and cockroaches are predominant in Ibeku and Olokoro (residential areas) whereas in Umuahia main and Aba road (commercial areas), houseflies and midges were common probably due to the nature of waste generated. These macrofauna are vectors of malaria and typhoid diseases presented by most respondents' resident around locations assessed. The health challenges might be attributed to these macro-fauna associated with these illegal and indiscriminate refuse dumpsites.

## SIGNIFICANCE STATEMENT

The study is aimed at identifying and characterizing micro-fauna present in RDS in Umuahia metropolis, Abia State, Nigeria and evaluated their potential risks to residence.

The study discovered the status of arthropod micro-fauna present in the surveyed RDS in each locality revealing a relationship with the residential or commercial activities. This information will also generate baseline data for arthropod pest management. This study will help the researchers to uncover the critical need for specialized waste management programme for specific area.

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