Knowledge and Practice of Solid Waste Management Among Households in Obudu Local Government Area, Cross River State, Nigeria

Simon Alain Inah[1], Cyril Lishilinimye Atabusi[1], Chinasa OrieAgwu Amadi[2],
Richard Owen Obinna[2], Alexis Ebikonbowei Okaba[3], Darlington Egbe
Egbonyi[4],

[1] Department of Public Health, University of Calabar, Calabar, Nigeria
[2] Department of Public Health, Federal University of Technology, Owerri, Nigeria
[3] Department of Biological Sciences, University of Africa, Toru OruaSagbama, Bayelsa, Nigeria
[4] Department of Environmental Resource Management, University of Calabar, Calabar

ABSTRACT : This study was aimed at determining the knowledge and practice of solid waste management among households in Obudu, Cross River State, Nigeria. A descriptive cross-sectional study design was used. The multi-stage sampling procedure was used to randomly select 390 respondents from 390 households for the study. A semi-structured questionnaire which was self-administered and interviewer-administered was given to the respondents. SPSS (version 20.0) was used to analyse the data. The results were interpreted and presented in simple percentages and tables. Types of household waste generated were mainly farmyard waste 314 (80.5%), polythene bag 278 (71.3%) and metals 89 (22.8%) with main sources from agricultural waste 333 (85.4%) and food processing waste 289 (74.1%). Household waste storage method was mainly in plastic bucket 180 (46.2%) and only 96 (24.6%) confirmed the availability of household waste bin. Most respondents 206 (52.8%) indicated that refuse dump/open dumpsites were their main place for disposal of household wastes. Environmental challenges associated with improper household solid waste management as indicated include; emission of offensive odour 337 (86.4%), pollution 256 (65.6%) and flood 121 (31.0%). As indicated, common diseases associated with improper household solid waste management as indicated were mostly malaria 303 (77.7%) and cholera 114 (29.2%). Environmental health officers should be involved in monitoring residential premises to ensure proper storage and frequent disposal of solid waste at the appropriate sites.

KEYWORDS: Knowledge, Practice, Solid Waste, Waste Management, Household

I. INTRODUCTION

Municipal or household solid wastes management (MSWM) is the process of collecting, storing, treatment and disposal of solid waste in such a manner that they are harmless to humans, plants, animals, ecology and the environment in general (Momodu et al., 2011). Household or municipal solid waste generation can be influenced by several factors such as economic development, income level, industrialisation, urbanization, human attitude and local climatic conditions (Ayuba et al., 2013). The common practice for waste management in Nigeria is land filling (open dumping)(Enoh, 2011).Solid waste management (SWM) is essential for sustainable development. Environmental and health effects are caused due to unsustainable management of waste, which was more shown in developing countries. Because of improper waste collection from the home and inappropriate disposal of waste, a result of pollutant is been generated. The pollutants from leachates at the landfill sites and these leachates contaminate and affect the groundwater qualities (Mei, 2011).Improper disposal of these untreated waste can be deleterious to health and air pollution, underground water contamination, land degradation, solid contamination, habitat deterioration can be caused by improper waste disposal (Odoemene, 2011). Environments close to dumpsites are constantly exposed to the risk of infection, reduced agricultural yield, groundwater contamination, toxicity and exposure to hazardous compounds (Ayuba et al., 2013).

Additionally, global warming, photochemical, oxidant creation, acidification, ecotoxicity of water eutrophication and abiotic resource deflection can be caused by indiscriminate dumping of waste (Nwachukwu et al., 2010). The management of waste is an unending problem in developed and low income countries and it is an increasingly serious issue in respect of flood risk management for obvious reasons. The poor disposal of waste frequently leads to blockages in drainage and watercourses; this effectively reduces their capacity of storage and conveyance and leads to flooding. During a flood, waste and other debris collected by flood waters can cause increased damage to properties and lead to higher flood losses (Inah et al., 2020).According to the World Health Organization (WHO) and the United Nations International Children Education Fund (UNICEF), improper sanitation, decaying or non-existent sewage system and toilets fuels the spread of various diseases

(cholera, diarrhoea, typhoid, and basic illness) which kills children less than 5 years of age (Momodu et al., 2011). It is on record that most Nigerian cities use open dump system of waste disposal, for instance, Lemna dumpsite in Calabar metropolis is an open dump with no control of rodents, and other pollutants thus posing environmental and public health consequences such as underground water and soil contamination by toxic metals, aesthetic nuisance, air pollution surface, water contamination, noxious odours and oftentimes, a suitable breeding ground for mosquitoes, flies, rodents, snakes and pathogenic organisms (Asikong et al., 2015). The area is also characterized by overcrowding and poor sanitation resulting from high level of refuse generation, indiscriminate dumping of refuse, open defecation, bushy surroundings, blocked gutters, potholes creating stagnant pools of water for mosquito breeding and odour nuisance (Inah et al., 2017). Solid waste management is a universal issue that matters to every single person in the world and with over 90% of waste openly dumped or burnt in low-income countries, it is the poor and most vulnerable who are most affected.

In recent years, landslides, of waste dumps have buried homes and people under piles of waste and it is the poorest that often live near waste dumps. "Poorly managed waste has been reported to be contaminating the world's oceans clogging drains and causing flooding, transmitting diseases, increasing respiratory problems from burning and harming animals that consume waste unknowingly and affecting economic development, such as through tourism" (World Bank, 2018). According to the World Bank's (what a waste 2.0) report, the world generates 2.01 billion tonnes of municipal solid waste annually with at least 33% of that not managed in an environmentally safe manner. An update to a previous edition, the 2018 report projects that rapid urbanization, population, growth and economic development will push global waste to increase by 70% over the next 30years to a staggering 3.40 billion tonnes of waste generated annually (World Bank, 2018). Solid waste management is the method of collecting, transporting, treating and recycling solid waste. If solid wastes are not properly managed even at landfill sites, it will result in negative impacts on both health and the environment. Due to urbanization, industrialization and population growth, the large amount of rising solid waste generation occur in low-income countries. In general, many low-income countries are still left behind developed countries concerning solid waste management (Abdulasoul, 2016).

A substantial quantity of solid wastes generated in Nigeria is indiscriminately deposited on the roadsides, unapproved dumpsites, in waterways (drainage system) or in open sites which negatively impacts the environment and affects its aesthetics (Ukpong et al., 2015). Some of all the open dumps are indiscriminately located at streams, valleys, water lands, open fields, abandoned borrow pits. This system of waste disposal accumulates a huge quantity of waste annually and it is associated with several problems such as contamination of groundwater and outbreak of various human diseases (Akor et al., 2013). Statically, in Nigeria, experimental studies have shown that about 47.3% of the total solid waste is organic and compostable whereas recyclable wastes account for about 4.69 – 9.90%. Solid waste management is the most pressing environmental challenge faced by urban and rural areas of Nigeria. Nigeria, with a population exceeding 170 million, is one of the largest producers of solid waste in Africa. Despite a host of policies and regulations, solid waste management in the country is assuming alarming proportions with each passing day. Nigeria generates more than 32 million tons of solid waste annually, out of which only 20-30% is collected.

Statistically, waste management in low-income countries is a challenge; both behaviours of citizens and the poor management of waste contribute to the issue of waste globally. A typical Egyptian city like Cairo generates around 11, 450 tons of municipal solid waste (MSW) per day with 45% moisture content, 30% volatile matter and calorific value of 1500kcal/kg (Ismail, 2015). The unmanaged solid waste landfills were waste has been directly dumped without any segregation, causes severe problems like leachate generation and air pollution (Anubhau, 2012).The challenges of household solid waste management in developing countries may include low collection coverage, inconsistency in the collection process, indecency in dumping, uncontrolled environmental pollution, indiscriminate waste picking, scavenging by domesticated animals and breeding of flies and other disease vectors which affect health (Zurrugg, 2002) as cited by (Karshima, 2016).

Indiscriminate disposal of municipal waste is increasingly becoming a prominent habit in Nigeria where wastes are usually dumped on roadsides, available open pits, drainage channels, rivers or streams (Onwughara et al., 2010). This indiscriminate disposal of solid waste is linked to urbanization, population growth, poor governance, poverty and low level of environmental awareness (Yakubu et al., 2015).Improper solid waste management has potential negative environmental impacts such as pollution of air, soil, land, generation of greenhouse gases from landfills, health and safety problems associated with different forms of pollution (United Nations, 2010).The volume of solid waste generated continues to increase at a faster rate due to income and economic growth that have impacts on the composition of waste. Moreso, waste characteristics vary according to the season, population, social behaviour, industrial production, size of the market for waste materials and the

extent of urbanization, effectiveness of recycling and work reduction (Yakubu et al., 2015).The general objective of this study was to assess the knowledge and practices of solid waste management among households in Obudu Local Government Area of Cross River State, Nigeria and specific objectives of this study were to determine the knowledge of respondents on solid waste management in Obudu Local Government Area of Cross River State; describe the types of solid waste generated by households in the study area; determine the solid waste management practices of respondents in the study area and determine the perceived public health implications associated with solid waste management in the study area.

II. MATERIALS AND METHODS

Study setting : The study area was the Obudu Local Government Area. It is one of the eighteen (18) Local Governments in Cross River State and one of the foremost tourist centres. It lies in the Northern Senatorial Distinct. Obudu Local Government is bounded in the North with Benue state; in the west it shares a boundary with Bekwara/Ogoja Local Government to the East with Obanliku Local Government Area and to the South Boki Local Government Area of Cross River State. ObuduLocal Government Area has a landmass of 379,164 square kilometres and a population of 161,457, National Population Census, (2006). The local government is inhabited predominantly by five ethnic groups or indigenous ethnic community of Bette, Alege, Ukpe, Ubang and Utugwang, all of which thrive as independent villages with strong cultural affinity, the people of Obudu speak a different language but Bette is highly speak and understand by the people. Obudu Local Government Area has 10 political wards namely; Allege/Ubang, Begiadin, Angiaba/ Begiaka, Ipong, Obudu urban 1, Obudu urban 11, Ukpe, Utugwang Central, Utugwang North, Utugwang South. The inhabitants of Obudu are predominately farmer's involved in the cultivation of both cash crops and food crop such as yam, cassava, plantain, garden egg, Banana etc. although a little number of people are civil servants, artisans, traders, hunters, local politicians and fishermen etc.

Study design : The descriptive cross-sectional study design was used.

Study population: The study population was made up of adults of both genders who were 18 years and above in the study area.

Sample size determination : The sample for this study was determined using Fisher's formula (1998)
n = desired sample size
d = margin of error
z = confidence interval
p = prevalence of household solid waste management
q = proportion or non-occurrence
z = (95% = 1.96)
d = (5% = 0.05)
p = (59% = 0.59)
q = 1 − p = 1 − 0.59
= 0.41
Assuming non response rate = 5%
n =
n = 18.6 + 372
= 390.6
n = 390

Sampling procedure : A multi-stage sampling technique was used in selecting the wards, Villages, households, and respondents.

Stage 1 (selection of wards): There are 10 political wards in Obudu Local Government Area. A simple random sampling technique was used to select five (5) wards from the political wards using the lottery method. The names of the 10 wards were written in pieces of papers, folded and put in a small basket and was thoroughly shaken, then 5 individuals were asked to pick from the basket. The 5 wards picked were used for this study. Seventy-eight (78) households were selected from each ward (5x78=390).

Stage 2 (selection villages): Simple random sampling was used to select 2 villages from the 5 selected wards. Ten (10) villages were selected 10 x 39 = 390).

Stage 3 (Selection of household): Systematic sampling was used to select households. The households were counted numbered, and then selection started from the first house at the entrance to the community. Thirty-nine (39) households were selected from each village (39x10=390)

Stage 4 (selection or respondents): The selection of respondents was done using a simple random sampling method. In a household with multiple qualified respondents, one respondent was randomly selected from the household. Where there is no eligible respondent in the household, the next household was considered.

Instrument for data collection : The instrument for data collection was semi-structured a questionnaire which was prepared base on the research objectives, it consists of four sections (A, B, C, D). Section A was on the knowledge of respondents on solid waste management; B, types of solid waste generated by households C, solid waste management practices D, perceived public health implications associated with solid waste management.

Data Collection: The 390 questionnaires administered were retrieved with the help of two (2) trained research assistants.

Method for Data Analysis : Descriptive statistics were used to analyse the data obtained from the questionnaire. The responses were coded and analyzed. Data were analyzed using Statistical Package for Social Sciences, (SPSS) version 20. The results were interpreted and presented in tables and simple percentage.

Justification of the study: The study on the knowledge and practices of the solid waste management in Obudu help inform the people, Local, State as well as the Federal Governments to realize the magnitude of problems and the health implication associated with indiscriminate waste disposal and management practices. It will help in pointing out the hazard of improper solid waste management on the environment and measures that should be taken to eliminate these hazards. This study also critically considered various ways or measures through which health education can be used to promote effective solid waste management. This research will help experts to suggest a possible solution to this problem and recommend effective strategies for effective management of solid waste in Obudu Local Government Area and beyond. Also, the study will help in better policy formulation and implementation that will guide solid waste management in the study area.

Ethical consideration : Ethical approval was obtained from the Department of Public Health Ethics Committee. Verbal consent was also obtained from the respondents before administering the questionnaire. All the respondents were informed that the information collected is treated confidentially, and that participation in this study was voluntary.

III.   RESULTS

Socio-demographic characteristics of respondents : All 390 copies of the questionnaire that were distributed were retrieved for analysis giving a response rate of 100%. The results of the study showed that 138 (35.4%) were aged between 26-30 years, 206 (52.8%) were female, 204 (52.3%) were married, 368 (94.4%) were Christians, 146 (37.4%) had secondary education, 156 (40.0%) were farmers and 145 (37.2%) earn a monthly income of between N30,000-N50,000 (Table 1).

Knowledge of Solid Waste Management among respondents : Results on knowledge of Solid Waste Management (SWM) as indicated by the respondents showed that only 145 (37.2%) confirmed awareness on SWM in their area, 132 (33.8%) confirmed the availability of adequate laws and regulations on SWM and 44 (33.3%) indicated that offenders are punished for violation of laws and regulations on SWM (Table 2).

Types of household solid waste generated : Types of household waste generated as indicated by the respondents were mainly farmyard waste 314 (80.5%), polythene bag 278 (71.3%) and metals 89 (22.8%). Sources of household solid waste as indicated by the respondents were mainly from agricultural waste 333 (85.4%) and food processing waste 289 (74.1%) (Table 3).

Table 1: Socio-demographic characteristics of respondents (n=390)

Variables	Number of respondents	Percentage
Age (in years)		
≤ 20	21	5.4
21-25	84	21.5
26-30	138	35.4
31-35	102	26.2
36 and above	45	11.5
Sex		
Male	184	47.2
Female	206	52.8
Marital status		
Single	181	46.4
Married	204	52.3
Divorce	1	0.3
Widow/widower	4	1.0
Religion		
Christianity	368	94.4
Islam	7	1.8
Traditional religion	15	3.8
Education		
No formal education	48	12.3
FSLC	78	20.0
SSCE	146	37.4
OND/NCE	61	15.6
B.Sc/HND	55	14.1
M.Sc& above	2	0.5
Occupation		
Civil servant	56	14.4
Business	69	18.2
Farming	156	40.0
Unemployed	55	14.1
Retired	34	8.7
Student	18	4.6
Monthly income		
<N30,000	93	23.8
N30,000-N50,000	145	37.2
N51,000-N70,000	77	19.7
N71,000-N100,000	63	16.1
N100,000 & above	12	3.1

Table 2: Knowledge of Solid Waste Management among respondents (n=390)

Variables	Number of respondents	Percentage
Awareness creation on SWM		
Present	145	37.2
Not present	245	62.8
Total	**390**	100
Availability of adequate laws and regulations on SWM		
Available	132	33.8
Not available	258	66.2
Total	**390**	100
Offenders of the laws and regulations on SWM		
Offenders are punished	44	33.3
Offenders are not punished	88	66.7
Total	**S132**	**100**

SWM- Solid Waste Management

Table 3: Types of household solid waste generated

Variables	Number of respondents	Percentage
Types of household waste generated*		
Farm yard waste	314	80.5
Polythene bags	278	71.3
Metals	89	22.8
Building residues	80	20.5
Grasses	62	15.9
Source of household solid waste*		
Agricultural waste	333	85.4
Food processing waste	289	74.1
Animal waste	62	15.9
None of the above	80	20.5

*Multiple responses

Solid Waste Management practices among respondents : Results on Solid Waste Management practices as indicated by the respondents showed that household waste storage method was mainly in plastic bucket 180 (46.2%) and only 96 (24.6%) confirmed the availability of household waste bin. While 206 (52.8%) indicated that refuse dump/open dumpsites were their main place for disposal of household waste, 112 (28.7%) respondents confirmed the provision of waste receptacle for waste management in their area. Only 91 (23.3%) respondents segregate waste at the source before disposing and 213 (54.6%) pinpointed that the distance to refuse dump was as close as between (500m-1km). Most respondents 241 (61.8%) expressed satisfaction with the waste agency in the handling, collection and disposal of household solid waste. Causes of ineffective waste collection and disposal as indicated by the respondents were mainly lack of waste bin/receptacles 316 (81.0%) and increase consumption pattern 134 (34.4%) (Table 4).

Public health implications associated with household Solid Waste Management : Environmental challenges associated with household solid waste management as indicated by the respondents include; emission of offensive odour 337 (86.4%), pollution 256 (65.6%) and flood 121 (31.0%). Common diseases associated with household solid waste management as indicated by the respondents were mostly malaria 303 (77.7%) and cholera 114 (29.2%). Results also showed that conveyance of wastes to dumpsites was mainly done by respondents themselves 143 (36.7%) and their children 97 (24.9%) (Table 5).

Table 4: Solid Waste Management practices among respondents

Variables	Number of respondents	Percentage
Household waste storage methods		
Polythene bag	76	19.5
Plastic bucket	180	46.2
Waste basket	111	28.5
None	23	5.8
Total	**390**	**100**
Availability of household waste bin		
Available	96	24.6
Not available	294	75.4
Total	**390**	**100**
Place for disposal of household waste		
On the roadside	47	12.0
Stream/river	35	9.0
Draining channel	0	0.0
In a nearby bush	102	26.2
Refuse dump site/open dump pit	206	52.8
Total	**390**	**100**

Provision of waste receptacle for proper waste management		
Waste receptacle provided	112	28.7
Waste receptacle not provided	278	71.3
Total	**390**	**100**
Segregate waste at the source before disposing		
Do segregate waste	91	23.3
Do not segregate waste	299	76.7
Total	**390**	**100**
Distance to waste dump site		
Too far (>2km)	77	19.7
Far (1-2km)	100	25.6
Close (500-1km)	213	54.6
Total	**390**	**100**
Satisfied with the waste agency in the handling, collection and disposal of household solid waste		
Satisfied	241	61.8
Not Satisfied	149	38.2
Total	**390**	**100**
Causes of ineffective waste collection and disposal*		
Poverty	42	10.8
Distance	84	21.5
Lack of waste bin/receptacles	316	81.0
Population growth	51	13.1
Increase consumption pattern	134	34.4

*Multiple responses

Table 5: Public health implications associated with household solid waste management

Variables	Number of respondents	Percentage
Environmental challenges associated with household solid waste management*		
Emission of offensive odour	337	86.4
Flood	121	31.0
Pollution	256	65.6
Common diseases associated with household solid waste management*		
Malaria	303	77.7
Dysentery	88	22.6
Diarrhea	85	21.8
Cholera	114	29.2
Conveyance of waste to dump site		
Hired help	72	18.5
Children	97	24.9
Sibling/friends/relative	44	11.3
Myself	143	36.7
Urban development agency	34	8.7

*Multiple responses

IV. DISCUSSION

Solid waste management has become a global issue especially in rapidly expanding regions and countries. Evidence has shown that an increase in solid waste generation is directly linked to rapid population growth and urbanization(Zerbock, 2003; Awomeso et al., 2010; Khatib, 2010; Medina, 2010; UNEP, 2010). Though, there are ongoing efforts to institutionalize effective Solid Waste Management (SWM) strategies in Nigeria, however, understanding the dynamics of SWM practices and the health implications of poor practices may positively influence the drive towards sustainable environmental hygiene. Findings in the current study showed that only one-third of the respondents confirmed awareness creation on SWM in their area; were aware of the availability of adequate laws and regulations on SWM; knew that defaulters of environmental laws and regulations especially on SWM are punished (Table 2). The poor knowledge level demonstrated in this study brings to light the poor level of sensitization on proper SWM in suburban and rural areas. This may largely result in poor community hygiene thereby increasing resident susceptibility to infections, diseases and/or health problems. This finding contradicts with other Nigerian studies where respondents recorded high knowledge level on SWM (Modebe, 2011; Adogu et al., 2015).

Types of household waste generated as indicated by the respondents were mainly farmyard waste and polythene bags with major sources from agricultural waste and food processing waste (Table 3). This result is congruent with a cross-sectional study carried out in North-East Nigeria where similar household wastes were mainly generated (Modebe, 2011), but contradicts another Nigerian study where food residues and vegetables were mostly reported (Adogu et al., 2015). The result in the current study is not surprising because a significant proportion of the respondents engage in farming practices which contributes largely to household solid waste (Table 1). These farm products are then processed to food products both for consumption and sale. This accounts for why agricultural practices and food processing activities fuel a large junk of household solid waste in the area.

As regards Solid Waste Management practices, results showed that household waste storage method was mainly in a plastic bucket and only one-fourth confirmed the availability of household waste bin. This result is comparable with that ofKaoje et al., 2017, where household wastes were mainly stored in sacks and plastic containers. This demonstrates the practice of waste minimization and re-use at the household level. In the absence of a waste bin which is common in rural areas, useless plastic or metallic containers are often used to store waste. However, this method of storage of solid waste becomes worrisome especially when the waste container is not properly covered thereby giving room for flies and rodent infestation and emission of offensive odour which consequently threatens the health of residents in the area.

More than half of the respondents indicated that refuse dump/open dumpsites were their main place for disposal of household wastes and one-fourth confirmed the provision of waste receptacle for proper waste management in their area. This finding corroborates with studies conducted byKaoje et al., 2017 and Shahzadi et al., 2017, where open space dumping was the main method for disposal of household waste. This method of waste disposal is commonly practised in rural settings in Nigeria where solid wastes are disposed into the open dumpsites and/or open pit. This practice, however, is considered unhealthy because it encourages rodent and flies infestations as well as the emission of offensive odour. Waste segregation was poorly practised as only one-fourth of the respondents segregate waste at the source before disposing of. This challenges the need to sensitize rural dwellers on the essence of waste segregation. More than half of the respondents 213 (54.6%) pinpointed that the distance to refuse dump was as close as between (500m-1km). This is linked to the fact that most households create a waste dumpsite behind their houses where household wastes are mainly disposed of. Hence, oftentimes such waste dumpsites are created close to where they domicile, mainly for ease of disposal of waste. Causes of ineffective waste collection and disposal as indicated by the respondents were mainly lack of waste bin/receptacles and increase consumption pattern (Table 4). This means, respondents, acknowledge the fact that the provision of waste bins for household use and provision of waste receptacles for community use is vital in improving SWM in rural communities as well as mitigating indiscriminate solid waste disposal.

Regarding the public health implications SWM, over 95% of respondents could identify at least one environmental challenge associated with improper household solid waste management include; emission of offensive odour, pollution and flood. Personal practices, access to environmental health information, observation of events around the community and reported cases on the electronic media may largely account for the knowledge of environmental challenges associated with household SWM among respondents reported in the current study. Common diseases associated with household solid waste management as indicated by the respondents were mostly malaria and cholera. These findings are congruent to that ofKaoje et al., 2017, where respondents knew the health problems associated with improper household SWM. Increase in reported cases of

morbidity and mortality from malaria and cholera may significantly account for the knowledge level. Results also showed that conveyance of wastes to dumpsites was mainly done by respondents themselves and their children (Table 5). This result is comparable with that ofKaoje et al., 2017, where children were mainly involved in the disposal of solid waste. This shows that household members are mainly involved in the disposal of household solid waste which represents a share of responsibility in SWM within their community

V. SUMMARY

This study was aimed at determining the knowledge and practice of solid waste management among households in Obudu Local Government Area of Cross River State, Nigeria. The design adopted for this study was a descriptive cross-sectional study design. The multi-stage sampling procedure was used to randomly select 390 respondents from 390 households who duly gave their consent to participate in the study. Data were generated using a semi-structured questionnaire which was self-administered and interviewer-administered to the respondents. Descriptive statistics were used to analyse the data obtained from the respondents and responses were coded and analyzed using Statistical Package for Social Sciences, (SPSS) version 20.0). The results were interpreted and presented in a simple percentage and tables. Variables measured in the study include; knowledge of solid waste management, types of household solid waste generated, solid waste management practices and perceived public health implications associated with solid waste management

The results obtained in this study are summarized as follows;

- 145 (37.2%) confirmed the presence of awareness creation on proper SWM in their area
- Types of household waste generated as indicated by the respondents were mainly farmyard waste 314 (80.5%), polythene bag 278 (71.3%) and metals 89 (22.8%).
- Source of household solid waste as indicated by the respondents were mainly from agricultural waste 333 (85.4%) and food processing waste 289 (74.1%)
- Household waste storage method was mainly in plastic bucket 180 (46.2%) and only 96 (24.6%) confirmed the availability of household waste bin
- 206 (52.8%) respondents indicated that refuse dump/open dumpsites were their main place for disposal of household waste,
- Environmental challenges associated with household solid waste management as indicated by the respondents include; emission of offensive odour 337 (86.4%), pollution 256 (65.6%) and flood 121 (31.0%).
- Common diseases associated with household solid waste management as indicated by the respondents were mostly malaria 303 (77.7%) and cholera 114 (29.2%).

VI. CONCLUSION

Efficient solid waste management has become one of the top priorities in Nigeria principally due to its implication on population health and the drive to achieve the global target of environmental sustainability by 2030. Currently, researchers and experts are exploring several newer applications and techniques to promote an easier and effective approach for SWM. Household SWM is also being considered as an integral part of urban infrastructure that ensures the protection of the environment and human health. Findings in the current study confirmed a significant lack of awareness creation on proper SWM, lack of knowledge of laws and regulations of SWM and poor SWM practice in the area. Also, respondents knew the public health implications of poor SWM. Hence, institutionalizing an effective approach for improved SWM is critical in achieving environmental sustainability and a healthier population.

Limitations of the study : One of the main limitations of this study was challenges on the literacy level of the residents, lack of co-operation among respondents and hoarding of information. Problems of administration and retrieval of the questionnaire from the respondents as well as multiple responses was another major limitation.

What is known about this topic
- Previous studies conducted on knowledge and practice of solid waste management do not translate to household waste management;
- Lack of sanitation facilities and cultural practices and dumpsites was the major reason for indiscriminate waste disposal.

What this study adds
Based on the findings in this study, we recommend the following;

- Individuals should make it a responsibility to properly dispose of their wastes to avert health implications associated with indiscriminate disposal wastes.
- Community associations and social groups such as age-grades, market women, youth's vanguard, etc. should be involved in providing wastes receptacles at strategic locations for ease of disposal of household wastes.
- Public health experts should collaborate with the government at all level to sensitize the rural dwellers on the implications of SWM and the merits of SWM within their vicinity.
- Aside from the routine monitoring of industrial outlets, Environmental health officers should also be involved in the monitoring of residential premises to ensure proper storage and frequency disposal of solid waste at the appropriate site and SWM.
- Environmental health officers should collaborate with the L.G.A. health system and community stakeholders to organize seminars where issues concerning SWM, its law and regulations as well as punishment accorded to defaulters are discussed.
- Further studies should be carried out to determine the knowledge and practice of SWM in market places, roadside traders, mechanic workshops, industrial outlets, etc.

Competing interests : The authors declare no competing interests.

Authors' contribution: Inah, Simon Alain was responsible for project conception and design, and analysis of data; Cyril LishilinimyeAtabusi was responsible for review of literature and preparation of draft manuscript and data acquisition; Chinasa OrieAgwu Amadiwas responsible for coordination; Richard Owen Obinna and Alexis Ebikonbowei Okaba were responsible for methodologies and interpretation of data; and Egbonyi Darlington Egbe was responsible for the preparation of draft manuscript. All authors read and approved the final manuscript.

ACKNOWLEDGEMENTS

TABLES AND FIGURES
Table 1: Socio-demographic characteristics of respondents
Table 2: Knowledge of Solid Waste Management among respondents
Table 3: Types of household solid waste generated
Table 4: Solid Waste Management practices among respondents
Table 5: Public health implications associated with household solid waste management

REFERENCES

1. Momodu, N. S., Dimuna, K. O. and Dimuna, J. E. (2011). Investigating the impact of solid wastes in urban centres in Nigeria. Journal of Human Ecology, 34: 125-133.
2. Ayuba K. A., Manaf L.A., Sabrina, A. H. and Azmin, S. W. N. (2013).Current status of municipal solid waste management practice in FCT, Abuja. Res. Journal of Environmental Science, 5: 295-304.
3. Enoh, O. C.(2011).Managing Nigeria's environment: The unresolved issues.Journal of Environmental Science Technology, 4: 250-263.
4. Mei L. (2011). Full cost accounting in solid waste management: The gap in the literature on newlyindustrialised countries. Journal of Applied Management Accounting Research, 9(1).
5. Odoemene, U. D. and Ofodu, J. (2011).Solid wastes management in Aba Metropolis.International Journal of Advanced Academic Research, 2:1-7.
6. Nwachukwu, O. I.,Chidi, N. I. and Charles, K. O. (2010). Issues of roadside disposal habit of municipal solid waste. Environmental Impacts and implementation of sound management
7. practices in developing countries "Nigeria". International Journal of Environmental Science Development, 5: 409-418.
8. Inah, S. A., Okpa, E. P., Nji, E. L., Egbonyi, D. E. and Mboto, F. E. (2020). Flooding and its Public Health Implications on Residents of Calabar South, Cross River State, Nigeria.
9. International Journal of EnvironmentalChemistry and Ecotoxicology Research, 3(1), 1-13.
10. Asikong, I. U., Brooks, Asikong, B. E. and Andy, E. (2015). Environment and public health aspect of solid waste management at the LEMNA dumpsite in Calabar, Cross River State,
11. Nigeria. International Journal of TropicalDiseases and Health,10(3): 1-13.
12. Inah, S. A.,Uwadiegwu, Z.,Eko, J. E. and Inah, J. A. (2017). Environmental Sanitation Practices on Malaria Control and Prevention in Abi Local Government Area, Cross River State,Nigeria. Asian Journal of Medicineand Health, 6(2), 1-12. doi: 10.9734/AJMAH/2017/34870.

13. World Bank (2018). What a waste? 2.0. Retrieved from www.worldbank.org.html/2018. Abdulasoul, A. A. (2016). Challenges and problems of solid waste management in three main

14. markets, Zanzibar. Advance in Recycling and Waste and Management, Open Access. Ukpong, E. C. U.,Udo, E. A. and Umoh, I. C. (2015). Characterization of materials from Aba waste dumpsites. International Journal of Engineering and Applied Science, 6: 1-10.

15. Akor, A. J., Ayotamuno, M. J.,Aman, L. I. and Umoh, S. O. (2013). Assessment of domestic solid waste generation in Port Harcourt by separator receptacle technology. International Journal of Science Engineering Research, 4: 1-7.

16. Ismail, T. M. (2015).Solid waste management in developing countries. Innovative Energy Research, 4:119.

17. Anubhau, O. (2012). Solid waste management in developing countries through plasma arc gasification – An alternative approach. ICESD, 5-7.

18. Karshima, S. N. (2016). Public health implications of poor municipal waste management in Nigeria. VOM Journal of Veterinary Sciences, 11; 152-160.

19. Onwughara, I. N.,Nnorum, I. C. and Kano, O. C. (2010). Issues of roadside disposal habit of municipal solid waste, environmental impacts and implementation of sound management practices in developing countries "Nigeria". International Journal Environmental Sciencesand Development,1(5): 409-418.

20. Yakubu, S. andAbdulkarim, B. (2015). Environmental impacts of climate change on waste management in Nigeria. African Journal of Social Sciences, 2015, 12(1): 133-142.

21. United Nations (2010). Solid waste management in the world's cities water and sanitation in the world cities (3rd edition). Washington DC: Earthscan.

22. Khatib, A.,Issam, A., Monou, M. Salam, A. F., Abu, A., Zahra, A.,Shaheen, H. Q. and Kassinos, D. (2010). Solid waste characterization, quantification and management

23. practices in developing countries. A case study: Nablus district Palestine. Journal of Environmental Management 91; 1131-1138.

24. Awomeso, J. A., Taiwo, A.,Gbadebo, O. and Arimoro, A. (2010).Waste disposal and pollution management in urban areas: A workable remedy for the environment in developing countries.American Journal ofEnvironmental Sciences, 2010, 6(1): 26-32.

25. Medina, M. (2010).Solid Wastes, Poverty and the Environment in Developing Country Cities: Challenges and Opportunities. United Nations University, World Institute for Development Economics Research.

26. Zerbock, O. (2003). Urban Solid Waste Management: Waste Reduction in Developing Nations.School of Forest Resources & Environmental Science, Master's International Program, Michigan Technological University.

27. UNEP (2019). Global Environment Outlook (GEO) 3 Data Portal, United Nations Environment Programme. Accessed, 21-8-2019

28. Modebe, I. and Ezeama, N. N. (2011). Public Health Implication of Household Solid Waste Management in Awka South East Nigerian.The Journal of Public Health 1(1)

29. Adogu, P. O. U.,Uwakwe, K. A.,Egenti, N. B., Okwuoha, A. P. and Nkwocha, I. B. (2015).Assessment of Waste Management Practices among Residents of Owerri Municipal Imo State Nigeria.Journal of Environmental Protection, 6(5): Article ID:56212,10

30. Kaoje, A. U.Sabir, A. A. Yusuf, S.,Jimoh, A.O. and Raji, M. O. (2017). Residents' perception of solid waste disposal practices in Sokoto, Northwest Nigeria. African Journal of Environmental Science and Technology, 11(2), 94-102.

31. Shahzadi, A.,Hussain, M., Afzal, M.andGillani, S. A. (2017). Determination the Level of Knowledge, Attitude, and Practices Regarding Household Waste Disposal among People in Rural Community of Lahore. Int. J. Soc. Sc. Manage, 5(3): 219-224