

Analysis of Household Hazardous Wastes Awareness Level in Enugu Metropolis

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Abstract

The study attempts to examine the awareness level household hazardous waste in Enugu metropolis. HHW generated in Enugu Metropolis were classified into eight, they include paints, garden chemicals, batteries, motoring products, medicines, home cleaning products, e-waste and household glasses. Ten layouts were randomly selected out of 41. A total number of 30 households per Layout were selected, totalling 300 respondents. A total of 24 checklists were used to evaluate the responses of householders to determine their level of awareness of HHW. Analysis of the awareness data was based on the frequency values obtained from our checklists. From our awareness analysis it was found that the level of householders' awareness on the dangers of HHW in the Enugu metropolis is low. This low awareness level on the dangers associated with HHW may largely be attributed to be attitudinal as income level and/ or level of education played little role in the general awareness level. From our PCA we identified four indices which include: general disposal problems, health related issues, environmental problems, and poor handling of HHW, which reflects low awareness of HHW in the study area. There is also no general consensus as to what constitute HHW in the study area as well as their potential health and environmental impacts. This was seen from variations in responses of like-hood impacts of HHW. For example while some respondents agreed that paints may constitute danger to the human health and environment if not properly disposed, other disagree. This development it is anticipated may frustrate any effort at HHW management unless people are sensitized and enlightened.

Keyword: Awareness level; Household hazardous waste, Health and Environment; environmental problem

1. Introduction

Municipal wastes represent an important percentage of those produced by the different activities human beings carry on. Studies have found that until a few years ago, the question of domestic products and their wastes did not represent a serious problem for the environment or for humanity's health. However, the introduction of toxic substances or potentially toxic substances into products on the market, the change of consumption habits in today's society, and the increase in urban population has caused an alarming general increase in the production of domestic wastes (Wilson, 1990; Canderio, 1999). In these wastes are various domestic elements which may be classified as contaminants. Most household wastes include among others: household cleaners, materials for home maintenance, garden products, medicines and automotive products. The used contents or leftovers of these products are known as household hazardous wastes. The term 'hazardous wastes' indicates the presence of discarded, unused or leftover portions of hazardous household products which are poisonous, toxic, flammable, caustic, corrosive, reactive, explosive, and radioactive or a combination of these characteristics. Study by Rosas and Gutiérrez (2001) shows that the quantity of HHW's varies from 0.01% to 1% of the total solid municipal wastes, depending on the characteristics and customs of each locality. Similarly, Luna (2002) found that 1% of domestic garbage sampled in his study was consisted of hazardous wastes. Globally, it is estimated that more than 70,000 chemicals are commonly utilized for a wide variety of purposes including production of household products (Connell, Lam Richardson, and Wu, 1999).

These chemicals so joins the streams of municipal waste, and since these waste is usually not disposed of improperly in most developing country, they pose a threat to sanitation workers and the environment. Household Hazardous Waste (HHW) discarded in the trash may ignite or explode in the collection truck. Trash collectors can be injured from fumes and splashing chemicals. In landfills, leachate from the waste pollutes soil, surface water and groundwater reservoirs. Disposal of HHW in drains can also pollute drinking water. In septic systems, hazardous waste can kill the organisms that make the system work. This may cause bulks of untreated waste to drain into the soil and eventually seep into the groundwater. Sewage treatment plants can be damaged by HHW in the same way as septic systems (Connell, Lam Richardson, and Wu, 1999). Tammenagi (1991) recorded that the environmentally hazardous dumps are unlined, have no leachate control or drainage systems, and the underground water or surface water unmonitored.

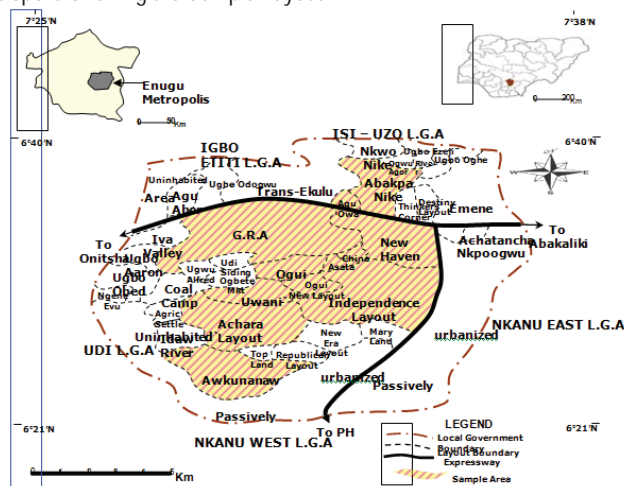
In the study area, HHW are usually stored in bins or cartons along with other wastes in individuals' homes and later deposited into public bins placed on the curbside or thrown inside built dumps for collection. The present solid waste disposal method based on mixing of HHW with other household wastes does not only pose problems of disposal but difficulty in monitoring the waste content, or estimating the extent of pollution risks at dumps. In addition, it worrisome to note that open dumping of waste into the nearest open space, either on land or surface water without any environmental consideration continues to be a common practice in the study area. This attitude could explain why there are heaps of wastes at every corner of the environment and the reluctance of municipal waste management staff to clear the waste because of potential injury. There is an increasing worry among environmentalists and Nigerian population that that given the growing population and more sophistication with respect to preferences and appetites for household products, the environmental problems associated with HHW generation and management in Nigerian cities may worsen. Yet, very few studies in the country have been done to examine level of awareness of dangers associated with HHW among the population. This informed the need for the present study.

2. Research Methodology

2.1 Study Area

The study area is Enugu capital Enugu State. It is located approximately between latitude $6^{\circ} 30' N$ and $6^{\circ} 40' N$ of the equator and longitude $7^{\circ} 20' E$ and $7^{\circ} 35' E$ of the Greenwich meridian. It covers an area of about, 145.8 square kilometers. It is administered by three local authorities namely, Enugu North, Enugu South, and Enugu East local government authorities. Enugu Metropolis is bounded in the north east by Isi-Uzo and northwest by Igbo-Etiti local Government Areas, in the east and south by Nkanu East and Nkanu West L.G.A respectively and in the west by Udi Local Government Area. (Fig.1).

Fig. 1: Map of Enugu Metropolis Showing the Sample Layout



Source: Town Planning Authority, ENUGU, 2009

The climate of the study area is the tropical wet and dry type according to the Koppen climatic classification system, and experiences two seasons (wet and dry) both which are warm. Rainfall occurrence is high with mean annual totals of 1600mm. The rainy season generally lasts from April to October, while the dry season lasts from November to March. The topographical features of Enugu Metropolis can be classified into two: to the west is the escarpment which is erosional and is continually eroded backward by the east-flowing rivers and to the east are the Cross River Plains that are generally low and of monotonous relief. Enugu lies at the foot escarpment, of the Cross River Plains, (Mamman, Oyebanji, and Petters 2000). In 2006, the population census figure for Enugu Metropolis was given as 722,665(Federal Republic of Nigeria Official Gazette, 2007).

2.2 Site selection

The study area is demarcated into 41 residential layouts for administrative reason, but for the purpose of this work, 10 Layouts were randomly selected. The criteria for selection of these layouts were to include typologies of layouts, and the diversity of households among the selected layouts. These layouts include, Abakpa, Achara, Asata, Awkunanaw, G.R.A., Independence layout, Iva-Valley, New Haven, Ogui, and Uwani (Fig.1). The sampling framework for this study was 300 households comprising 30 households from each of the 10 wards named above.

2.3 Data Collection

The study is largely quantitative and utilized data collected through household questionnaire survey. Questionnaire was administered for the purpose of exploring level of awareness of HHW on health, environment and disposal in Enugu Metropolis were analyzed. A number of questions were asked about perception of HHW issues. Householders were asked about their understanding of the impacts of household products covered by the survey on their own health when in use, the harm it might cause to the environment, and if they are a problem when disposed of. The checklist was administered to three hundred inhabitants in ten layouts spatially segregated and randomly selected in Enugu metropolis. Thirty households were selected for the study in each layout, a total of 300 householders responded. The data were collected between August and September 2010.

A total of 24, (twenty-four) checklist were used to evaluate the responses of householders to determine their level of awareness of HHW in Enugu Metropolis. Analysis of the awareness data was based on the frequency values obtained from our checklists. This enabled us to obtain the mean scores, standard deviation and variance of the frequency counts of the response values whose sum total is 15 for each variable. There are 24 variables which were assessed on the Likert five point response continuum scales. The Strongly Agree was rated 5, Agree 4, Undecided 3, Disagree 2, and Strongly Disagree 1. Adding all the ratings together gave us a total of 15 points. In our interpretation, any mean above 3.5 indicates that they agree, and they are aware. Mean below 3 implies that they disagree and the level of awareness is low and exactly 3 or between 2.5 and 3.4 shows a moderate level of awareness. Thus, each of the variables was assessed to determine the degree of the level of public awareness of HHW in Enugu Metropolis.

Interview was carried out with Municipal Solid Waste Management officials to provide information of the institutional framework for HHW management, officials' attitude and efforts at HHW collection and management in Enugu Metropolis. The Enugu State Sanitary landfill site (ENSEPA) was visited and workers in the site were interviewed, and pictures were taken at the site.

2.4 Data Analysis

The data were analyzed using descriptive and simple statistical analysis i.e. percentages, pie charts and bar graphs were used to relate the factors affecting HHW generation and also the magnitude of generation of HHW. The checklists method were used and coded with Likert five point response continuum scales with total of 24 structured questions to evaluate the level of awareness of HHW for this study. Principal component analysis (PCA) was used to extract the major underlying components that determine the level of HHW awareness in the study area.

3. Results and Discussion

3.1 Awareness of Household Hazardous Waste on Usage, Health, and Disposal Issues

The statistical frequency of the awareness level of HHW is shown in Table 1. The interpretation of the obtained results here reflects the perception of the householders on how HHW is a danger to health, environment and disposal problem.

Table 1: Absolute and Relative Frequency Distribution of Responses on the Level of Public Awareness of HHW in Enugu Metropolis.

code	Variable	5 Strongly Agreed	4 Agreed	3 Undecided	2 Disagree	1 Strongly disagreed	Total	Mean	Standard deviation	Variance
A1	Paints can be harmful to health if not used properly	57 19%	93 31%	40 13.3%	73 24.3%	37 12.3%	300	3.2	1.0	1.0
A2	Paints can be harmful to the environment	57 19%	93 31%	40 13.3%	73 24.3%	37 12.3%	300	3.2	1.0	1.0
A3	Paints can be a problem to dispose of	57 19%	93 31%	40 13.3%	37 12.3%	73 24.3%	300	3.1	1.0	1.0
B1	Garden chemicals can be harmful to health	31 10.3%	119 39.7%	65 21.7%	66 22%	19 6.3%	300	3.3	1.0	0.9
B2	Garden chemicals can be Harmful to the environment	87 29%	96 32%	63 21%	40 13.3%	14 4.7%	300	3.8	1.0	0.9
B3	Garden chemicals can cause problem when disposed of	81 27%	102 34%	36 12%	18 6%	63 21%	300	3.4	1.0	0.9
C1	Motoring Products can be harmful to health if not used properly	22 7.3%	28 9.3%	50 16.7%	114 38%	86 28.7%	300	2.3	0.9	0.9
C2	Motoring Products can be harmful to the environment	22 7.3%	18 6%	80 26.7%	114 38%	66 22%	300	2.4	0.9	0.9
C3	Motoring Products can be a problem to dispose of	22 7.3%	18 6%	66 22%	80 26.7%	114 38%	300	2.2	0.9	0.9
D1	Household Batteries can be harmful to health if not used properly	15 5%	65 21.7%	80 26.7%	107 35.7%	33 11%	300	2.7	1.0	0.9
D2	Household Batteries can be harmful to the environment	15 5%	65 21.7%	80 26.7%	107 35.7%	33 11%	300	2.7	1.0	0.9
D3	Household Batteries can be a problem to dispose of	15 5%	65 21.7%	80 26.7%	107 35.7%	33 11%	300	2.7	1.0	0.9
E1	E-waste can be harmful to health if not used properly	22 7.3%	78 26%	120 40%	50 16.7%	30 10%	300	3.0	1.0	0.9
E2	E-waste can be harmful to the environment	62 20.7%	73 24.3%	45 15%	24 8%	96 32%	300	2.9	0.9	1.0
E3	E-waste can be a problem to dispose of	62 20.7%	73 24.3%	45 15%	24 8%	96 32%	300	2.9	0.9	1.0
F1	Medicines can be harmful to health if not used properly	22 7.3%	78 26%	12 4%	88 29.4%	100 33.3%	300	2.6	0.9	0.9
F2	Medical waste can be harmful to the environment	54 18%	76 25.3%	45 15%	25 8.3%	100 33.3%	300	2.0	0.7	0.7
F3	Medical waste can be a problem to dispose of	54 18%	76 25.3%	45 15%	25 8.3%	100 33.3%	300	2.0	0.7	0.7
G1	Home-cleaning products can be harmful to health if not properly used	20 6.7%	83 27.7%	47 15.7%	40 13.3%	110 36.7%	300	2.5	0.9	0.9
G2	Home-cleaning products can be harmful to the environment	41 13.7%	94 31.3%	45 15%	45 15%	75 25%	300	3.4	1.2	1.1
G3	Home-cleaning products can be a problem to dispose of	15 5%	65 21.7%	80 26.7%	107 35.7%	33 11%	300	2.7	0.9	0.9

H1	Glasses can be harmful to health if not used properly	75 25%	100 33.3%	32 10.7%	75 25%	18 6%	300	2.9	0.8	0.7
H2	Glasses can be harmful to the environment	31 10.3%	119 39.7%	66 22%	19 6.3%	65 21.7%	300	3.1	1.0	0.9
H3	Glasses can be a problem to dispose of	15 5%	65 21.7%	80 26.7%	107 35.7%	33 11%	300	3.0	1.0	0.9

Source: Field work 2010

From Table, variable A1 (Paints and their related products can be harmful to the health if not used properly) and variable A2 (Paints and their related products can be harmful to the environment), both scored 31% under the Agreed column, 24.3% for Disagree, while 19% and 13.3% for strongly agree and undecided respectively, strongly disagree scored 12.3%. Although 50% majority of the respondents agree they are aware that these variables can be a problem to health (e.g. irritate skin, eyes), and environment (e.g. pollution of water), 36.6% of the respondents are not aware and 13.3% were indeed uncertain and unwilling to express an opinion on these variables. With a mean of 3.2 a standard deviation and variance of 1.0, we concluded that the level of awareness for variable A1 and A2 is moderate in the study area.

Variable A3 (Paints and their related products can be a problem to dispose of) the perception of the people again was moderate. Our analysis returned a mean score of 3.1, standard deviation and variance of 1.0. This is because the highest score of 31% for Agree, 24.3% of strongly Disagree, 19% on Strongly Agree and 13.3% for Undecided and 12.3% for Disagree respectively. 50% of respondents were aware of problems in disposal (for example to collection workers, leakage on roads and contamination of recyclables) 32.2% were unaware and 12.3% were indecisive.

Variable B1 (Garden chemicals can be harmful to health if not used properly), scored 39.7% for Agree, 22% of Disagree, 21.7% was registered for Undecided. The score of other categories are very low ranging from 10.3% for Strongly Agree and 6.3% for Strongly Disagree. 50% of the respondents agree they are aware, (these variable can be a harmful in use when you do not follow the instructions. It can cause harm to pets children, skin irritants etc), 28% were unaware and 21.7% were indecisive. The variable scored a mean of 3.3, standard deviation of 1.0 and variance of 0.9 to show that the level of HHW is moderate.

Variable B2 (Garden chemicals can be harmful to the environment) scored 32% on Agree, 29% on Strongly Agree; 21% for Undecided; 13.3% for Disagree; and 4.7% for strongly Disagree. 61% of the respondents agree that this variable can be harmful to the environment. There is a strong consensus that the level of public awareness of variable B2 is high because of the mean of 3.8, standard deviation of 1.0 and variance of 0.9. The householders in Enugu Metropolis are aware that garden chemicals can be harmful to the environment.

Variable B3 (Garden chemicals can cause a problem when disposed off), recorded 34% for Agree; 21% for Strongly Disagree; 27% for Strongly Agree; 12% under Undecided; 6% for Disagree. With a mean of 4, standard deviation 1.0 and variance 0.9, the people again were aware of the dangers of improper disposal of garden chemicals (eg they cause liquid mess in dust bin). Therefore, the level of awareness of this variable is high.

Variable C1 (Motoring products can be harmful to health if not used properly), scored 38% for Disagree; 28.7% for Strongly Disagree; 16.7% on Undecided; 9.3% on Agree, and 7.3% for Strongly Agree. There is a strong consensus that 66.7% of respondents are unaware of threats this variable can be to their health (they are toxic and some products are skin irritants), with a mean of 2.3, and standard deviation and variance of 0.9. This implies that the level of public awareness of this variable is very low.

Variable C2 (Motoring products can be harmful to the environment), the householders disagree with the dangers of this HHW and this implies that their level of awareness is low. Our analysis returned a mean score of 2.4, standard deviation and variance of 0.9. This was because the highest score of 60% was recorded for Disagree, 22% for Undecided, and 13.3% for Agree.

Variable C3 (Motoring products can be a problem to dispose off), recorded scores of 38% and 26.7% under the Disagree and Strongly Disagree column. 22% for Undecided, 7.3% and 6% for Strongly Agree and Agree respectively. A total of 65.7% of responded to disagree, and with a mean of 2.2, Standard deviation and variance of 0.9. We can conclude that the level of awareness of the dangers of these variables to the public is low.

Variables D1 (Household batteries can be harmful to health), D2 (household batteries can be harmful to the environment), and D3 (household batteries can be a problem to dispose off), all scored 35.7% for Disagree; 26.7% for Undecided; 21.7% for Agree; 11% for Strongly Disagree, and 5% for Strongly Agree. A high number of respondent 46.7% disagree with these variables. With a mean score of 2.7, and standard deviation of 1.0 and variance of 0.9, it implies that people are unaware of the dangers of these variables.

Variable E1 (E-waste can be harmful to health if not used properly), recorded scores of 40% for Undecided; 26% for Agree; 16.7% on Disagree; 10% for Strongly Disagree; and 7.3 % on Strongly Agree positive. 40% of the respondents were indecisive, 33.3% are aware and 26.7% are not aware of this variable. With a mean score of 3.0, standard deviation of 1.0, and variance of 0.9, this implies that the public are indifferent to the dangers of variable E1.

Variable E2 (E-waste can be harmful to the environment if not used properly) and E3 (E-waste can be a problem to dispose off) both scored 32% for Strongly Disagree; 24.3% for Agree; 20.7% for Strongly Agree; 15% for Undecided; and 8% for Disagree. A mean of 2.9, standard deviation 0.9 and variance 1.0 was recorded. 45% agree, and are aware; 40% disagree and are unaware and 15% were indecisive. The response of the public is so diverse but indicates there is a moderate level of awareness of these variables.

Variable F1(Medicine can be harmful to health if not properly used), scored 33.3% on Strongly Disagree, while Strongly Disagree scored 29.4%, to show a low level of awareness. However, a score of 26% was recorded for Agree, and 7.3% and 4% for Strongly Agree and Undecided respectively. 66.7% of the respondents are unaware of the dangers of this variable to their health. With a mean of 2.6, and standard deviation and variance 0.9, this shows that the level of awareness of this variable is low.

Variables F2 (Medical waste can be harmful to the environment) and F3 (Medical waste can be a problem to dispose off) both scored the same. The response of the people was so low so the level of awareness of these variables is low. This is because our analysis returned a mean score of 2.0, which implies that the people disagree. The highest score of 41% was recorded for agree, 43.3% for disagree and 15% were indecisive. Their low responses have slight edge over the high responses, a situation that the people could not readily perceive the dangers of these variables to the environment and disposal.

Variable G1(Home cleaning products can be harmful to health if not used properly) scored 36.7% on Strongly Disagree, 27.7% for Agree; 15.7% Undecided; 13.3% on Disagree; 6.7% on Strongly Agree. 50% of the respondent ticked disagree; 34.1% agree; 15.7% undecided. With a mean of 2.5, standard deviation, and variance of 0.9. The interpretation is that the awareness of the dangers of this variable on health is low.

Variable G2(Home cleaning products can be harmful to the environment), scored high on Agree; 39.7% and 33.3% on Strongly Disagree; 15% Undecided and Disagree, and 15% on Strongly Agree. 53.4% of the responded ticked that they are aware of the effect of these variables to health. A mean of 3.4 on our 5-point scale of estimation is not significantly observed which implies that the level of awareness of the variable is moderate.

Variable G3 (Home cleaning products can be a problem to dispose off), recorded scores of 35.7% on Disagree column; 26.7% on Undecided; 21.7% on Agree; 11% on Strongly Disagree and, 5% Strongly Agree respectively. 46.7% of the respondents are aware of the effects of these variable during disposal. With a mean score of 2.7, standard deviation and variance 0.9, shows the variable G3 is not significantly responded to, so its public level of awareness is moderately low.

Variable H1(Household glasses can be harmful to health) scored 33.3% on Agree; 25% on Strongly Agree and Disagree column, 10% on Undecided, and 6% on Strongly Disagree. 58.3% of respondents are aware of the effects this variable have to their health if not used properly. A mean score of 2.9, standard deviation of 0.8, and variance of 0.7, implies a low level of awareness of the variable.

Variable H2 (Household glasses can be harmful to your environment) recorded scores of 39.7% under Agree; 22% under Undecided, 21.7% on Strongly Disagree, 10.3% on Strongly Agree, and 6.3% on Disagree. 48% of the sampled householders are aware of the effect of these variables to the environment. With a mean of 3.1, it shows that the public were indeterminate. The level of awareness is moderate.

Variable H3 (Household glasses can be a problem to dispose off) scored 35.7% on Disagree, 26.7% on Undecided; 21.7% on Agree; 11% Strongly Disagree; 5% Strongly Agree. 46.7% are unaware that these variables can be a problem to dispose of. A mean score of 3.0, standard deviation of 1.0 and variance of 0.9, shows that the response was indeterminate and the level of awareness is moderate.

Variables A1-H3 are represented on a Bar chart as shown in Fig 1 (A-H have been defined previously). The variables were plotted against their means.

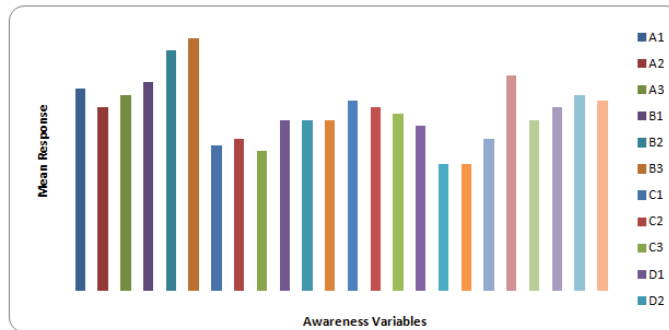


Fig 1 shows that with exceptions of B2 and B3 which the public agreed to, C1, C2, C3, F2 and F3 which the public disagreed to, the other 18 variables the public were undecided or indecisive. Therefore there is a strong consensus that the level of HHW awareness in Enugu Metropolis is low.

3.2 Factor Analysis of Awareness level of HHW in Enugu Metropolis

We adopted the PCA model to identify important factors which could be employed to explain the underlying factors responsible for the low level of awareness of HHW in Enugu Metropolis. The model successfully transformed our 24 attributes to 4 underlying dimensions which are shown in the order of importance (Table 3). The varimax orthogonal rotation was utilized to maximize variances and place the component axes in a unique position such that the components can be interpreted by as large a loading as possible relating to the fewer attributes possible. From Table 2, it is observable that Component I explains 33.182% of the total variance in the attributes, while Component IV, with a percentage of 17.218%, explains the least. Thus, the 4 components explain 100% of the total variance.

Table 2: PCA of the attributes of awareness of household hazardous waste.

Code	Attributes of level of awareness of HHW	Components			
		I	II	III	IV
X1	Paints can be harmful to health if not used properly	.255	.955*	.089	.120
X2	Paints can be harmful to the environment	.104	-.321	.936*	-.198
X3	Paints can be a problem to dispose of	-.228	.979*	.304	-.009
X4	Garden chemicals can be harmful to health	.537	.673	.426	-.277
X5	Garden chemicals can be Harmful to the environment	-.131	.692	.004	-.710
X6	Garden chemicals can cause problem when disposed of	.985*	.475	.528	-.251
X7	Motoring Products can be harmful to health if not used properly	.458	.926*	-.195	.492
X8	Motoring Products can be harmful to the environment	.630	-.462	-.385	.990*
X9	Motoring Products can be a problem to dispose of	.222	-.749	.066	-.621
X10	Batteries can be harmful to health if not used properly	.550	.131	-.087	.082
X11	Batteries can be harmful to the environment	-.658	.117	.972*	.102
X12	Batteries can be a problem to dispose of	.965*	.136	-.213	.076
X13	E-waste can be harmful to health if not used properly	.704	-.142	.301	-.628
X14	E-waste can be harmful to the environment	-.698	.193	.979*	.120
X15	E-waste can be a problem to dispose of	.984*	.694	.464	.022
X16	Medicines can be harmful to health if not used properly	.065	.145	.387	.909*
X17	Medical waste can be harmful to the environment	-.081	-.209	.964*	.187
X18	Medical waste can be a problem to dispose of	.989*	-.572	.356	.422
X19	Home-cleaning products can be harmful to health if not properly used	-.196	-.239	.422	.937*
X20	Home-cleaning products can be harmful to the environment	.029	.305	.925*	.199
X21	Home-cleaning products can be a problem to dispose of	.989*	.056	.004	.140
X22	Glasses can be harmful to health if not used properly	.047	.991*	-.084	-.988
X23	Glasses can be harmful to the environment	.021	.229	.926*	-.298
X24	Glasses can be a problem to dispose of	.959*	.066	-.249	.012

Eigen values	7.964	6.044	5.860	4.132
%of explained variance	33.182	25.182	24.417	17.218
Cumulative % variance	33.182	58.365	82.782	100.00

* significant loadings exceeding +/- 0.9, at 95% confidence level.

3.2.1 Component I

Component I has an eigen value of 7.964 and explains 33.182% of the total variance. High positive loadings are found on 6 attributes namely X6 (Garden chemicals can cause a problem when disposed of), X12 (batteries can be a problem to dispose of), X15(E-waste can be a problem to dispose of), X18(Medical waste can be a problem to dispose of), X21(Home cleaning products can be a problem to dispose of), X24 (Household glasses can be a problem to dispose of). These attributes are describing the general disposal problem of HHW arising from poor awareness of the harmful effects of HHW. Consequently many people are exposed to the dangers of improper disposal of HHW in Enugu metropolis. Component I is identified as general disposal problems.

3.2.2 Component II

Component II has an eigen value of 6.044 and explains 25.182% of the total variance. Three attributes have high positive loadings which are X1(Paints and their related products can be harmful to the health if not used properly), X3 (Paints can be a problem to dispose of) X7(Motoring Products can be harmful to health if not used properly), X22(Household glasses can be harmful to health). It is identified as poor handling of HHW associated especially with paints, used motoring products and glasses. The component II is therefore, identified as poor handling of HHW.

3.2.3 Component III

Component III has an eigen value of 5.860 and accounts for 24.417% of the total explained variance. Also this component has high positive loadings on five attributes. X2(Paints can be harmful to the environment), X11(Batteries can be harmful to the environment), X14(E-waste can be harmful to the environment), X17(Medical waste can be harmful to the environment), X20 (Home cleaning products can be harmful to the environment), X23(glasses can be harmful to the environment).This component is thus, an index of the environmental problems caused by HHW. This indicator reflects that householders are not aware of the dangers of HHW to their environment. It is identified as environment hazards.

3.2.4 Component IV

Component IV has an eigen value of 4.132 and explains 17.218% of the total variance. It has high positive loadings on four attributes. X8(Motoring Products can be harmful to the environment), X16(Medicine can be harmful to health if not properly used), X19 (Home-cleaning products can be harmful to health if not properly used), X22(Glasses can be harmful to health if not used properly). It is identified as the dangers of HHW to health.

Table 3: The relative strength of the underlying dimension of the attributes that determine the level of awareness of HHW in Enugu Metropolis.

S/N	Components	Underlying Dimensions	Relative Contribution	Cumulative
1	I	Disposal problems	33.182	33.182
2	II	Poor Handling	25.182	58.365
3	III	Environmental Hazards	24.417	82.782
4	IV	Health Problem	17.218	100.00

4. Conclusion and Recommendations

The HHW generated in Enugu Metropolis were classified into eight, they include paints, garden chemicals, batteries, motoring products, medicines, home cleaning products, e-waste and household glasses. From our awareness analysis it was found that the level of householders' awareness on the dangers of HHW in the Enugu metropolis is low. This low awareness level on the dangers associated with HHW may largely be attributed to be attitudinal as income level and/ or

level of education played little role in the general awareness level. From our PCA we identified four indices which include: general disposal problems, health related issues, environmental problems, and poor handling of HHW, which reflects low awareness of HHW in the study area. There is also no general consensus as to what constitute HHW in the study area as well as the potential health and environmental impacts which HHW hold. This resulted from variations in responses of like-hood impacts of HHW. For example while some respondents agreed that paints may constitute danger to the human health and environment if not properly disposed, other disagree. This development it is anticipated may likely to frustrate any effort at HHW management unless people are sensitized and enlightened.

During the field study it was observed that only the state solid waste management agency Enugu State Waste Management Agency ESWAMA manages domestic waste from households and there is no provision for HHW management. In addition, it was observed that at the moment there is no HHW collection taking place in Enugu Metropolis. From our awareness analysis, the people have a low level of awareness of the dangers of HHW to their health, environment and improper disposal. Thus for an effective management of HHW in Enugu Metropolis, we suggest the creation of laws or legislations backing the management of HHW in the study area. In addition, there should be a creation of a unit under ESWAMA solely for the management of HHW in Enugu Metropolis. This unit will be in charge of awareness campaigns on HHW. They will provide facilities for the collection, disposal and recycling of HHW in Enugu Metropolis. Also, this unit under ESWAMA should provide facilities for proper disposal of HHW. Since HHW are not separated from other wastes, it is necessary for it to provide a separate bag for HHW and distribute them to homes to ease and promote sorting.

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