Health-seeking behavior and waste management practices among women in major urban markets in Owerri, Nigeria

Cyprian Ezedike¹, Eudora Ohazurike², Faisal C Emetumah¹* and Okechukwu O Ajaegbu³

¹ Department of Geography & Environmental Management, Imo state university, Owerri, Imo state, Nigeria
² Department of Political Science, Imo state university, Owerri, Imo state, Nigeria
³ Department of Sociology, Imo state university, Owerri, Imo state, Nigeria

* Correspondence: Email: fc.emetumah@imsu.edu.ng.

Abstract: Behavioral patterns on seeking health are pertinent in terms of how waste is managed. However, informal approach towards waste management has led to poor environmental attitude and pernicious health consequences for many Nigerians. Despite plethora of scientific investigation on waste management, there has been paucity of information on health-seeking behavior and waste management practices among market women, hence the need for this research. The study aimed at assessing the health-seeking behavioral pattern of women traders on waste management in major urban markets in Owerri, Nigeria by identifying the extent of their commitment to sustainable waste management practices, investigating health-seeking behaviors that influence their attitude towards waste management and measuring prevalence of waste-related diseases among them. Data collection for the study involved a cross-sectional survey of 739 women trading in three Owerri major urban markets in line with the study’s aim. Results show that motivation to manage waste for disease control was effectively predicted by type of trading item (Omnibus Test: $\chi^2 = 13.871$, df = 3, p-value = 0.003); Cochrans-Armitage tests of trend show that there is no statistically linear trend between the proportions of understanding the 3Rs and the rankings for methods of seeking health; understanding the 3Rs was not determined by health-seeking method as most methods were with motivation to manage waste discordant (4 out 5 health-seeking methods had negative Goodman & Kruskal’s $G$ values); PCA on the prevalence of waste-related diseases had a two-component structure which followed acute and chronic dimensions; vegetable and plastics comprised the highest waste streams with plastics being most reused waste type while government is
mainly responsible for waste disposal. The study recommends a knowledge transfer approach in entrenching sustainable waste management practices.

**Keywords:** health-seeking behavior; health-seeking method; Owerri; market women; sustainable waste management; 3Rs; waste-related diseases

### 1. Introduction

Waste is any material that is not useful to the current owner and requires getting rid of while waste management involves activities aimed at protecting the overall health and wellbeing of all those who come in contact with waste materials [1]. The way waste is produced, stored, treated and disposed of, affects the overall health condition of any given community [2]. On that note, health-seeking behavior looks at the ability to strive for health care services and also understand the procedural approach to managing illness [3,4]. The concept of sustainable development as espoused in the Bruntland Report [5,6] provides the basis for sustainable waste management by ensuring that there is social, economic and environmental balance in handling waste materials. On that note, sustainable waste management covers activities aimed at: reducing, reusing, recycling and recovering energy from waste materials [7,8]. Much emphasis is placed on waste reduction, reuse and recycling due to their perceived environmental health benefits, hence they are sometimes referred to as “the 3Rs” [9]. However, putting sustainable waste management into practice is a problem [10], as waste disposal practices in Nigeria are still plagued by serious challenges [11]. In Nigeria, waste storage, treatment and disposal does not follow a sustainable approach due to poor supervisory guidelines which makes waste management a free-for-all activity [12]. Furthermore, environmentalism in Nigeria is predominantly anthropocentric in terms of viewpoint [13]. This has resulted to an informal approach to waste with pernicious environmental and health implications for all stakeholders in Nigeria [14]. Similarly, there are serious challenges in terms of domesticating and applying sustainable waste management practices in Nigeria [15]. Moreover, many individuals are not cognizant of the consequences of undiscerning environmental attitude on their health [16]. In addition, health challenges from waste contamination in Nigeria generally stem from carcinogenic heavy metals [17], waterborne diseases [18], respiratory infections, skin diseases [19] as well as spread of disease carrying pests [20]. Studies have been done on health-seeking behavior among communal household members [21], health-seeking behavior in rural areas [22], health-seeking behavior and electronic waste (e-waste) handlers [23]. However, there has been little focus on health-seeking behavior and waste management practices among market women. On that note, the study aims at evaluating the health-seeking behavioral pattern of women trading in three major urban markets in Owerri on waste management practices. Individual objectives were to identify the extent of commitment to sustainable waste management practices by women in selected Owerri urban area markets, to investigate health-seeking behaviors that influence attitude of women towards waste management in selected Owerri urban area markets and to measure prevalence of waste-related diseases among women in selected Owerri urban markets. Literature was reviewed based on these objectives.
1.1. Sustainable waste management practices

Sustainable waste management centered on reducing, reusing, recycling or recovering energy from waste has been explicated in many studies [24–33]. Nonetheless, understanding sustainable waste management is not wide-spread in many parts of the developing world [34,35]. In a top Nigerian university campus, recyclables make up over 70% of the waste stream but most of them are not recycled [36]. Similarly, individual daily waste generation in a private higher institution stood at about 0.35 kg/capita/day and material recovery has a market potential of about 1 million US dollars/year which is yet to be realized [37]. The situation is similar in Ghana where sustainable waste management practices covers mainly reusing and recycling metals and Polyethylene Terephthalate (PET) bottles [38]. In terms of waste collection challenges, public education has been identified as the most vital impediment to sustainable waste management [39]. On that note, a knowledge-based approach where a community can be technically informed and practically trained on the positives of sustainable waste management practices has been established and tested in Ibadan Nigeria [40]. In the same vein, a framework for sustainable waste management has been proposed in Egypt which combines improved management systems, government guidelines, increased stakeholder involvement and information sharing [41]. In the United Kingdom, neonatal health workers understand that sustainably managing waste will require more resourcefulness but are ready to make the necessary sacrifice [42].

1.2. Health-seeking behaviors that influence attitude

A number of studies have tried to elucidate health issues in Nigeria in terms of health-seeking behavior for mostly common ailments and maternal health afflictions [43–53]. However, there are several factors that affect whether or not an individual will seek good health in Nigeria: level of education, socio-economic status, age bracket, location, gender [54–56] socio-cultural and religious beliefs [57,58], traditional customs and marital status [59–61]. However, women are more likely to seek health than men [62] while socio-economic factors significantly affect willingness of some Nigerians to engage in sustainable waste management practices [63]. In many Nigerian communities, health-seeking behavior patterns show that low to middle income earners frequented unregistered chemists and pharmacy shops for their health issues, while most high income earners sought the services of private clinics [21,64]. Similarly, Nigerian university undergraduates depend on their family members, colleagues in health-related disciplines, pharmacies around the campus and trado-religious centers for healthcare information and services [65,66]. The situation is also similar among Nigerian parents who are mostly reticent in seeking healthcare for their children [67], due to factors like urbanization [68], healthcare quality, communal ethnic diversity [69,70] and even health insurance uptake [71].

1.3. Prevalence of waste-related diseases

In Nigeria, prevalence of acute diseases like malaria, meningitis and other water and air borne diseases are attributable to improper waste management [72–74]. Perinatal mortality, birth deformities and leukemia have also been identified as chronic waste-related ailments in many parts of the world [75]. In addition, waste that is contaminated with heavy metals can lead to
cardiovascular diseases like heart disease, hypertension [76–78], chronic respiratory and reproductive diseases even among children [79,80]. The situation is not different in Osun State Nigeria where river pollution by heavy metals have high carcinogenic potential [81]. Similarly, lack of vaccination against diseases like tetanus and hepatitis is a significant factor in the health status of informal waste collectors [82]. In the same vein, many cleaners in a Nigerian tertiary hospital are not very knowledgeable about hepatitis infection and vaccination with serious consequences [83]. In addition, Phosphogypsum and phosphate waste from fertilizer production have been identified as radiological with significant carcinogenic effect [84]. This may be why fish sampled from Nigerian waters polluted by agricultural wastes have pernicious levels of organochlorine pesticides [85] with a significant cancer risk. Therefore, it is not surprising that waste materials as a result of oil exploration in the Niger Delta area of Nigeria have been linked to the prevalence of gastrointestinal ailments [86].

2. Methods

The study was conducted in Owerri metropolitan area which includes the capital territory of Imo State, Southeast Nigeria. Owerri metropolitan area is approximately 120 km² in area, covering four Local Government Areas (LGAs): Owerri Municipal, Owerri West, Owerri North and Mbaite with a 2016 projected population of about 882,500 for the four LGAs [87]. The area lies on the geographical coordinates of latitudes 5°26' North to 5°53' North and longitudes 6°97' East to 7°03' East. The study which was explorative in approach, focused on three major urban markets in the study area: Eke-Ukwu Owerri market, Owerri relief market and Egbeada modern market. These markets were purposively selected after carefully considering all major markets in the study area; the selected markets were considered largest in terms of size and designation. Cross-sectional survey research design using questionnaire was utilized as data collection instrument. The questions followed the study objectives as the questionnaire was divided into sections covering these objectives. In terms of validation, the questions were designed with contributions by all authors after which they were reviewed and corrections made by the first and second authors. Furthermore, the final questionnaire was also reviewed and affirmed by a female academic with years of experience as a trader in an Owerri major market. The population of the study includes all market women in Owerri metropolitan area who numbered about 35,000 according to market union officials; 780 of these market women were sampled for quantitative data collection. Quota sampling method was used in surveying 260 (780/3) women operating in each of the 3 selected major urban markets in Owerri metropolitan area. Necessary approvals were gotten from the market union prior to commencing the survey. Questionnaires were serially numbered before distribution for identification purposes during data processing. After the field work, 753 questionnaires were retrieved out of which 739 were appropriately filled. Distribution and collection of questionnaires took about 3 months and were concluded by 6th of May, 2019. SPSS version 21 was used in analyzing the study results. In order to facilitate inputting data into SPSS, options for each question were numbered-coded mostly in ascending order; this was done prior to distributing the questionnaires. The 739 retrieved questionnaires were individually inputted into an SPSS data template based on the numbering codes initially given to the respective questions.
2.1. Data analysis

Ordinal logistic regression based on proportional odds was used in analyzing data collected on extent of motivation to manage waste in order to control disease (dependent variable) predicted by type of item traded by market women in the study area (independent predictor variable). Firstly, dummy variables which are dichotomous coefficients that can be able to fit into the regression model, were created for both dependent and independent variables. Ordinal logistic regression has assumptions which determine its practicability: proportional odds model should be a good fit [88]; no multi-collinearity for the independent variables indicated by tolerance values of collinearity statistics from dummy variables created [89]; covariate patterns should be acceptable if the independent variable is measured on a scale above nominal [90]. Since the study’s regression is the proportional odd model type, Generalized Linear Model (GENLIN) procedure and its Polytomous Universal Model (PLUM) output were used for testing for full likelihood ratio (parallel lines test) [91]. Separate binomial regressions were also carried out for the respective cumulative-dichotomous dependent variables (dummies) so as to confirm the results of the full likelihood ratio test by checking for similarities between the parameter estimates and odds ratio values [92]. Furthermore, negative notations on some of the parameter estimate values do not affect similarities between the values [93]. The thresholds for the dependent variable are the cumulative logits for the dummy variables and are mainly applicable in determining probabilities of the categorical variables [94].

In looking at methods of seeking health and understanding the 3Rs of sustainable waste management, Cochran-Armitage test of trend was used in determining whether there was a linear trend between the levels of each health-seeking method and understanding the 3Rs of sustainable waste management. In doing this, crosstabs were done for each method of seeking health (ordinal) and whether or not market women in Owerri understood the 3Rs of sustainable waste management (dichotomous). In addition, binary logistic regression was ran for each combination of the respective methods of seeking health and understanding sustainable waste management which part of the test procedure [95]. Cases were also weighted by the frequency counts of respective cross-tabulated sets.

Goodman and Kruskal’s $G$ was used in correlating the extent of motivation to sustainably manage waste so as to have a clean/healthy environment (slight, moderate, considerate and great) and rankings of patronage of different methods of seeking health. In doing this, respective variable cases were weighted by the frequency count for individual crosstabs of the variables under scrutiny. Goodman and Kruskal’s $G$ ranges from 1 to $-1$ with positive $G$ indicating concordance while negative $G$ indicates discordance depending on the significance level [96].

Principal component analysis (PCA) was used in analyzing the prevalence rate of waste-related diseases. PCA was applied because sample size was deemed suitable since it was more than 300. Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) which measures adequacy using scores ranging from 0 to 1; scores closer to 1 are more adequate. In addition, Bartlett’s test of sphericity indicates practicability of PCA if its calculated p value is significant. The number of components to be retained are usually determined by eigenvalue scores more than 1, scree plot test, and interpretability criterion using varimax rotation method [97,98].
3. Results

3.1. Socio-demographic characteristics and waste management practices among market women that participated in the study

Most of the respondents surveyed were less than 55 years in age with 203 of them aged between 30 and 41 years while 173 were aged between 42 and 53 years. Over 80% of the respondents were educated with 45.9% and 32.9% of them having primary and secondary education respectively, as their highest level of education. In terms of trading item, over 50% of the respondents traded in vegetables/foodstuff while cloths and provisions traders comprised about 17% each. Traders in building materials/electrics comprised 12.6% of the surveyed respondents.

The study results show that vegetable/food and plastics were the commonest waste types with over 80% of the responses (see Table 2). This was followed by paper waste at 11.7% while glass waste had the least responses at 3.6%. Furthermore, government was identified as the main evacuator of waste in major markets in Owerri as 52.8% of the responses were under this category. This was followed by paid disposal (16%) and self-disposal (14.8%). In addition, 9.4% of the respondents disposed their waste by burning it while market unions were responsible for disposing waste as opined by about 7% of the respondents.

Table 1. Socio-demographic data on market women who participated in the study (n = 736).

| Respondents’ characteristics               | N  | %  |
|-------------------------------------------|----|----|
| 1. Age groups                             |    |    |
| 18–29 years                               | 130| 20.4|
| 30–41 years                               | 203| 31.8|
| 42–53 years                               | 173| 27.1|
| 54–65 years                               | 86 | 13.5|
| 66+                                       | 46 | 7.2 |
| 2. Highest level of education             |    |    |
| None                                      | 41 | 5.7 |
| Vocational                                | 90 | 12.4|
| Primary                                   | 332| 45.9|
| Secondary                                 | 238| 32.9|
| Tertiary                                  | 22 | 3.0 |
| 3. Type of trading item                   |    |    |
| Foodstuff/vegetables                      | 378| 52.3|
| Cloths                                    | 125| 17.3|
| Provisions                                | 129| 17.8|
| Building/electric materials               | 91 | 12.6|
Table 2. Common waste type and waste disposal strategies among respondents of the study (n = 736).

| Common waste type | N   | %   |
|-------------------|-----|-----|
| Plastic           | 182 | 25.1|
| Glass             | 26  | 3.6 |
| Vegetable         | 431 | 59.5|
| Paper             | 85  | 11.7|

| Waste disposal strategies | N   | %   |
|---------------------------|-----|-----|
| Burning                   | 68  | 9.4 |
| Self-disposal             | 107 | 14.8|
| Union                     | 50  | 6.9 |
| Government                | 381 | 52.8|
| Paid disposal             | 115 | 16  |

In terms of the extent of waste reuse among women in Owerri major urban markets (see Table 3), the responses indicate that waste reuse was generally not very high. Plastics had the highest responses for great and considerable extent of reuse (cumulatively a little over 35%), while glass and vegetable/food wastes had the most responses for slight extent of reuse at 61.4% and 51% respectively. Reuse of paper and glass waste to great extent had similar responses at about 8% each.

Table 3. Extent of waste reuse among market women that participated in the study (n = 736).

| Extent of waste reuse | N   | %   |
|-----------------------|-----|-----|
| 1. Plastic waste      |     |     |
| Great                 | 106 | 15.1|
| Considerable          | 152 | 21.6|
| Moderate              | 174 | 4.7 |
| Slight                | 272 | 38.6|
| 2. Vegetable waste    |     |     |
| Great                 | 67  | 9.5 |
| Considerable          | 120 | 17  |
| Moderate              | 159 | 22.5|
| Slight                | 360 | 51  |
| 3. Paper waste        |     |     |
| Great                 | 60  | 8.5 |
| Considerable          | 130 | 18.4|
| Moderate              | 179 | 25.4|
| Slight                | 336 | 47.7|
| 4. Glass waste        |     |     |
| Great                 | 62  | 8.7 |
| Considerable          | 97  | 13.7|
| Moderate              | 115 | 16.2|
| Slight                | 436 | 61.4|
3.2. Ordinal logistic regression model for predicting motivation to manage waste for disease control among respondents of the study

Responses by the study’s respondents on the extent of motivation to manage waste in order to control disease (great extent, considerable extent, moderate extent and slight extent) were subjected to ordinal logistic regression based on proportional odds using the categorical types of trading item (foodstuff/vegetables, cloths, provisions and building/electric materials) as the independent predictor variable. The assumptions of ordinal logistic regression were examined for the extent of motivation to manage waste in order to control disease through dummy variables created for the both the dependent and independent variables.

Table 4. Test for collinearity tolerance between the predictor and dependent variables for the regression model.

| Predictor: type of trading item | Collinearity tolerance coefficients |
|--------------------------------|-----------------------------------|
| Vegetables/foodstuff           | 0.404                             |
| Cloths                         | 0.510                             |
| Provisions                     | 0.501                             |
| Building/electrics*            | -                                 |

Note: *Reference category.

In terms of collinearity, Table 4 show that all the tolerance values of the types of trading item were above 0.400 for extent of motivation manage waste for disease control, indicating that multi-collinearity was very unlikely. The problem of covariate pattern did not arise for the regression model since one nominal independent variable was used. Therefore, ordinal logistic regression modelling was carried out using the GENLIN procedure in SPSS. Furthermore, PLUM output generated in the GENLIN procedure was used in only carrying out full likelihood ratio test (parallel lines test). The results show that there is an insignificant difference between the proportional odds model and a variant location parameter model ($\chi^2 (6) = 2.284, p = 0.892$), indicating that the assumption of proportional odds based on the parallel lines test was met. Separate binomial regressions were also carried out for the respective cumulative-dichotomous dependent variables so as to confirm the results of the full likelihood ratio test. In doing this, the aim was to identify the similarities between the parameter estimates (coefficients) and odds ratio values for each independent variable; similarities are checked since they are likely not going to have exact values in reality.

From Table 5, the results show categories for types of trading item with extent of motivation for disease control were quite similar in the values of their parameter estimates and exponential odds ratio which also agrees with the insignificant result of the full likelihood test using parallel lines.

Table 6 shows that extent of motivation to manage waste in order to control disease-type of trading item regression model fitted the data quite well given that values for both deviance ($\chi^2 (6) = 2.284, p = 0.381$) and Pearson ($\chi^2 (6) = 2.257, p = 0.376$) in the goodness-of-fit test were insignificant. Moreover, the extent of motivation to manage waste in order to control disease was also predicted significantly by the threshold model as shown by the statistics of the Omnibus test, $\chi^2 (3) = 13.871, p = 0.003$. Furthermore, the predictive model based on the type of trading item was effective in predicting the extent
of motivation to manage waste in order to control disease as demonstrated by the tests of model effects, \( \chi^2 (3) = 13.759, p = 0.003 \). The value for Akaike’s information criterion has also been provided for comparison with other similar models based on the parameters used for this particular model.

**Table 5.** Separate binomial logistic regressions for the three dichotomized variables created for the regression model.

| Type of trading item                  | Extent of motivation for disease control (“great extent” as reference) | Parameter estimates(B) | Exp(B) (Odds ratio, OR) |
|--------------------------------------|------------------------------------------------------------------------|------------------------|------------------------|
|                                      |                          | Cat1                   | Cat2                   | Cat3                   | Cat1       | Cat2       | Cat3       |
| Vegetable/foodstuff vs. (ref*)        |                           | 0.158                  | 0.377                  | 0.105                  | 1.171      | 1.458      | 1.111      |
| Cloths vs. (ref*)                     |                           | −0.307                 | −0.137                 | −0.378                 | 0.735      | 0.872      | 0.686      |
| Provisions vs. (ref*)                 |                           | 0.529                  | −0.234                 | −0.450                 | 0.589      | 0.792      | 0.638      |

Note: Ref* = Building/electrics; Cat1 = Slight vs. other responses; Cat2 = Moderate & considerable vs. other responses; Cat3 = Slight, moderate & considerable vs. other responses.

**Table 6.** Goodness-of-fit tests for the ordinal logistic regression model.

| Test                          | Value | Df | p-value |
|-------------------------------|-------|----|---------|
| Deviance                      | 2.284 | 6  | 0.381   |
| Pearson Chi-Square            | 2.257 | 6  | 0.376   |
| Akaike’s Information Criterion (AIC) | 71.951 |     |         |

Note: Omnibus Test: Likelihood Ratio Chi-Square = 13.871, df = 3, p-value = 0.003; Test of Model Effects: Wald Chi-Square = 13.759, df = 3, p-value = 0.003.

The results in Table 7 shows that odds of respondents selling provisions being motivated to manage waste in order to control disease was 1.524 (95% CI, 0.918 to 2.531) times that of those dealing on building materials while those selling cloths had odds of 1.307 (95% CI, 0.782 to 2.185) times that of those selling building materials. Respondents selling food stuff/vegetables had similar odds to those dealing on building materials since its exponent of .806 is close to 1.

**Table 7.** Parameter estimates for the overall ordinal logistic regression model using GENLIN procedure.

| Parameter                        | B     | Std. Error | Sig. | Exp(B) | 95% Wald CI for Exp(B) |
|----------------------------------|-------|------------|------|--------|-----------------------|
|                                  |       |            |      |        | Lower     | Upper    |
| Threshold [Cat1]                 | 0.014 | 0.2024     | 0.945| 1.014  | 0.682     | 1.508    |
| [Cat2]                           | 0.835 | 0.2050     | 0.000| 2.304  | 1.542     | 3.444    |
| [Cat3]                           | 2.082 | 0.2228     | 0.000| 8.020  | 5.182     | 12.413   |
| [Vegetable/foodstuff vs. (ref*)] | −0.216| 0.2240     | 0.335| 0.806  | 0.519     | 1.250    |
| [Cloths vs. (ref*)]              | 0.268 | 0.2621     | 0.307| 1.307  | 0.782     | 2.185    |
| [Provisions vs. (ref*)]          | 0.422 | 0.2587     | 0.103| 1.524  | 0.918     | 2.531    |

Note: Ref* = Building/electrics, Threshold = Extent of motivation to manage waste for disease control, Cat1 = Slight vs. other responses, Cat2 = Moderate & considerable vs. other responses Cat3 = Slight, moderate & considerable vs. other responses, CI = Confidence Interval.
3.3. Health-seeking behavior and waste management attitude among market women that participated in the study

Cochran-Armitage test of trend was used in determining whether there was a linear trend between the levels of each health-seeking method and understanding the 3Rs of sustainable waste management. In doing this, crosstabs were done for each method of seeking health (ordinal) and whether or not market women in Owerri understood the 3Rs of sustainable waste management (dichotomous). In addition, binary logistic regression was ran for each combination of the respective methods of seeking health and understanding sustainable waste management. Cases were also weighted by the frequency counts of respective cross-tabulated sets.

Table 8. Cochran-Armitage test of trend results for understanding the 3Rs of sustainable waste management and methods of seeking health among respondents of the study (n = 736).

| Method of seeking health | Proportions of understanding sustainable waste management’s 3Rs for each method of seeking health | CATT score | p-value |
|--------------------------|-------------------------------------------------------------------------------------------------|-----------|--------|
|                          | Not at all | Not often | Often | Very often |          |          |
| Divine healer            | 0.893      | 0.888     | 0.820 | 0.841      | 3.260    | 0.071    |
| Chemist shop             | 0.960      | 0.915     | 0.859 | 0.862      | 1.783    | 0.182    |
| Pharmacy                 | 0.870      | 0.821     | 0.863 | 0.890      | 1.659    | 0.198    |
| Hospital                 | 0.941      | 0.874     | 0.840 | 0.873      | 0.799    | 0.371    |
| Traditional medicine     | 0.905      | 0.849     | 0.837 | 0.930      | 0.414    | 0.520    |

Note: CATT = Cochran-Armitage test of trend.

The proportions of market women that agreed to understanding the 3Rs based on the rankings for the different methods of seeking health in decreasing order of p-values, are shown in Table 8. The results shows that none of the test results specifies a statistically linear trend between the proportions of understanding the 3Rs and the rankings for each method of seeking health.

Goodman and Kruskal’s G was used in correlating the extent of motivation to sustainably manage waste so as to have a clean/healthy environment (slight, moderate, considerate and great) and rankings of patronage of different methods of seeking health (see Table 9). In doing this, respective variable cases were weighted by the frequency count for individual crosstabs of the variables under scrutiny.

Table 9. Goodman and Kruskal’s G scores and significance levels of correlating motivation to manage waste and the different methods of seeking health among respondents in the study (n = 736).

| Crosstab variables | Goodman and Kruskal’s G | p-value |
|--------------------|-------------------------|--------|
| Motivation to manage waste so as to have a clean/healthy environment | Divine healer | −0.301 | 0.000 |
|                     | Hospital                | −0.265 | 0.000 |
|                     | Chemist shop            | 0.159  | 0.004 |
|                     | Pharmacy                | −0.115 | 0.039 |
|                     | Traditional medicine    | −0.091 | 0.062 |
Results of the Goodman and Kruskal’s $G$ test showed that all the methods of seeking health were discordant (negative $G$) with motivation to manage waste in order to maintain a clean/healthy environment, except for seeking health in a chemist shop which was concordant (positive $G$). However, the $p$ values showed that the concordance and discordance for seeking health through a diving healer, hospitals, chemist shop and pharmacy were significant ($p \leq 0.05$) while that for seeking health through traditional medicine was not significant ($p > 0.05$).

3.4. Analysis of waste-related disease prevalence among respondents of the study using PCA

Results on waste-related disease prevalence were subjected to PCA with the aim of identifying the patterns in the prevalence rate of these diseases. In terms of suitability, the sample size was deemed suitable since it was more than 300 and the calculated Cronbach alpha for the 8 items was 0.816. In addition, Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) was 0.771; individual KMO values ranged between 0.723 and 0.852. Bartlett’s test of sphericity was statistically significant, $\chi^2 (28) = 1760.66, p < 0.0005$. Therefore, both KMO and Bartlett’s test results were within acceptable range for conducting PCA [96,97]. From Table 4, the analysis indicates that only the first two components had > 1 eigenvalues with individual variance explained values of 44.13% and 19.26% respectively.

Rotation of the two extracted components evened values for percentages of variance for the first and second components which were now 32.24% and 31.15% respectively (see Table 10). Furthermore, the scree plot showed viability of retaining two components while the interpretability criterion was also supported by a two-component structure. Therefore, two components were retained with a cumulative variable explained of 63.39%. As shown in Table 5, Varimax rotation was utilized to facilitate a simple structure in line with the interpretability criterion.

Table 10. Total variance explained by the PCA for waste-related disease prevalence among respondents of the study.

| Component | Initial eigen values | Extraction sums of squared loadings | Rotation sums of squared loadings |
|-----------|----------------------|------------------------------------|----------------------------------|
| Component | Total | % of Variance | Cumulative | Total | % of Variance | Cumulative | Total | % of Variance | Cumulative |
| 1         | 3.530 | 44.125 | 44.125 | 3.530 | 44.125 | 44.125 | 2.579 | 32.242 | 32.242 |
| 2         | 1.541 | 19.264 | 63.389 | 1.541 | 19.264 | 63.389 | 2.492 | 31.147 | 63.389 |
| 3         | 0.932 | 11.645 | 75.034 |
| 4         | 0.565 | 7.066 | 82.099 |
| 5         | 0.484 | 6.055 | 88.154 |
| 6         | 0.398 | 4.974 | 93.129 |
| 7         | 0.292 | 3.654 | 96.783 |
| 8         | 0.257 | 3.217 | 100.000 |

Components that loaded strongly to both components are emboldened in Table 11. The rotated component matrix shows that prevalence values of diarrhea and cough are strongly loaded (0.836 and 0.806 respectively) to component 1, while prevalence values of malaria and tetanus are moderately loaded (0.700 and 0.658 respectively) also with component 1. Hypertension and hepatitis are strongly loaded (0.824 and 0.814 respectively) with component 2. The communality values after extraction for the whole components had an average of 0.634 which was relatively adequate.
Table 11. Rotated Component Matrix (Varimax rotation) for the extracted components and communalities.

| Variable (Disease prevalence) | Components | Communality |
|-------------------------------|------------|-------------|
|                               | 1          | 2          |
| Prevalence of Diarrhea        | 0.836      | 0.131      | 0.717       |
| Prevalence of Cough           | 0.806      | 0.085      | 0.656       |
| Prevalence of Malaria         | 0.700      | 0.026      | 0.490       |
| Prevalence of Tetanus         | 0.658      | 0.373      | 0.572       |
| Prevalence of Hypertension    | 0.013      | 0.824      | 0.680       |
| Prevalence of Hepatitis       | 0.055      | 0.814      | 0.666       |
| Prevalence of Eczema          | 0.262      | 0.798      | 0.705       |
| Prevalence of Respiratory disease | 0.487    | 0.590      | 0.585       |

4. Discussion

Study results in Table 2 indicate that most respondents depend on government in terms of waste collection and evacuation. Over dependence on government in terms of waste disposal can be perceived as an informal approach [14] due to inconsistencies and unreliability of government in terms of overall waste management in a Nigerian state as espoused in [11]. Furthermore, burning of waste as practiced by some market women in Owerri demonstrates the challenges of domesticating sustainable waste management in Nigeria [15]. Findings of the study in Table 3 shows that plastic waste had the highest extent of reuse among market women in Owerri. This position is in line with the waste reuse in Ghana were plastics, especially PET bottles have the highest rate of reuse unlike other waste streams [38].

Results of the ordinal regression shows the extent of motivation to manage waste in order to control disease was predicted significantly by the threshold model (Omnibus test, $\chi^2 (3) = 13.871, p = 0.003$) which was also supported by the statistically significant test of model effects (Wald $\chi^2 (3) = 13.759, p = 0.003$). However, none of these odds had a statistically significant effect in terms of predicting the dependent variable as shown in Table 6. The odds of provision and cloth sellers being high than those of foodstuff/vegetable sellers supports the assertions that sustainable waste management is still rudimentary in a developing country like Nigeria [34,35]. This is because foodstuff/vegetable sellers would be expected to have more motivation to manage waste in order to control disease since vegetable waste is the commonest waste generated in the study area (see Table 2). This result could be attributable to poor environmental health attitude of many Nigerians [16] which results in many health issues for waste generators and handlers [17–20].

The study results on Cochran-Armitage test of trend of the 3Rs of sustainable waste management and methods of seeking health show that understanding the 3Rs is not determined by the extent of seeking health, irrespective of the method as none of the trends were significant (see Table 8). This may be attributable to the anthropocentric perspective of Nigeria’s environmentalism [13] which is reflected in the haphazard nature waste is managed in the country [12]. This could be the reason why factors relating to education, socio-economics, location and age have been identified as pertinent in health-seeking behavior [54–56]. However, seeking health through a divine healer was very close to linearity with a test score of 3.260 and a significance value of 0.071 which was higher than the significance levels for all
other health-seeking methods. This is in agreement with the assertions about the relevance of religious beliefs on the way some Nigerians seek health [58]. In addition, traditional medicine method of seeking health had the lowest test score (0.414) and also showed the most insignificance (p = 0.520). Even though traditional values in Nigeria have been significantly affected by westernization, they are still important in health-seeking behavior [59–61].

Results of the study on Goodman and Kruskal’s G test of crosstabs between motivation to manage waste so as to have a clean/healthy environment and five different methods of seeking health show that four out of the five methods were not concordant (negative G) with only chemist shop as a health-seeking method have a concordant relationship (positive G). The concordance in seeking health through a chemist shop points towards affordability as many Nigerians patronize these outlets since they may not afford going to hospitals [21,64]. Similarly, their patronage of conventional health-seeking methods may be detered by urban development and ethnicity [68–70]. Furthermore, the Goodman and Kruskal’s G test results imply that higher motivation to manage waste in order to have a clean/healthy environment is negatively related with frequently seeking health through divine healer, hospital, pharmacy and traditional medicine. This is because rather than seek health from qualified professionals, some Nigerians resort to family members, quacks and other unorthodox means for healthcare services [65,66], even for their children [67].

In terms of the PCA carried on the prevalence of eight waste-related diseases, the two component structure interpreted by the PCA was in line with the prevalence of waste-related diseases which follow the main constructs of acute [74,73] and chronic [76–78] waste-related diseases and ailments. Therefore, the prevalence of acute (malaria, diarrhea, cough and tetanus) and chronic (Hypertension, respiratory disease and hepatitis) waste-related diseases can be interpreted as following the PCA structure of component 1 and component 2 respectively. In addition, market women in Owerri especially those dealing on foodstuff/vegetables may be indirectly affected by the pollution in some Nigerian rivers [81] and even fertilizer waste [84] as these pollutants may find their way into food products in the market [85]. Furthermore, the prevalence of these diseases can also be attributed to poor vaccination systems by waste handlers [82] and ignorance about the relationship between these diseases and waste management [83].

5. Conclusions

The study elucidated waste management practices of women trading in three Owerri main markets in relation with their health-seeking behavior, attitude as well as waste-related disease prevalence. The study recognized that vegetable and plastics are the most common waste type among the surveyed market women. Furthermore, government was identified as the major evacuator of waste from the markets while plastic waste was the most reused waste stream even though vegetable waste is more common. The study also identified that motivation to manage waste due to disease control was predicted by the type of trading item. In terms of waste management attitude affecting health-seeking behavior, understanding the 3Rs of sustainable waste management was not a significant factor in the method of seeking health among the surveyed market women. Similarly, most methods of seeking health among the market women surveyed were not in agreement with motivation to manage waste in order to have a clean environment which points towards affordable healthcare. Nonetheless, waste-related diseases had acute and chronic diseases as their principal components which implies that it is important to fill the knowledge gap in recognizing the basic nature of these diseases. The study has demonstrated the need for more awareness creation on waste management that adequately considers health attitude in Nigeria, especially among
market women who are very resilient micro-economic drivers; they can only be productive when they are in good health. However, domesticating these “alien” principles to many in the developing world must take a practical approach for it to be most effective. Therefore, the study recommends adopting a knowledge transfer approach which involves practical training exercises for health institutions, schools, markets and other public place where various waste streams are continually generated. This will provide more insight into health-seeking behavior and waste management practices, thereby driving home the fundamentals of sustainable development.

Acknowledgements

This work was approved by Imo State University (IMSU), Owerri research ethics committee and supported by IMSU 2018 IBR-TETFUND research funding program. We would like to acknowledge all market women that participated in the study and also 2018/2019 IMSU students from departments of Sociology and Geography & Environmental Management that participated as field assistants during data collection.

Conflict of interest

All authors declare no conflicts of interest in this paper.

References

1. Amasuomo E, Baird J (2016) The concept of waste and waste Management. J Mgt Sustainability 4: 88–96.
2. Mamady K (2016) Factors influencing attitude, safety behavior, and knowledge regarding household waste management in Guinea: a cross-sectional study. J Environ Pub Health.
3. MacKian S (2001) A review of health seeking behavior: problems and prospects. Health Sys Develop Prog.
4. Uche EO (2017) Factors affecting health seeking behavior among rural dwellers in Nigeria and its implications on rural livelihood. Eur J Soc Sci Stud 2: 74–86.
5. Brundtland GH, Khalid M, Agnelli S, et al. (1987) Our common future. New York, 8.
6. United Nations Environment Program (UNEP) (2011) Towards a green economy: Pathways to sustainable development and poverty eradication. Nairobi, Kenya: UNEP.
7. Seadon JK (2010) Sustainable waste management systems. J Cleaner Prod 18: 1639–1651.
8. Fratta KD, Toneli JT, Antonio GC (2019) Diagnosis of the management of solid urban waste of the municipalities of ABC Paulista of Brasil through the application of sustainability indicators. Waste Mgt 85: 11–17.
9. Manickam P, Duraisamy G (2019) 3Rs and circular economy. In: Circular Economy in Textiles and apparel: Processing, Manufacturing, and Design. Sawston: Woodhead Publishing, 77–93.
10. Almasi A, Mohammad M, Azizi A, et al. (2019) Assessing the knowledge, attitude and practice of the kermanshahi women towards reducing, recycling and reusing of municipal solid waste. Res Conser Recycling 141: 329–338.
11. Kazaure MB (2016) Survey on SWM for sustainable development and public health in Dutse metropolis, Jigawa state, Nigeria. Procedia Environ Sci 35: 57–64.
12. Ezeah C, Roberts CL (2014) Waste governance agenda in Nigerian cities: A comparative analysis. *Habitat Int* 41: 121–128.

13. Emetumah FC (2017) Modern perspectives on environmentalism: ecocentrism and technocentrism in the Nigerian context. *Asian Res J Arts Soc Sci*, 1–9.

14. Oguntuoyinbo OO (2012) Informal waste management system in Nigeria and barriers to an inclusive modern waste management system: a review. *Public Health* 126: 441–447.

15. Abd’Razack NT, Medayese SO, Shaibu SI, et al. (2017) Habits and benefits of recycling solid waste among households in Kaduna, north west Nigeria. *Sust Cities Soc* 28: 297–306.

16. Lawanson T, Fadare S (2015) Environment and health disparities in urban communities: focus on Eti Osa, Nigeria. *City Culture Soc* 6: 43–52.

17. Ebong GA, Etuk HS, Dan EU (2017) Distribution, pollution index and associated health risk of trace metals in waste-impacted soils within Akwa Ibom State, Nigeria. *Geosyst Engr* 21: 121–134.

18. Otufale GA, Coster AS (2012) Impact of water scarcity and drudgery of water collection on women’s health in Ogun of Nigeria. *J Human Ecol* 39: 1–9.

19. Oguntoke O, Otusanya OK, Annegarn HJ (2013) Emission of pollutants from wood waste incineration at sawmills in Abeokuta metropolis, Nigeria. *Int J Environ Stud* 70: 964–975.

20. Olaseha IO, Sridhar MKC, Oyewo OA (2005) Developing sustainable market waste management through the joint efforts of technocrats and traders: a case study from Ibadan, Nigeria. *Int J Health Prom Edu* 43: 36–44.

21. Akande TM, Owoyemi JO (2009) Healthcare-seeking behavior in Anyigba, north central, Nigeria. *Res J Med Sci* 3: 47–51.

22. Omotoso O (2010) Health seeking behavior among the rural dwellers in Ekiti state, Nigeria. *African Res Rev* 4: 125–138.

23. Asampong E, Dwuma-Badu K, Stephens J, et al. (2015) Health Seeking behaviors among electronic waste workers in Ghana. *BMC Public Health* 15: 1065.

24. Moore SA (2012) Garbage matters: concepts in new geographies of waste. *Progress Human Geo* 36: 780–799.

25. Al-Maaded M, Madi NM, Kahraman R, et al. (2012) An overview of solid waste management and plastic recycling in Qatar. *J Polymer Environ* 20: 186–194.

26. Abdul-Rahman F (2014) Reduce, reuse, recycle: alternatives for waste management. *Guide* 314: 1–4.

27. Brunner PH, Rechberger H (2015) Waste to energy-key element for sustainable waste management. *Waste Mgt* 37: 3–12.

28. Cucchiella F, ID’Adamo I, Gastaldi M (2017) Sustainable waste management: waste to energy plant as an alternative to landfill. *Energy Conver Mgt* 131: 18–31.

29. Lam C, Yu IK, Medel Y, et al. (2018) Life-cycle cost-benefit analysis on sustainable food waste management: the case of hong kong international airport. *J Cleaner Prod* 187: 751–762.

30. Srikanth S, Kumar M, Puri SK (2018) Bio-electrochemical system (BES) as an innovative approach for sustainable waste management in petroleum industry. *Biore Tech* 265: 506–518.

31. Edalatpour MA, Al-e-hashem SMJ, Karimi B, et al. (2018) Investigation on a novel sustainable model for waste management in megacities: A case study in tehran municipality. *Sust Cities Society* 36: 286–301.

32. Blaisi NI (2019) Construction and demolition waste management in Saudi Arabia: current practice and roadmap for sustainable management. *J Cleaner Prod* 221: 167–175.
33. Santos AC, Mendes P, Teixeira MR (2019) Social life cycle analysis as a tool for sustainable management of illegal waste dumping in municipal services. *J Cleaner Prod* 210: 1141–1149.

34. Gani BA, Chiroma A, Gana BA (2012) Women and solid waste segregation in Bauchi Nigeria. *J Env Earth Sci* 2: 25–45.

35. Shams S, Sahu JN, Rahman SM, et al. (2017) Sustainable waste management policy in bangladesh for reduction of greenhouse gases. *Sust Cities Society* 33: 18–26.

36. Adeniran AE, Nubi AT, Adelopo AO (2017) Solid waste generation and characterization in the university of lagos for a sustainable waste management. *Waste Mgt* 67: 3–10.

37. Coker AO, Achi CG, Sridhar MK, et al. (2016) Solid waste management practices at a private institution of higher learning in nigeria. *Procedia Environ Sci* 35: 28–39.

38. Peprah K, Amoah ST, Achana GT (2015) Assessing „3Rs” model in relation to municipal solid waste management in Wa, Ghana. *J World Environ* 5: 112–120.

39. Ezeah C, Roberts CL (2012) Analysis of barriers and success factors affecting the adoption of sustainable management of municipal solid waste in Nigeria. *J Environ Mgt* 103: 9–14.

40. Hammed TB, Wandiga SO, Mulugetta Y, et al. (2018) Improving knowledge and practices of mitigating green house gas emission through waste recycling in a community, Ibadan, Nigeria. *Waste Mgt* 81: 22–32.

41. Ibrahim M, Mohamed NA (2016) Towards sustainable management of solid waste in Egypt. *Procedia Environ Sci* 34: 336–347.

42. Nichols A, Mukonoweshuro R (2017) Understanding and knowledge of sustainable waste management within the neonatal unit: a qualitative investigation. *J Neonatal Nurs* 23: 127–133.

43. Tinuade O, Iyabo R, Durotoye O (2010) Health-care-seeking behavior for childhood illnesses in a resource-poor setting. *J Paediatrics Child Health* 46: 238–242.

44. Ugwueje EA (2012) Cultural environment, health seeking behavior and survival chances of under five children in south east Nigeria. *Int J Dev Mgt Review* 7.

45. Bisiriyu L, Ojemgui TK (2014) Mothers” health seeking behavior and socio-economic differentials: A factor analysis of full childhood immunization in south-western Nigeria. *J Public Health Epidemiol* 6: 132–147.

46. Okafor IP, Dolapo DC, Onigboghi MO, et al. (2014) Rural-urban disparities in maternal immunization knowledge and childhood healthseeking behavior in Nigeria: a mixed method study. *African Health Sci* 14: 339–347.

47. Liu J, Isiguzo C, Sieverding M (2015) Differences in malaria care seeking and dispensing outcomes for adults and children attending drug vendors in Nasarawa, Nigeria. *Trop Med Intl Health* 20: 1081–1092.

48. Egbhunwe MC, Egboka OL, Nwankwo UC (2016) Health seeking behavior amongst pregnant women attending antenal clinic in primary health care centers in rural communities of Nnewi North L.G.A Anambra State. *J Res Nurs Midwifery* 5: 1–10.

49. Akeju DO, Oladapo OT, Vidler M, et al. (2016) Determinants of health care seeking behavior during pregnancy in Ogun State, Nigeria. *Reprod Health* 13(1 Supplement): 32.

50. Fawibe AE, Odeigah LO, Akande TM, et al. (2017) Self-reported medical care seeking behavior of doctors in Nigeria. *Alexandria J Med* 53: 117–122.

51. Ogunjuyigbe PO, Fasogbon O, Oduusina KE, et al. (2017) Knowledge levels, treatment preferences and neonatal health problems in southwest Nigeria. *J Neonatal Nurs* 23: 258–266.
52. Onah MN, Horton S (2018) Male-female differences in households’ resource allocation and decision to seek healthcare in south-eastern Nigeria: results from a mixed methods study. *Soc Sci Med* 204: 84–91.

53. Kugbey N, Meyer-Weitz A, Asante KO (2019) Access to health information, health literacy and health-related quality of life among women living with breast cancer: Depression and anxiety as mediators. *Patient Educ Counseling* 102: 1357–1363.

54. Oluwadare C, Ibirinde B (2010) Health seeking behavior of tuberculosis patients in Ekiti state, Nigeria. *J Ethno Med* 4: 191–197.

55. Odaman OM, Ataman JE (2010) Youth welfare and health seeking behavior in Edo central, Nigeria. *Stud Ethno-Med* 4: 177–182.

56. Oshi DC, Oshi SN, Alobu IN, et al. (2016) Gender-related factors influencing women’s health seeking for tuberculosis care in Ebonyi state, Nigeria. *J Biosoc Sci* 48: 37–50.

57. Iyalomhe GB, Iyalomhe SI (2012) Health-seeking behavior of rural dwellers in southern Nigeria: implications for healthcare professionals. *Int J Trop Disease Health* 2: 62–71.

58. Ihaji E, Gerald EU, Ogwuche CH (2014) Educational level, sex and church affiliation on health seeking behavior among parishioners in Makurdi metropolis of Benue state. *J Educ Policy Entrepreneurial Res* 1: 311–316.

59. Duru CB, Iwu AC, Uwakwe KA, et al. (2017) Health care seeking behavior and predictors of combined orthodox and traditional health care utilization among households in communities in Owerri, Imo State, Nigeria. *Med Healthcare* 7: 115–137.

60. Adam VY, Aigbokhaode AQ (2018) Sociodemographic factors associated with the healthcare-seeking behavior of heads of households in a rural community in Southern Nigeria. *Sahel Med J* 21: 31–36.

61. Salami KK, Olugbayo AO (2013) Health-seeking behavior of migrant beggars in Ibadan, Southwestern Nigeria. *Health*.

62. Atchessi N, Ridde V, Abimbola S, et al. (2018) Factors associated with the healthcare-seeking behavior of older people in Nigeria. *Arch Geront Geriatrics* 79: 1–7.

63. Odufuwa BA, Odufuwa BO, Ediale OM, et al. (2012) Household participation in waste disposal and management in Ijebu-Ode, Nigeria. *J Human Ecol* 40: 247–254.

64. Latunji OO, Akinyemi OO (2018) Factors influencing health-seeking Behavior among civil servants in Ibadan, Nigeria. *Annals Ibadan Postgrad Med* 16: 52–60.

65. Afolabi MO, Daropale VO, Adegoke AA, et al. (2013) Health-seeking behavior and student perception of healthcare services in a university community in Nigeria. *Health 5*: 817–824.

66. Ajaegbu OO, Ubochi II (2016) Health seeking behavior among undergraduates in the faculty of health sciences and technology, university of Nigeria Enugu campus. *Int J Evaluation Res Edu* 5: 181–188.

67. Abdulkadir MB, Abdulkadir ZA (2017) A cross-sectional survey of parental care-seeking behavior for febrile illness among under-five children in Nigeria. *Alexandria J Med*, 53.

68. Okeke TA, Okeibunor JC (2010) Rural–urban differences in health-seeking for the treatment of childhood malaria in south-east Nigeria. *Health Policy* 95: 62–68.

69. Ukwaja KN, Talabi AA, Aina OB (2012) Pre-hospital care seeking behavior for childhood acute respiratory infections in south-western Nigeria. *Intl Health* 4: 289–294.

70. Adekanmbi VT, Adedokun ST, Taylor-Phillips S, et al. (2017) Predictors of differences in health services utilization for children in Nigerian communities. *Preventive Med* 96: 67–72.
71. Bonfrer I, Van de Poel E, Gustafsson-Wright E, et al. (2018) Voluntary health insurance in Nigeria: effects on takers and non-takers. *Soc Sci Med* 205: 55–63.
72. Coker A, Sangodoyin A, Sridhar M, et al. (2009) Medical waste management in Ibadan, Nigeria: obstacles and prospects. *Waste Mgt* 29: 804–811.
73. Ayandiran TA, Fawole OO, Dahunsi SO (2018) Water quality assessment of bitumen polluted Oluwa river, South-Western Nigeria. *Water Res Industry* 19: 13–24.
74. Orisakwe OE (2018) Nigeria: environmental health concerns. *Ref Module Earth Sys Environ Sci.*
75. Marfe G, Di Stefano C (2016) The evidence of toxic wastes dumping in Campania, Italy. *Critical Rev Oncol Hematol* 105: 84–91.
76. Essien JP, Inam ED, Ikpe DI, et al. (2019) Ecotoxicological status and risk assessment of heavy metals in municipal solid wastes dumpsite impacted soil in Nigeria. *Environ Nanotech Monitoring Mgt.*
77. Leung AOW (2019) Environmental contamination and health effects due to E-waste recycling. *Electr Waste Mgt Treatment Tech*, 335–362.
78. Pahari AK, Dubey BJ (2019) Waste from electrical and electronics equipment. *Plastics Energy*, 443–468.
79. Zeng X, Xu X, Boezen HM, et al. (2016) Children with health impairments by heavy metals in an e-waste recycling area. *Chemosphere* 148: 408–415.
80. Huo X, Wu Y, Xu L, et al. (2019) Maternal urinary metabolites of PAHs and its association with adverse birth outcomes in an intensive e-waste recycling area. *Environ Pollution* 245: 453–461.
81. Titilawo Y, Adeniji A, Adeniyi M, et al. (2018) Determination of levels of some metal contaminants in the freshwater environments of Osun State, Southwest Nigeria: A risk assessment approach to predict health threat. *Chemosphere* 211: 834–843.
82. Black M, Karki J, Lee ACK, et al. (2019) The health risks of informal waste workers in the Kathmandu Valley: a cross-sectional survey. *Public Health* 166: 10–18.
83. Abiodun O, Shobowale O, Elikwu C, et al. (2019) Risk perception and knowledge of hepatitis B infection among cleaners in a tertiary hospital in Nigeria: A cross-sectional study. *Clin Epidemiol Global Health* 7: 11–16.
84. Attallaha MF, Metwally SS, Moussa SI, et al. (2019) Environmental impact assessment of phosphate fertilizers and phosphogypsum waste: elemental and radiological effects. *Microchem J* 146: 789–797.
85. Taiwo AM (2019) A review of environmental and health effects of organochlorine pesticide residues in Africa. *Chemosphere* 220: 1126–1140.
86. Nriagu J (2011) Oil industry and the health of communities in the Niger delta of Nigeria. *Encyclop Environ Health*, 240–250.
87. City Population (2017) Imo State in Nigeria: subdivision. Available from: https://www.citypopulation.de/php/nigeria-admin.php?adm1id=NGA017.
88. Harrell FE (2017) *Regression modelling*. Vanderbilt university Nashville: Biostatistics department.
89. Harrell FE (2015) *Regression modeling strategies: with applications to linear models, logistic and ordinal regression, and survival analysis*, 2Eds., New York: Springer.
90. Horton NJ, Laird NM (1998) maximum likelihood analysis of generalized linear models with missing covariates. *Stat Methods Med Res* 8: 37–50.
91. Das S, Rahman R (2011) Application of ordinal logistic regression analysis in determining risk factors of child malnutrition in Bangladesh. *Nutrition J* 10: 124.

92. Bender R, Grouven U (1998) Using binary logistic regression models for ordinal data with non-proportional odds. *J Clin Epidemiol* 51: 809–816.

93. Park H (2013) An introduction to logistic regression: from basic concepts to interpretation with particular attention to nursing domain. *J Korean Acad Nurs* 43: 154–164.

94. Mielenz N, Spilke J, Borell EV (2010) Analysis of ordered categorical data with threshold models exemplified by plumage damage scores from laying hens differing in their genotype and rearing environment. *Poultry Sci* 89: 2521–2534.

95. Buonaccorsi JP, Laake P, Veierød M (2014) On the power of the Cochran–Armitage test for trend in the presence of misclassification. *Stat Methods Med Res* 23: 218–243.

96. Goodman LA, Kruskal WH (1972) Measures of association for cross classification IV: Simplification for asymptotic variances. *J Amer Stat Assoc* 338: 415–421.

97. Anderson HP, Ward J (2015) Principle component analyses of questionnaires measuring individual differences in synaesthetic phenomenology. *Consciousness Cog* 33: 316–324.

98. Kaiser HF (1974) An index of factorial simplicity. *Psychometrika* 39: 31–36.

© 2020 the Author(s), licensee AIMS Press. This is an open access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0)