Spatial Proximity, Household Vulnerability and Health Effects of Informal Solid-Waste Disposal in Obio/Akpor Local Government Area, Rivers State

Gospel Chimenma Dimkpa[1], Priscilia Nyekpunwo Ogbonda[1], Cookeygam Idawarifa Frank[1], Sogbeye Tonye Geroge[1], Dominic Joshua Osondu[2], Bapakaye Ibifuro Kemmer[3]
Department of Public Health Sciences, Faculty of Basic Medical Science,
College of Medical Science, Rivers State University, Nkpolu Oroworukwo, Port Harcourt[1]
Department of Environmental Management, University of Calabar, Calabar[2].
Institute of Geosciences and Environmental Management, Rivers State University, Nkpolu Oroworukwo, Port Harcourt[3]
ORCID id's:
Dr. Gospel Chimenma Dimkpa – 0009-0001-4295-0501,
Priscilia Nyekpunwo Ogbonda -0000-0003-4105-4518,
Cookeygam Idawarifa Frank – 0009-0006-8850-8838,
Sogbeye Tonye Geroge - 0009-0008-8483-0269,
Dominic Joshua Osondu – 0000-0001-5095-4695,
Bapakaye Ibifuro Kemmer -0009-0001-5613-6527
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Corresponding Author: idawarifa.cookeygam@ust.edu.ng

Abstract
Informal solid-waste disposal in rapidly urbanising communities poses environmental and public health concerns, particularly where residential areas are located near unmanaged waste sites. This study assessed household proximity to informal solid-waste disposal sites, vulnerability characteristics, and self-reported health symptoms in Obio/Akpor Local Government Area (LGA), Rivers State, Nigeria. A cross-sectional analytical design integrated household questionnaire surveys with geographic information system (GIS)-based spatial analysis. Of 427 questionnaires administered, 389 valid responses were retained, yielding a response rate of 91.1%. Additionally, 10 informal waste disposal sites were mapped, and their spatial distribution was assessed using Average Nearest Neighbor analysis. Descriptive statistics, Pearson's chi-square tests, and multivariable logistic regression were used to examine associations between residential proximity and reported health symptoms. Results showed that 238 respondents (61.2%) lived within 250 m of an identified disposal site. Dust exposure was reported by 71.5% of respondents, while 77.6% reported exposure to offensive odours. Headache (44.7%) and cough (43.2%) were the most frequently reported symptoms. Reanalysis of the supplied contingency-table counts revealed significant associations between residential-distance categories and headache ($\chi^2 = 19.76$, $p < 0.001$), cough ($\chi^2 = 15.59$, $p = 0.001$), breathing difficulty ($\chi^2 = 21.94$, $p < 0.001$), eye irritation ($\chi^2 = 15.25$, $p = 0.002$), and skin irritation ($\chi^2 = 16.14$, $p = 0.001$). The nearest-neighbour ratio of 0.60 suggested a clustered distribution of disposal sites, pending verification of the spatial-analysis parameters. The reported regression results indicated higher adjusted odds of respiratory

symptoms among respondents residing within 100 m of disposal sites (AOR = 2.84, 95% CI: 1.68–4.81), although the model requires verification against the original statistical output. The findings highlight the proximity of residential communities to informal waste disposal sites and the frequent reporting of environmental exposures and health symptoms. Improved waste management, spatial planning, and environmental monitoring are recommended. Given the cross-sectional design and reliance on self-reported symptoms, the findings indicate associations rather than causal relationships.

Keywords: *Informal solid-waste disposal, spatial proximity, household vulnerability, health effects, environmental exposure, waste-related health risks*

1. Introduction

Solid-waste management is an increasingly important environmental and public health challenge in rapidly urbanising communities, where population growth, changing consumption patterns, and inadequate waste collection services can contribute to the accumulation of refuse in residential environments. The indiscriminate disposal of solid waste in open spaces, roadsides, drainage channels, and other unregulated locations may create environmental nuisances, obstruct drainage, increase contact with decomposing materials, and provide conditions favourable to disease vectors. The location of informal disposal sites relative to residential settlements is therefore an important consideration in environmental health assessment and urban planning (Haywood et al., 2021; Okpara et al., 2021). Across the Niger Delta, the proliferation of irregular household waste-disposal sites has raised concerns about environmental sanitation and the capacity of local authorities to maintain safe and sustainable waste-management systems. Okpara et al. (2021) examined irregular household waste dumpsites in the Niger Delta and highlighted their implications for environmental management and public health monitoring. In Port Harcourt Metropolis, Ogboeli et al. (2024) also discussed the public health challenges associated with poor solid-waste management. These studies provide a regional basis for examining how informal waste disposal interacts with residential conditions and potential exposure pathways.

Spatial proximity is an important consideration because households situated close to informal disposal sites may experience more frequent contact with dust, smoke from waste burning, offensive odours, and other environmental nuisances. Depending on the composition and condition of the waste, the surrounding environment, and the pathways of contact, such conditions may contribute to exposure to potentially harmful substances or biological agents. However, residential distance is a proxy for potential exposure rather than a direct measurement of contaminant dose. Actual exposure may also depend on waste composition, prevailing wind direction, drainage and runoff patterns, groundwater conditions, household activities, and the duration and frequency of contact. Evidence from other settings reinforces the need to assess waste disposal within its broader social and environmental context. Akmal and Jamil (2021) investigated the health implications of improper solid-waste disposal in metropolitan Islamabad–Rawalpindi, while Haywood et al. (2021) examined waste-disposal practices in low-income South African settlements. Jakeni et al. (2024) investigated illegal dumping and community perspectives in informal settlements in Cape Town. Collectively, these studies demonstrate the importance of considering residential circumstances, service access, and community experiences when examining informal waste disposal. Nevertheless, differences in study design, exposure assessment, and health-outcome measurement mean that findings from other locations should not automatically be generalised to Obio/Akpor. Household vulnerability is another important dimension of waste-related

environmental health research. Vulnerability reflects the circumstances that may increase exposure to environmental hazards or limit a household's capacity to avoid, withstand, or recover from them. These circumstances may include residential proximity to waste sites, duration of residence, housing conditions, access to safe water and sanitation, socioeconomic constraints, and the availability of alternative residential locations. Environmental exposure indicators such as dust, smoke, and offensive odours can help describe household experiences, although they should be distinguished from underlying socioeconomic vulnerability and from direct measurements of contaminant exposure (Ogboeli et al., 2025).

In Obio/Akpor Local Government Area (LGA), Rivers State, the coexistence of residential neighbourhoods and informal waste-disposal locations makes the spatial relationship between waste sites and households an important subject of investigation. Dimkpa et al. (2026) examined environmental contamination and pollutant exposure pathways among households surrounding informal solid-waste disposal sites in the LGA. Other studies have considered waste-site suitability, waste-management practices, and the environmental implications of inadequate disposal in the wider Port Harcourt area (Okoro and Ogboeli, 2025). These studies provide relevant local context, but an integrated assessment of residential proximity, household vulnerability characteristics, and the distribution of self-reported symptoms remains valuable.

A combined household survey and geospatial approach can help identify where informal disposal sites are concentrated, describe the proportion of households living close to them, and assess whether reported symptoms differ across residential-distance categories. Such evidence can support the prioritisation of environmental inspections, waste collection, community engagement, and further exposure assessment. However, spatial proximity and self-reported symptoms alone cannot establish that a disposal site caused a particular health condition.

Against this background, the present study examined spatial proximity, household vulnerability characteristics, and self-reported health symptoms among households surrounding informal solid-**waste disposal sites in Obio/Akpor LGA.**

Specifically, the study sought to:

1. Characterise the spatial distribution of identified informal solid-waste disposal sites and determine the residential proximity of surveyed households to the nearest sites.
2. Assess household vulnerability characteristics and reported environmental exposure experiences associated with informal waste disposal.
3. Determine the distribution of self-reported health symptoms across residential-distance categories and examine their statistical associations with selected environmental exposure indicators.
4. Evaluate the association between very close residential proximity and reported respiratory symptoms using multivariable logistic regression, subject to adjustment for relevant confounding factors.

2. Materials and Methods

2.1 Study Design

The study employed a cross-sectional analytical design integrating a household questionnaire survey with GIS-based spatial analysis. The survey collected information on respondent characteristics, residential proximity to informal solid-waste disposal sites, reported environmental exposure experiences, and self-reported health symptoms. The geospatial component examined the distribution of identified disposal sites and their spatial relationship with residential locations.

The cross-sectional design enabled the assessment of exposure-related characteristics and reported symptoms within the study period. However, it did not establish the temporal sequence between exposure and symptom onset. Consequently, the statistical analyses were interpreted as identifying associations rather than demonstrating causal effects.

2.2 Study Area

The study population comprised adults aged 18 years and above who represented households in communities surrounding identified informal solid-waste disposal sites in Obio/Akpor LGA. Eligible respondents were individuals able to provide information about household circumstances, environmental exposure experiences, and reported symptoms.

The study focused on communities with identified informal solid-waste disposal sites and households located at varying distances from these locations. This approach enabled comparisons between households living close to disposal sites and those residing farther away.

2.3 Study Population and Sample Size

The study population comprised adult household representatives residing in communities surrounding informal solid-waste disposal sites in Obio/Akpor LGA. Eligible respondents were individuals aged 18 years and above who could provide information about household living conditions, environmental exposure, and reported health experiences.

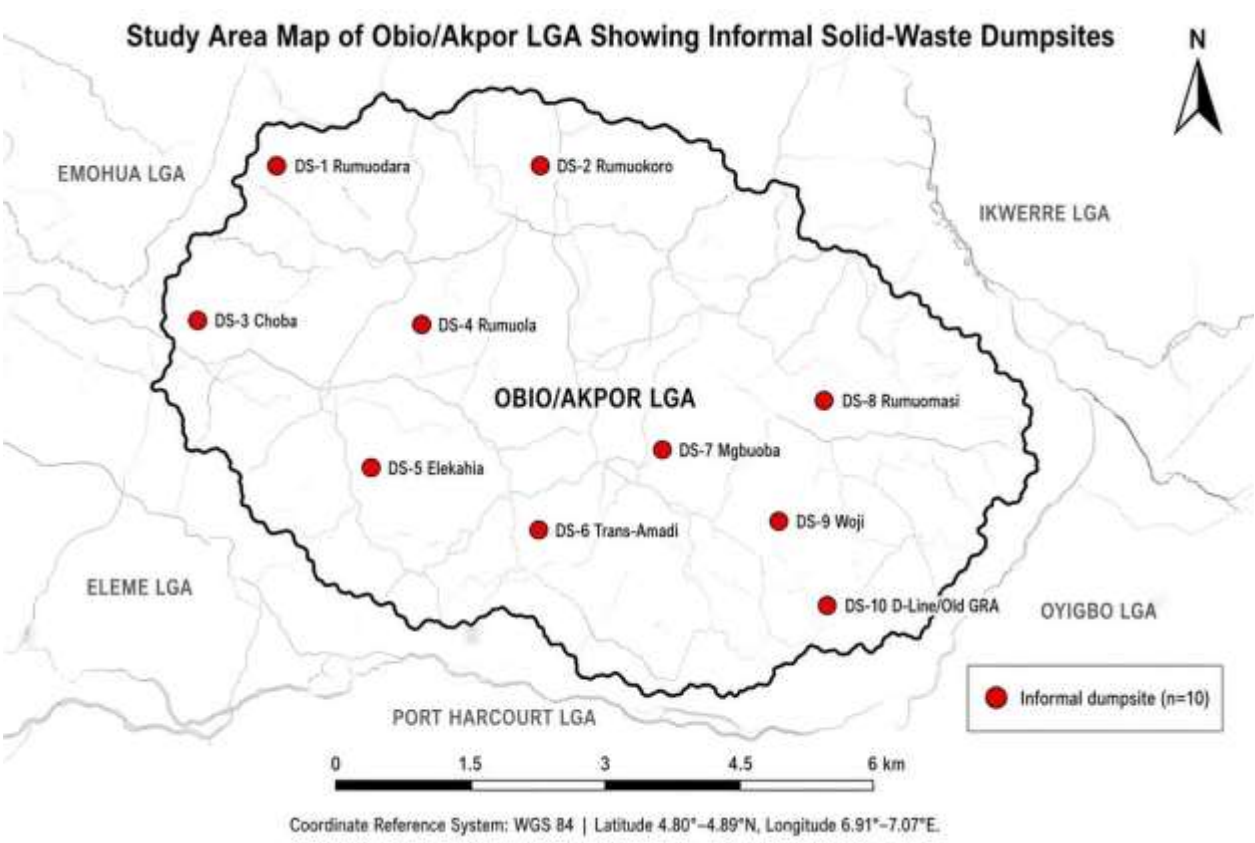
A total of 427 questionnaires were administered to eligible household representatives. Of these, 389 were adequately completed and retained for analysis, representing a response rate of 91.1%. The remaining 38 questionnaires were excluded from the final analysis because they were not adequately completed or were otherwise unsuitable for analysis. The valid responses constituted the dataset for the household-level statistical analyses.

2.4 Identification and Spatial Mapping of Informal Disposal Sites

Ten informal solid-waste disposal sites were identified across the study area and assigned unique codes (DS-1 to DS-10). Their locations were documented using geographic coordinates and incorporated into a geographic information system (GIS) for spatial representation and analysis.

The mapped sites provided the spatial basis for examining disposal-site distribution and proximity to residential households. Where household coordinates were available, distances to the nearest disposal sites were determined to support comparisons of residential proximity and reported environmental exposure experiences. Spatial analysis was also used to assess whether the sites exhibited clustered, dispersed, or random distribution patterns.

The GIS approach enabled the study to evaluate the geographical relationship between informal waste disposal and nearby residential areas beyond respondents' perceptions of distance. The ten sites were located in Rumuodara, Rumuokoro, Choba, Rumuola, Elekahia, Trans-Amadi, Mgbuoba, Rumuomasi, Woji, and the D-Line/Old GRA vicinity. Their recorded coordinates ranged approximately from 4.8023° to 4.8891° N and 6.9103° to 7.0653° E.



2.5 Assessment of Residential Proximity

Residential proximity was assessed by grouping households according to their distance from the nearest informal solid-waste disposal site. Four distance categories were used: within 100 m, 101–250 m, 251–500 m, and beyond 500 m. These categories enabled the comparison of household characteristics and reported health effects across different levels of proximity.

For descriptive analysis, households located within 250 m of a disposal site were also grouped to determine the proportion of respondents living relatively close to the identified sites. This classification was used to describe residential proximity and examine its relationship with household vulnerability and reported health symptoms.

Distance was treated as an indicator of potential environmental exposure. It was not assumed that all households within a particular distance experienced identical exposure, since waste characteristics, prevailing environmental conditions, and household activities could differ.

2.6 Household Survey and Data Collection

Primary household data were collected using a structured questionnaire administered to eligible household representatives. The questionnaire covered four principal areas: respondents' socio-demographic characteristics, residential proximity to informal disposal sites, household vulnerability indicators, and self-reported health effects.

Socio-demographic information included age, sex, educational attainment, and duration of residence. These variables were considered relevant for describing the respondents and examining whether household circumstances were associated with reported health outcomes.

Household vulnerability was assessed using indicators such as residential distance from disposal sites, duration of residence, and reported exposure to dust, smoke, and offensive odours. These indicators provided information about environmental conditions experienced by respondents and the possible circumstances that could increase their vulnerability.

Health-related questions focused on symptoms reported by respondents, including headache, cough, breathing difficulty, eye irritation, skin irritation, fever, diarrhoea, abdominal discomfort, and nausea. Responses were recorded and coded for statistical analysis. These outcomes were treated as self-reported symptoms rather than clinically verified diagnoses.

Completed questionnaires were reviewed for adequacy before entry into the analytical dataset. Only 389 valid questionnaires were included in the final analysis.

2.7 Data Processing and Statistical Analysis

Questionnaire responses were coded, entered, cleaned, and analysed using statistical software. Descriptive statistics, including frequencies and percentages, were used to summarise respondents' socio-demographic characteristics, residential proximity, household vulnerability indicators, and reported health effects.

The Pearson chi-square test of independence was used to examine associations between residential-distance categories and selected reported health symptoms. It was also applied to assess relationships between household vulnerability indicators and reported respiratory symptoms. Statistical significance was evaluated at the 5% level ($(p < 0.05)$).

Multivariable logistic regression was used to examine whether residence within 100 m of an informal disposal site was associated with reported respiratory symptoms after adjustment for selected respondent and exposure characteristics. The model included residential proximity, age, sex, educational attainment, duration of residence, dust exposure, smoke exposure, and offensive-odour exposure. Results were expressed as adjusted odds ratios (AORs), 95% confidence intervals, and p-values. An adjusted odds ratio greater than one indicated higher odds of the outcome for the relevant category, subject to the reference category and coding used in the model.

2.8 Spatial Distribution Analysis

To characterize the spatial pattern of the 10 identified disposal sites, an Average Nearest Neighbor (ANN) analysis was conducted. This method evaluates spatial distribution by comparing the observed mean distance between each site and its nearest neighbor ($\bar{d}_o$) against the mean distance expected under a random spatial distribution ($\bar{d}_e$).

The nearest-neighbor ratio (R) was calculated using Equation 1:

$$R = \frac{\bar{d}_o}{\bar{d}_e}$$

An R value less than 1 reflects spatial clustering, an R value near 1 indicates a random distribution, and an R value greater than 1 signifies dispersion. Statistical significance was evaluated using the corresponding z-score and p-value to determine whether the observed spatial configuration differed significantly from complete spatial randomness (CSR).

2.9 Integration of Spatial, Vulnerability, and Health Data

The final stage involved interpreting the spatial and statistical results together. The distribution of disposal sites and household distance categories was considered alongside environmental exposure indicators and reported health symptoms. This integrated approach enabled the study to examine

whether households closer to informal disposal sites reported different health experiences from households located farther away, while also considering selected socio-demographic and environmental factors.

The combined analysis was intended to identify spatial patterns and statistical associations that could inform environmental sanitation planning and public health interventions in Obio/Akpor LGA. Because the research used a cross-sectional design and self-reported symptoms, the findings were interpreted as associations rather than proof of direct causation.

2.10 Ethical Considerations

Participation in the household survey was voluntary and based on informed consent. Respondents' identities and personal information should be protected, and collected data should be used only for the stated research purposes. Any institutional ethical approval, permission from relevant authorities, and consent procedures undertaken for this study should be documented in the final manuscript.

3. Result

Response Rate and Characteristics of Respondents

Of the 427 questionnaires administered, 389 were valid for analysis, giving a response rate of 91.1%. The sample comprised 176 males (45.2%) and 213 females (54.8%). Respondents aged 28–37 years constituted the largest age group (28.8%), followed by those aged 38–47 years (24.9%). Secondary education was the most frequently reported educational level (43.2%).

Regarding duration of residence, 154 respondents (39.6%) had lived in their communities for more than 10 years, while 143 (36.8%) had resided there for 5–10 years. The remaining 92 respondents (23.7%) reported less than five years of residence. These characteristics describe the study population and provide context for interpreting the reported environmental experiences.

Table 1. Socio-demographic Characteristics of Respondents

Variable	Category	n	%
Age (years)	18–27	68	17.5
	28–37	112	28.8
	38–47	97	24.9
	48–57	71	18.3
	≥58	41	10.5
Sex	Male	176	45.2
	Female	213	54.8
Educational attainment	No formal education	47	12.1
	Primary	89	22.9
	Secondary	168	43.2
	Tertiary	85	21.9
Duration of residence	<5 years	92	23.7
	5–10 years	143	36.8
	>10 years	154	39.6
Total		**389**	**100.0**

Spatial Proximity of Households to Informal Waste-Disposal Sites

Of the 389 respondents, 97 (24.9%) lived within 100 m of an informal disposal site, while 141 (36.2%) lived between 101 and 250 m away. Combined, 238 respondents (61.2%) lived within 250 m of an identified site. A further 98 respondents (25.2%) were located 251–500 m away, while 53 (13.6%) lived beyond 500 m.

These findings indicate that a substantial proportion of surveyed households were situated relatively close to identified informal disposal sites. The results describe proximity, however, and do not independently establish that every household experienced equivalent exposure.

Table 2. Distribution of Households by Distance from Informal Waste-Disposal Sites

Distance from disposal site	n	%
≤100 m	97	24.9
101–250 m	141	36.2
≤250 m	238	61.2
Total	**389**	**100.0**

Household Vulnerability Characteristics and environmental exposure experiences

Reported environmental exposure experiences were common among respondents. Dust exposure was reported by 278 respondents (71.5%), while 302 (77.6%) reported exposure to offensive odours. The residential-distance and duration-of-residence distributions further show that many respondents had lived within the affected neighbourhoods for several years.

These indicators suggest that environmental nuisances were widely reported among the surveyed households. They should not, however, be interpreted as direct measurements of airborne pollutants, toxicant concentrations, or individual exposure dose.

Table 3. Household Vulnerability Indicators

Vulnerability indicator	Category	n	%
Residential proximity	≤100 m	97	24.9
	101–250 m	141	36.2
	251–500 m	98	25.2
	>500 m	53	13.6
Duration of residence	<5 years	92	23.7
	5–10 years	143	36.8
	>10 years	154	39.6
Dust exposure	Yes	278	71.5
	No	111	28.5
Offensive odour exposure	Yes	302	77.6
	No	87	22.4
Smoke exposure			
Total		**389**	**100.0**

Prevalence of Reported Health Effects

Headache was reported by 174 respondents (44.7%), making it the most frequently reported symptom. Cough followed, affecting 168 respondents (43.2%), while 129 (33.2%) reported breathing difficulty. Eye irritation was reported by 117 respondents (30.1%), and skin irritation by

98 (25.2%). Fever, diarrhoea, abdominal discomfort, nausea, and other symptoms were also reported.

These frequencies describe the proportion of respondents reporting each symptom. Since respondents could report more than one symptom, the categories are non-mutually exclusive and their percentages should not be summed to estimate the overall proportion experiencing illness.

Table 4. Prevalence of Reported Health Effects among Respondents

Health effect	n	%
Headache	174	44.7
Cough	168	43.2
Breathing difficulty	129	33.2
Eye irritation	117	30.1
Skin irritation	98	25.2
Fever	86	22.1
Diarrhoea	79	20.3
Abdominal discomfort	71	18.3
Nausea	64	16.5
Other reported effects	41	10.5

Reported symptoms across residential-distance categories

The supplied data show that the prevalence of several reported symptoms was higher among respondents living closer to informal disposal sites. For headache, the reported prevalence declined from 59.8% among respondents within 100 m to 26.4% among those living beyond 500 m. Cough prevalence declined from 57.7% in the nearest category to 32.1% in the farthest category. A similar pattern was observed for breathing difficulty, eye irritation, and skin irritation.

Pearson chi-square statistics were recalculated from the displayed symptom counts and the four residential-distance group totals. The recalculated results indicated statistically significant differences across distance categories for headache, cough, breathing difficulty, eye irritation, skin irritation, and diarrhoea. Fever was borderline but did not meet the conventional 5% significance threshold, while abdominal discomfort and nausea were not statistically significant.

Table 5. Prevalence of Selected Health Effects by Distance from Informal Waste-Disposal Sites

Health effect	≤100 m n (%)	101–250 m n (%)	251–500 m n (%)	>500 m n (%)	χ^2	p-value
Headache	58 (59.8)	67 (47.5)	35 (35.7)	14 (26.4)	19.76	<0.001
Cough	56 (57.7)	63 (44.7)	32 (32.7)	17 (32.1)	15.59	0.001
Breathing difficulty	49 (50.5)	47 (33.3)	22 (22.4)	11 (20.8)	21.94	<0.001
Eye irritation	43 (44.3)	42 (29.8)	22 (22.4)	10 (18.9)	15.25	0.002
Skin irritation	38 (39.2)	35 (24.8)	17 (17.3)	8 (15.1)	16.14	0.001
Fever	31 (32.0)	29 (20.6)	17 (17.3)	9 (17.0)	7.76	0.051
Diarrhoea	29 (29.9)	27 (19.1)	15 (15.3)	8 (15.1)	8.03	0.045
Abdominal discomfort	26 (26.8)	24 (17.0)	14 (14.3)	7 (13.2)	6.84	0.077
Nausea	24 (24.7)	21 (14.9)	13 (13.3)	6 (11.3)	6.84	0.077

Multivariable analysis of respiratory symptoms

The supplied logistic regression results indicated that residence within 100 m of an informal disposal site was associated with higher adjusted odds of reported respiratory symptoms (AOR = 2.84, 95% CI: 1.68–4.81, $p < 0.001$). Dust exposure (AOR = 2.17, 95% CI: 1.31–3.59, $p = 0.003$), smoke exposure (AOR = 1.68, 95% CI: 1.02–2.76, $p = 0.041$), and offensive-odour exposure (AOR = 1.94, 95% CI: 1.12–3.36, $p = 0.018$) were also reported as statistically significant predictors. Age, sex, educational attainment, and duration of residence were not statistically significant at the 5% level in the supplied model.

Table 6. Multivariable Predictors of Respiratory Symptoms among Households

Predictor	AOR	95% CI	p-value
Residence ≤100 m from disposal site	2.84	1.68 – 4.81	<0.001
Age	1.42	0.89 – 2.27	0.142
Sex	1.18	0.76 – 1.83	0.461
Educational attainment	1.35	0.84 – 2.17	0.213
Duration of residence	1.51	0.93 – 2.45	0.096
Dust exposure	2.17	1.31 – 3.59	0.003
Smoke exposure	1.68	1.02 – 2.76	0.041
Offensive odour exposure	1.94	1.12 – 3.36	0.018

Spatial Pattern of Informal Waste-Disposal Sites

The ANN results supplied for the 46 mapped sites showed an observed mean nearest-neighbour distance of 187.4 m and an expected distance of 312.6 m. The corresponding nearest-neighbour ratio was approximately 0.60. The reported z-score of −5.82 and p-value below 0.001 indicate a clustered pattern if confirmed by the original GIS output and the assumptions of the analysis.

Table 7. Average Nearest Neighbor analysis of informal disposal sites

Spatial analysis	Result
Number of mapped disposal sites	46
Observed mean nearest-neighbour distance	187.4 m
Expected mean distance	312.6 m
Nearest-neighbour ratio	0.60
z-score	–5.82
p-value	<0.001
Spatial pattern	Clustered

4. Discussion

Spatial Distribution and Residential Proximity to Informal Waste Disposal Sites

The finding that 61.2% of respondents lived within 250 m of an informal solid-waste disposal site indicates substantial residential proximity to potential environmental hazards in Obio/Akpor, Rivers State. The Average Nearest Neighbour (ANN) ratio of 0.60 further indicates a clustered spatial distribution of disposal sites. This pattern suggests that waste accumulation is concentrated in particular locations, potentially reflecting differences in settlement density, waste collection services, land use, and access to disposal facilities.

These findings are consistent with the concerns raised by Okpara et al. (2021) regarding the proliferation of irregular household waste dumpsites in the Niger Delta. Similarly, Jakeni et al. (2024) examined illegal dumping in informal settlements, highlighting the relevance of settlement conditions to waste-management challenges. The present findings suggest that interventions should prioritise clusters of disposal sites located close to residential areas. However, spatial proximity alone does not establish contamination severity; site characteristics, waste composition, drainage connectivity, and nearby sensitive receptors should also inform intervention priorities.

Environmental Nuisances and Household Vulnerability

Dust exposure was reported by 71.5% of respondents, while 77.6% reported offensive odours. These findings indicate that environmental nuisances were common in the surveyed communities. Dust and smoke from waste burning may provide potential inhalation pathways, while offensive odours may indicate waste decomposition or other waste-related processes. Nevertheless, these perceptions do not independently establish pollutant concentrations or toxicity.

Haywood et al. (2021) provide a comparative context through their investigation of waste-disposal practices in low-income South African settlements. Locally, Ogboeli et al. (2024) examined poor solid-waste management and public health challenges in Port Harcourt, while Ogboeli et al. (2025) investigated odour and health-related concerns around the Obiri-Ikwerre dumpsite. These studies are relevant to understanding waste-management challenges in the region, although differences in study design and measurements limit direct comparison.

The relatively long residential duration reported by many respondents may indicate prolonged opportunities for encountering local environmental conditions. However, length of residence does not establish cumulative exposure without information on exposure intensity, frequency, and historical site conditions. Residential distance, duration of residence, and reported environmental nuisances should therefore be interpreted as distinct indicators rather than combined into a vulnerability index without a validated framework.

Self-Reported Health Symptoms and Residential Distance

Headache and cough were the most frequently reported symptoms, followed by breathing difficulty, eye irritation, and skin irritation. These symptoms warrant environmental health investigation but are not specific to waste-related exposure. Respiratory and irritation symptoms may have several environmental or non-environmental causes, while gastrointestinal symptoms may arise from multiple sources. Accordingly, the findings represent self-reported symptoms rather than confirmed waste-related diseases. Akmal and Jamil (2021) assessed health damages associated with improper solid-waste disposal in metropolitan Islamabad–Rawalpindi, while Rawlings and Idehen (2024) investigated environmental and health concerns around a dumpsite in Benin City, Nigeria. These studies provide comparative contexts for examining waste-related health concerns. Dimkpa et al. (2026) also addressed environmental contamination and pollutant exposure pathways among households surrounding informal disposal sites in Obio/Akpor, making their work particularly relevant to the local setting. The present results indicate that the prevalence of headache, cough, breathing difficulty, eye irritation, and skin irritation generally declined across increasing residential-distance categories. Recalculated Pearson chi-square tests showed statistically significant differences across distance groups for these symptoms. Diarrhoea also showed a nominally significant association, whereas fever was borderline and abdominal discomfort and nausea did not meet the 5% significance threshold.

This pattern suggests that reported symptoms varied with residential distance and is compatible with a possible association between proximity to disposal sites and environmental health concerns. Nevertheless, distance is an imperfect exposure proxy because wind direction, waste composition, burning, drainage, and household activities may influence actual exposure. The cross-sectional design also prevents establishing whether symptoms developed after exposure. Consequently, the observed associations should not be interpreted as evidence of causation.

Logistic Regression and Respiratory Symptoms

The supplied logistic regression results reported an adjusted odds ratio (AOR) of 2.84 for residence within 100 m of an informal disposal site. If verified, this indicates 2.84 times the adjusted odds of the model-defined respiratory-symptom outcome relative to the specified reference group, conditional on the covariates included in the model. It does not imply a 2.84-fold increase in the probability of symptoms. Dust, smoke, and offensive odours were also reported as statistically significant predictors. These associations identify environmental conditions requiring further investigation. However, interpretation depends on exposure measurement, control of confounding, and the potential overlap between perceived exposure and symptom reporting. Because dust, smoke, and odour may lie along pathways linking proximity to symptoms, adjusting for them may also alter the interpretation of the proximity estimate. Ogboeli et al. (2025) provide a relevant local comparison concerning odour and health-related concerns near a solid-waste dumpsite. Nevertheless, the regression findings should be reported only after verifying the outcome definition, reference categories, 95% confidence intervals, model diagnostics, and covariate specification. Even if confirmed, the results demonstrate adjusted associations rather than definitive causal effects.

Implications for Environmental Management

The combined spatial and household findings support targeted waste-management interventions in Obio/Akpor. The clustering of disposal sites suggests that geospatial information could guide site inspections, collection-route planning, and the prioritisation of clearance or remediation activities. The high prevalence of reported dust and odours also supports environmental assessments that distinguish perceived nuisances from objectively measured pollution.

Follow-up investigations should incorporate particulate matter monitoring, assessment of open waste burning, waste characterisation, and evaluation of drainage and surface-water pathways. Soil or groundwater testing may be appropriate where site conditions indicate plausible contamination pathways. Clinical assessment and longitudinal studies would also help determine whether reported symptoms are associated with measured exposures after accounting for relevant confounding factors. Summarily, the findings demonstrate substantial residential proximity to clustered informal waste disposal sites, frequent environmental nuisances, and spatial differences in self-reported symptoms. They identify potential environmental health concerns that warrant targeted monitoring and improved waste-management services. However, the cross-sectional design and reliance on self-reported information limit causal conclusions. Integrating geospatial analysis with environmental measurements and appropriate health assessments would provide a stronger evidence base for environmental management and public health planning in Obio/Akpor.

5. Public Health and Policy Implications

The findings support five practical priorities:

1. Targeted site inspection: Prioritise clusters of informal disposal sites situated near residential areas and other sensitive receptors.
2. Improved waste collection: Strengthen reliable household and neighbourhood waste collection to reduce reliance on unregulated disposal locations.
3. Environmental exposure assessment: Measure relevant pollutants and investigate burning, drainage, soil, and water pathways where warranted by site conditions.
4. Community engagement: Provide residents with accessible channels for reporting illegal dumping and information on safer waste handling and disposal.
5. Health surveillance: Investigate commonly reported respiratory and irritation symptoms using appropriate clinical and epidemiological methods without presuming a causal relationship.

6. Study Limitations

The cross-sectional design limits the establishment of temporal relationships and causality. Health outcomes were self-reported without clinical confirmation, making the findings susceptible to recall error and differences in symptom interpretation.

Residential distance served as a proxy for potential exposure but did not measure actual contaminant exposure or absorbed dose. Potential confounders, including smoking, occupational exposures, household cooking fuels, socioeconomic status, pre-existing conditions, and water and sanitation conditions, may not have been fully controlled.The representativeness of the sample depends on the sampling procedure, while the spatial analysis was based on 46 mapped disposal sites and may be affected by site identification and positional accuracy. The regression estimates and inferential statistics also require verification against the original dataset and software outputs. Finally, the findings may not be generalisable to areas with different environmental conditions, settlement patterns, and waste-management systems.

7. Recommendations for Further Research

Future studies should combine spatial analysis with direct environmental measurements to investigate whether distance from informal disposal sites corresponds to measurable gradients in particulate matter, relevant chemical contaminants, or microbiological indicators. Where groundwater and soil contamination are plausible, appropriately designed sampling should be used to assess the relevant exposure pathways. Longitudinal studies would help clarify whether changes in exposure conditions precede changes in reported or clinically assessed health outcomes. Research should also incorporate socioeconomic indicators, housing conditions, access to essential services, occupational exposures, and household practices to improve confounding control and the assessment of vulnerability. Further methodological development could include a validated spatial risk-prioritisation model that integrates disposal-site characteristics, nearby population, environmental sensitivity, and measured contamination. Such a model should be independently evaluated before being used to allocate remediation resources or infer public health risk.

8. Conclusion

This study examined residential proximity to informal solid-waste disposal sites, household vulnerability characteristics, and self-reported health symptoms in Obio/Akpor LGA, Rivers State. Of the 389 respondents included in the analysis, 61.2% lived within 250 m of an identified disposal site. Dust exposure and offensive odours were commonly reported, while headache and cough

were the most frequently reported symptoms. The supplied spatial results suggested clustering of the 10 mapped disposal sites, and recalculated contingency-table analyses indicated that several reported symptoms differed significantly across residential-distance categories.

The supplied regression results also suggested an adjusted association between very close residential proximity and reported respiratory symptoms, although those estimates require verification against the original statistical output. Collectively, the findings identify spatial proximity and environmental exposure experiences as relevant considerations for waste-management planning and environmental health investigation. The study does not establish that informal disposal sites caused the reported symptoms. Nevertheless, the spatial concentration of disposal sites, the substantial proportion of households living nearby, and the frequency of reported environmental nuisances support improved waste collection, targeted environmental monitoring, and further epidemiological investigation. A combination of geospatial planning, direct exposure measurement, community engagement, and appropriately designed health surveillance would provide a stronger evidence base for reducing potential environmental health risks in Obio/Akpor.

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