



# Residents' Knowledge and Perception of Environmental and Health Risks from Landfill Leachate Pollution around the Solous Landfill, Lagos, Nigeria

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## Abstract

Accelerating urbanization in developing nations intensifies solid waste management challenges, particularly where inadequate landfill practices pose severe health and environmental hazards. This study examined community knowledge, risk perceptions, and awareness of environmental and health risks associated with the Solous Landfill in Lagos, Nigeria. A mixed-methods research design, integrating quantitative statistical analysis (descriptive statistics, chi-square tests of independence, and Pearson correlation coefficients) with qualitative thematic content analysis was employed. The study focused on community perceptions rather than direct environmental measurements such as water or air quality testing. Data were obtained through questionnaires administered to 140 respondents and focus group discussions involving 16 purposively selected community members. Findings revealed substantial awareness of leachate-associated risks: 78.6% of respondents acknowledged health implications, while 84.3% recognised environmental threats. Educational attainment, age, and occupational status emerged as significant determinants of awareness ( $p < 0.05$ ). Approximately 63.6% of participants reported psychological distress attributed to offensive odour, water quality deterioration, and inadequate confidence in landfill management systems. A positive correlation was identified between health and environmental risk awareness ( $r = 0.635$ ,  $p < 0.01$ ). Qualitative data confirmed widespread concern regarding groundwater pollution and strong community support for landfill relocation, underscoring deficient trust in existing management frameworks. The study reveals that visible signs of pollution primarily shape risk perception through

lived experience rather than formal knowledge alone. Educational improvements and visible environmental remediation measures are essential alongside transparent governance and community participation to rebuild institutional trust and achieve sustainable waste management outcomes in developing nations like Nigeria.

**Keywords:** Landfill leachate, Risk perception, Environmental health, Community awareness, Waste management

## Introduction

Solid waste management poses a critical environmental challenge in rapidly urbanizing nations where waste generation outpaces management infrastructure capacity. Landfills constitute significant sources of anthropogenic greenhouse gas emissions, releasing methane ( $\text{CH}_4$ ) with global warming potential 21 times greater than carbon dioxide ( $\text{CO}_2$ ), alongside offensive odours, groundwater contamination from leachate, bioaerosols, and volatile organic compounds (Njoku *et al.*, 2019; Salah *et al.*, 2020). The World Health Organization attributes 23% of global mortality to environmental factors, with landfill leachate contaminating soil and water resources while releasing toxic emissions containing heavy metals and persistent organic pollutants (Ogbuehi *et al.*, 2022; Salah *et al.*, 2020; Yatoo *et al.*, 2024). In developing countries like Nigeria, rapid urbanization and population growth have intensified waste generation challenges,

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compounding environmental and public health risks in peri-landfill communities. The magnitude of waste management challenges in Sub-Saharan Africa has grown exponentially, with urban centers experiencing unprecedented population influx that strains existing waste disposal infrastructure (Okorundu *et al.*, 2024). Lagos, Nigeria's largest metropolis with an estimated population exceeding 20 million, generates approximately 13,000 metric tons of municipal solid waste daily, yet collection efficiency remains below 60%, resulting in widespread illegal dumping and overreliance on inadequate landfill facilities (Ichipi & Senekane, 2023; Olaoye & Baird, 2025).

Landfill siting requires comprehensive evaluation of health, safety, environmental, social, and economic parameters to minimize risks and optimize benefits, incorporating geological, hydrological, ecological, and socio-political considerations (Al-Khatib *et al.*, 2015; Rawat *et al.*, 2022). However, such systematic approaches remain limited in developing nations compared to developed economies (Awino & Apitz, 2024). Research indicates that community well-being is influenced as profoundly by decision-making processes for noxious land use siting as by the outcomes themselves (Wakefield & Elliott, 2000; King, 2020). The absence of transparent, participatory decision-making frameworks in many developing countries has resulted in inequitable distribution of environmental burdens, disproportionately affecting marginalized communities with limited political voice (Sebunya & Gichuki, 2024). Socioeconomic vulnerability often forces low-income populations to settle in environmentally compromised areas near landfills, creating environmental justice concerns that perpetuate cycles of poverty and health disparities (Hendricks & Van Zandt, 2021). Understanding community perceptions in these contexts becomes essential for developing inclusive waste management policies that balance technical efficiency with social equity considerations.

Studies examining resident perceptions near landfills reveal diverse awareness levels regarding health and environmental risks. While initial community opposition typically accompanies facility siting, adaptation often occurs once operations stabilize over time (Okeke & Armour, 2000). Njoku *et al.* (2019) documented reduced neighbourhood satisfaction among landfill-proximate residents and recommended enhanced gas capture systems, daily waste covering, and odour mitigation strategies. Epidemiological evidence links hydrogen sulfide exposure from landfills with elevated mortality from lung cancer and respiratory diseases (Vrijheid 2000; Mataloni *et al.*, 2016). Qualitative investigations

describe psychological stress, social marginalization, and community fragmentation as indirect consequences of landfill proximity (Wakefield & Elliott, 2000; Ta *et al.*, 2025). These psychological dimensions, though less quantifiable than physical health outcomes, significantly affect quality of life and community cohesion. Residents frequently report feelings of abandonment by municipal authorities, perceiving their neighbourhoods as sacrifice zones where environmental standards are compromised (De Souza, 2021). Such perceptions foster distrust in government institutions and environmental management systems, hindering collaborative efforts toward sustainable waste management solutions (Pastor *et al.*, 2024). Ogbuehi *et al.* (2022) observed that residents within 250–500 m experienced skin irritation, nausea, and fever, with those within 250 m reporting additional symptoms including sore throat, diarrhea, and abdominal pain. Research consistently identifies landfilling as a primary contributor to environmental degradation through groundwater contamination, air pollution, and odour nuisance (De Feo *et al.*, 2013; Palmiotto *et al.*, 2014; Siddiqua *et al.*, 2022). Leachate migration through soil strata threatens aquifer systems, particularly in regions where shallow water tables and permeable geological formations facilitate contaminant transport (Alao, 2025). In many Nigerian communities, groundwater obtained from hand-dug wells and boreholes constitutes the principal source of drinking water, thereby increasing the potential exposure of residents to pollutants originating from landfill leachate (Adedeji & Oladimeji, 2017; Taiwo *et al.*, 2026). Risk perception is fundamentally shaped by lived experiences and observable environmental transformations (Etea *et al.*, 2021). Socio-demographic variables including age, gender, marital status, occupation, and educational attainment significantly influence risk perception (Che *et al.*, 2013; Etele *et al.*, 2022), while social attachment and economic constraints often explain residential persistence in hazard-prone areas (Dada, 2021). Landfill proximity adversely affects property values and child health, with children facing nearly threefold elevated risks of diarrheal illness (Danthurebandara *et al.*, 2013; Shibata *et al.*, 2015; Alao, 2025). Vulnerable populations, including children, pregnant women, and elderly individuals, face disproportionate health burdens due to physiological susceptibility and prolonged exposure durations (Anjum & Aziz, 2025).

International studies examining community perceptions near landfill sites reveal patterns remarkably consistent with challenges faced in Lagos, despite geographical and methodological variations. In Khulna, Bangladesh, a study of 180 households

living at varying distances from temporary waste disposal sites found that 74% of residents identified odor as their primary environmental concern, with 80.5% explicitly linking bad odor to their current poor health status (Shammi *et al.*, 2023). The proximity-health relationship was particularly pronounced for waterborne diseases, with diarrhea prevalence reaching 32.1% among residents living within 50 m of dumpsites compared to 22.8% among those residing 50-300 m away ( $p < 0.05$ ). Airborne health problems exhibited similar distance gradients: allergies affected 30.2% of near-residents versus 18.1% of distant residents, while asthma prevalence was 11.3% and 3.1%, respectively (Shammi *et al.*, 2023).

In Chittagong, Bangladesh, research on open landfill health impacts documented that residents reported eye irritation (38.2%), hepatitis (27.9%), and headaches (23.5%), with waste collectors experiencing even higher frequencies of occupational health problems (Paul *et al.*, 2025). Studies from South Asia more broadly indicate that residents living within 100 m of dumpsites face significantly elevated risks of diarrhea, cholera, dengue, malaria, and asthma compared to those residing beyond 500 m (Akmal & Jamil, 2021). These findings underscore the universal relationship between landfill proximity and adverse health outcomes across diverse urban contexts in developing nations. Within Sub-Saharan Africa, comparable patterns emerge. Research in Thohoyandou, South Africa, revealed that 76% of community members living near landfills demonstrated awareness of health risks, while 82% expressed concerns about environmental degradation, with psychological stress reported by 45% of respondents (Njoku *et al.*, 2019). Across developing regions, municipal solid waste management challenges are characterized by collection coverage rates exceeding 70% in most areas, yet low-income countries struggle with open dumping prevalence ranging from 66% in some contexts, directly contributing to documented health burdens (Chen *et al.*, 2024). The consistency of high community awareness levels ranging from 74% to 84% across Lagos, Khulna, Chittagong, and South African studies suggests that experiential knowledge of environmental health risks transcends formal education and official communication campaigns in generating community concern. These international comparisons contextualize the present Lagos study within a broader pattern of waste management-related health impacts in rapidly urbanizing developing nations. The similar awareness levels (78.6% for health risks and 84.3% for environmental impacts in the present study) and psychological burden patterns (63.6% reporting distress) documented across diverse geographical

contexts indicate shared challenges requiring coordinated regional and global policy responses. Notably, studies from both Nigeria and Bangladesh have documented community preferences for landfill relocation over technical management improvements, reflecting profound distrust in existing institutional frameworks which is a critical insight for environmental governance strategies in developing nations.

Contrasting evidence suggests health risks remain difficult to quantify owing to limited exposure data (Vrijheid, 2000; Hanninen *et al.*, 2014). Some studies report no substantial associations between landfill proximity and building deterioration, nor elevated risks for bladder, brain, hepatobiliary cancers, or leukemia among populations within 2 km (Jarup *et al.*, 2002; Olawoye *et al.*, 2019). These inconsistencies underscore the complexity of establishing causal relationships between landfill exposure and health outcomes, emphasizing the need for context-specific investigations that account for local environmental conditions, waste composition, and management practices. This study represents the first community-based mixed-methods investigation of leachate-related knowledge, risk perception, and psychological burden specifically among residents proximate to the Solous Landfill in Lagos, one of sub-Saharan Africa's largest operational municipal solid waste facilities. This study assessed knowledge levels, risk perceptions, and emotional responses of residents and business operators near the Solous Landfill in Lagos, Nigeria, regarding health and environmental impacts of leachate contamination. Specific objectives were to: (i) evaluate community awareness of leachate-associated risks; (ii) determine how demographic characteristics influence risk perception; (iii) examine emotional responses and their relationship with risk awareness; and (iv) identify community preferences for mitigation strategies addressing leachate contamination impacts.

## **Methodology**

### **Description of the study area**

The study was conducted at the Solous Landfill located in Ikotun/Igando Local Council Development Area (LCDA) of Alimosho Local Government Area, Lagos State, Southwest Nigeria. Lagos experiences a tropical wet and dry climate with bimodal rainfall patterns characterised by a primary rainy season from April to July, a secondary rainy season in October and November, a brief dry interlude in August and September, and an extended dry season from December to March. The Solous Landfill comprises three sites: Site A (Solous I), Site B (Solous II), and

Site C (Solous III). This study focused on Site C (No6°33.897', E003°15.082'), the largest and only operational site covering 12 hectares divided into cells with access roads, as Sites A and B have been closed. Geographic coordinates were obtained using Global Positioning System (GPS) technology.

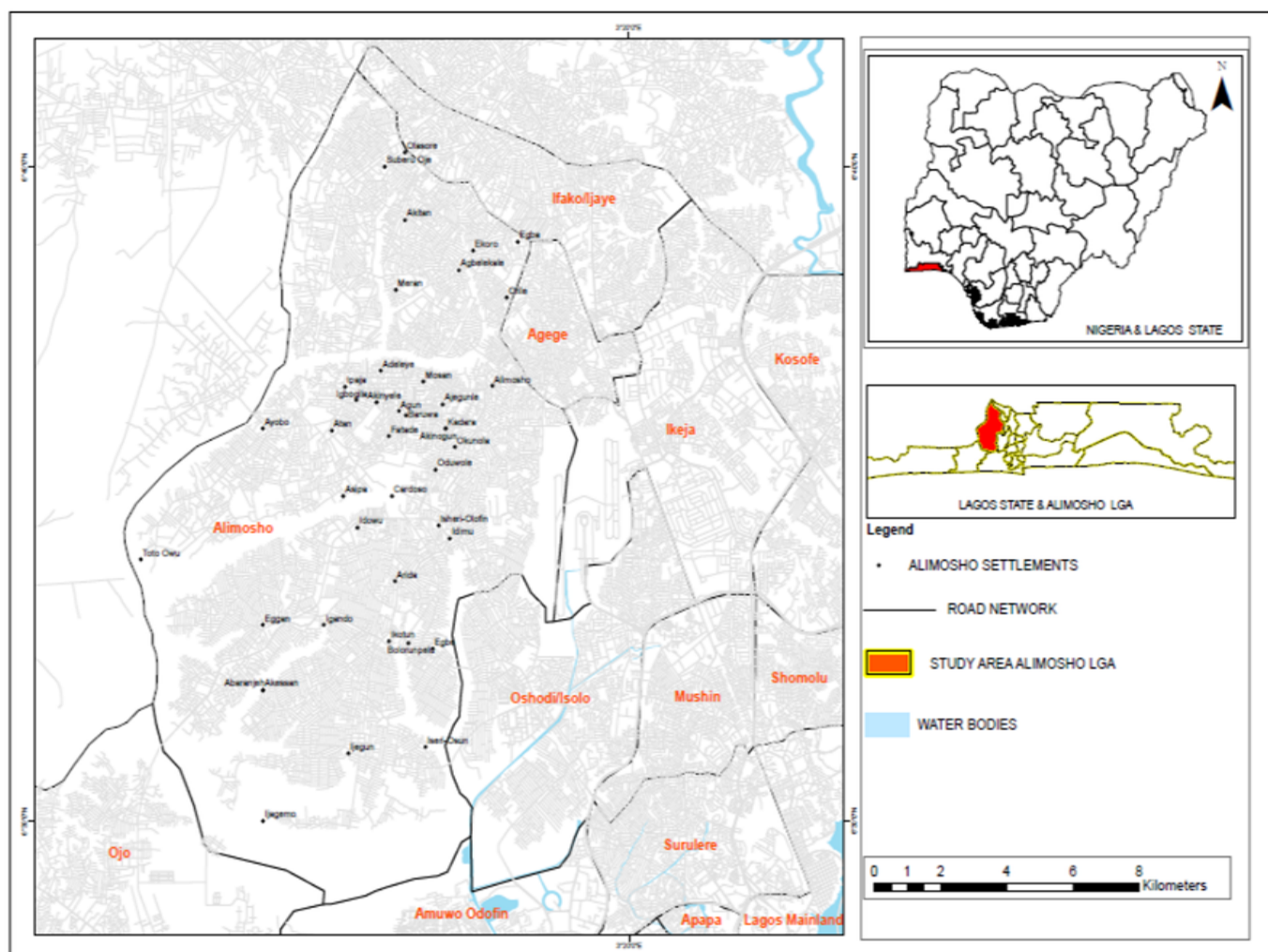


Figure 1: Map of the study area in Alimosho Local Governemnt Area, Lagos State, Nigeria



Figure 2: Satellite image of Solous III Landfill and neighbouring communities

## Research Design and Sampling

The study utilised a mixed-methods research design combining quantitative and qualitative techniques. The study population comprised residents from seven communities adjoining the Solous Landfill: Raimi Ajibowo, Salvation, Mike Anison, Cele, Abidek, Akanmu Olaleye, and Odubanjo. These communities were selected based on: (1) geographic proximity to Solous Site C (within 500 m), (2) documented reliance on groundwater from boreholes, (3) highest population density adjacent to the landfill, and (4) accessibility for field data collection. The selection of these communities ensured maximum exposure assessment of residents to landfill-related environmental hazards. Households were selected using simple random sampling, with eligibility criteria requiring a minimum residence duration of one year to ensure adequate exposure assessment. The sample size ( $n = 140$ ) was determined using the Krejcie and Morgan (1970) sampling technique at a 95% confidence level. All participants were adults aged 18 years and above who provided informed consent prior to participation. Additionally, qualitative focus group discussions (FGDs) involved 16 purposively sampled community members. Purposive sampling was employed for FGDs

to deliberately select individuals with diverse perspectives and experiences: (1) residents with varying lengths of residence (long-term vs. recent), (2) individuals representing different occupational backgrounds (business owners, traders, labourers), (3) community leaders and opinion formers, and (4) those directly and indirectly exposed to landfill hazards. This purposive approach enabled capture of the full range of community perspectives and experiences regarding leachate impacts, ensuring rich qualitative data reflecting diverse lived experiences within the study communities.

## Data Collection Instruments

This research focused on community risk perception and awareness rather than direct environmental sampling. The study did not include physicochemical analysis of water samples or air quality measurements, which would require specialized laboratory equipment and additional resources. Quantitative data were collected using structured questionnaires designed based on established perception and risk communication frameworks. The instrument utilized a five-point Likert scale format to measure attitudes and opinions systematically. Questionnaire validity was established through expert review and pilot

testing to ensure clarity and content validity. Independent variables examined included age, gender, education level, occupation, employment status, and length of residence. The dependent variable, public perception of leachate impacts, was assessed through self-reported evaluations of odour intensity, water quality concerns, and health impacts. Qualitative data were gathered through two focus group discussions (FGDs), each comprising eight purposively selected participants. FGD groups were stratified by community proximity to the landfill and occupational exposure levels to capture diverse lived experiences and perspectives. Discussion sessions were audio recorded with participant consent, transcribed verbatim, and subjected to thematic content analysis. The FGD guide covered five thematic areas: (1) general awareness and sources of information about landfill leachate; (2) perceived health impacts and personal experiences of illness; (3) perceived environmental changes including water quality and odour; (4) emotional responses and psychological well-being; and (5) community preferences for remediation, including management improvements versus landfill relocation. Each session lasted approximately 60 minutes and was conducted in a familiar community setting to encourage open discussion.

### **Data Analysis**

Quantitative data were analysed using the Statistical Package for Social Sciences (SPSS) version 26.0. Analysis utilised descriptive statistics (frequencies, percentages, means, and standard deviations), chi-square tests of independence to assess associations between socio-demographic variables and awareness, and Pearson correlation coefficients to examine relationships between health and environmental risk awareness domains. Statistical significance was established at  $p < 0.05$ . Qualitative data were analysed using thematic content analysis to identify recurring patterns and concerns. Triangulation of findings was used to enhance validity.

### **Research Hypotheses**

The study tested the following hypothesis:

H<sub>0</sub>: There is no significant relationship between residents' level of awareness of leachate and their perception of its health and environmental effects.

### **Ethical Considerations**

Ethical approval was obtained from the Research Ethics Committee of the Lagos State University, Ojo, Nigeria and all procedures complied with the principles outlined in the Declaration of Helsinki (2013). Participants provided written informed consent after receiving detailed explanation of study objectives, procedures, and their right to withdraw at

any time without penalty. Confidentiality and anonymity were maintained throughout the research process, with all data coded and stored securely.

## **Results/Findings**

### **Demographic Characteristics**

A total of 140 respondents participated in the survey, while 16 individuals engaged in focus group discussions. Table 1 presents the demographic distribution of survey respondents. The majority (27.9%) were aged 25–34 years, with balanced gender representation (54.3% female, 45.7% male). Most respondents were married (60.0%), had completed secondary education (40.7%), and were self-employed (54.3%). Approximately 51.4% resided in households of 2–5 persons, with 42.1% having lived in the community for 1–10 years.

Table 1: Demographic profiles of survey respondents (n = 140). Data source: Structured questionnaire survey of 140 residents in seven communities adjoining Solous Landfill, Lagos, 2024.

| Demographic Item  | Category            | Frequency | Percentage (%) |
|-------------------|---------------------|-----------|----------------|
| Age               | 18–24 years         | 28        | 20.0           |
|                   | 25–34 years         | 39        | 27.9           |
|                   | 35–44 years         | 32        | 22.9           |
|                   | 45–54 years         | 25        | 17.9           |
|                   | 55 years and above  | 16        | 11.4           |
|                   | Total               | 140       | 100            |
| Gender            | Male                | 64        | 45.7           |
|                   | Female              | 76        | 54.3           |
|                   | Total               | 140       | 100            |
| Marital Status    | Single              | 46        | 32.9           |
|                   | Married             | 84        | 60.0           |
|                   | Divorced            | 2         | 1.4            |
|                   | Widowed             | 6         | 4.3            |
|                   | Others              | 2         | 1.4            |
|                   | Total               | 140       | 100            |
| Education         | Primary             | 19        | 13.6           |
|                   | Secondary           | 57        | 40.7           |
|                   | National Diploma    | 22        | 15.7           |
|                   | BSc./HND            | 30        | 21.4           |
|                   | MSc./MA             | 2         | 1.4            |
|                   | No formal education | 10        | 7.1            |
|                   | Total               | 140       | 100            |
| Occupation        | Employed            | 37        | 26.4           |
|                   | Self-employed       | 76        | 54.3           |
|                   | Unemployed          | 12        | 8.6            |
|                   | Others              | 15        | 10.7           |
|                   | Total               | 140       | 100            |
| Head of Household | Yes                 | 60        | 42.9           |
|                   | No                  | 80        | 57.1           |
|                   | Total               | 140       | 100            |
| Household Size    | 2–5 persons         | 72        | 51.4           |
|                   | 6–10 persons        | 49        | 35.0           |
|                   | 11 and above        | 19        | 13.6           |
|                   | Total               | 140       | 100            |
| Length of Stay    | 1–10 years          | 59        | 42.1           |
|                   | 11–20 years         | 51        | 36.4           |
|                   | 21–30 years         | 17        | 12.1           |
|                   | Over 30 years       | 13        | 9.3            |
|                   | Total               | 140       | 100            |

## **Awareness Patterns Across Demographic Variables**

Leachate awareness varied across demographic groups. Middle-aged adults (25–44 years) demonstrated the highest awareness levels (80–85%), likely reflecting combined formal education and life experience (Figure 3). Older respondents ( $\geq 45$  years) exhibited elevated health impact awareness due to prolonged exposure, while younger adults showed greater recognition of psychological impacts. Gender analysis revealed equivalent awareness levels across both groups (approximately 79%), with no statistically significant differences ( $p > 0.05$ ) (Figure 4). Educational attainment emerged as the strongest predictor of awareness, with higher-educated respondents demonstrating nearly complete recognition of health and environmental impacts (Figures 5 and 6). Chi-square analysis confirmed significant associations between education level and awareness ( $p < 0.05$ ). Self-employed respondents (54%) experienced highest direct exposure, with 85.7% observing environmental impacts, while formally employed individuals demonstrated superior technical knowledge (70% recognizing toxic components) despite less frequent direct observation (Figure 7).

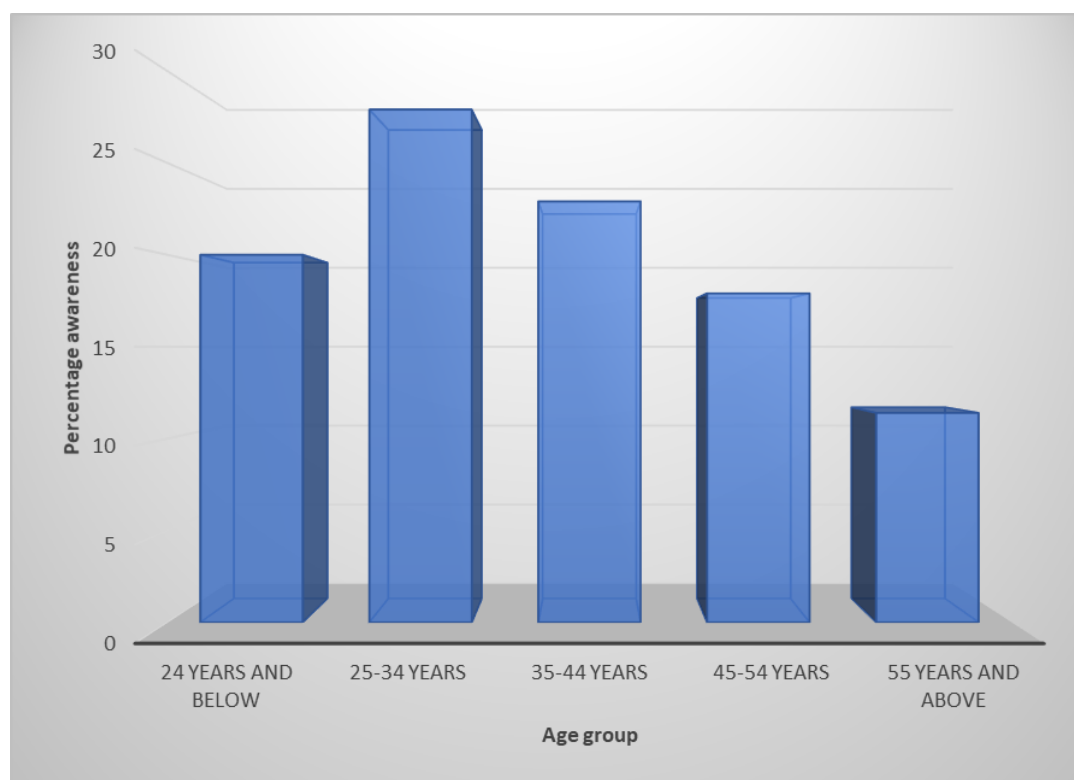


Figure 3: Awareness of leachate impacts by age groups ( $n = 140$ ). Source: Field survey data, 2024. The figure displays community awareness levels across five age categories, showing highest awareness in middle-aged respondents (25–44 years, 80–85%).

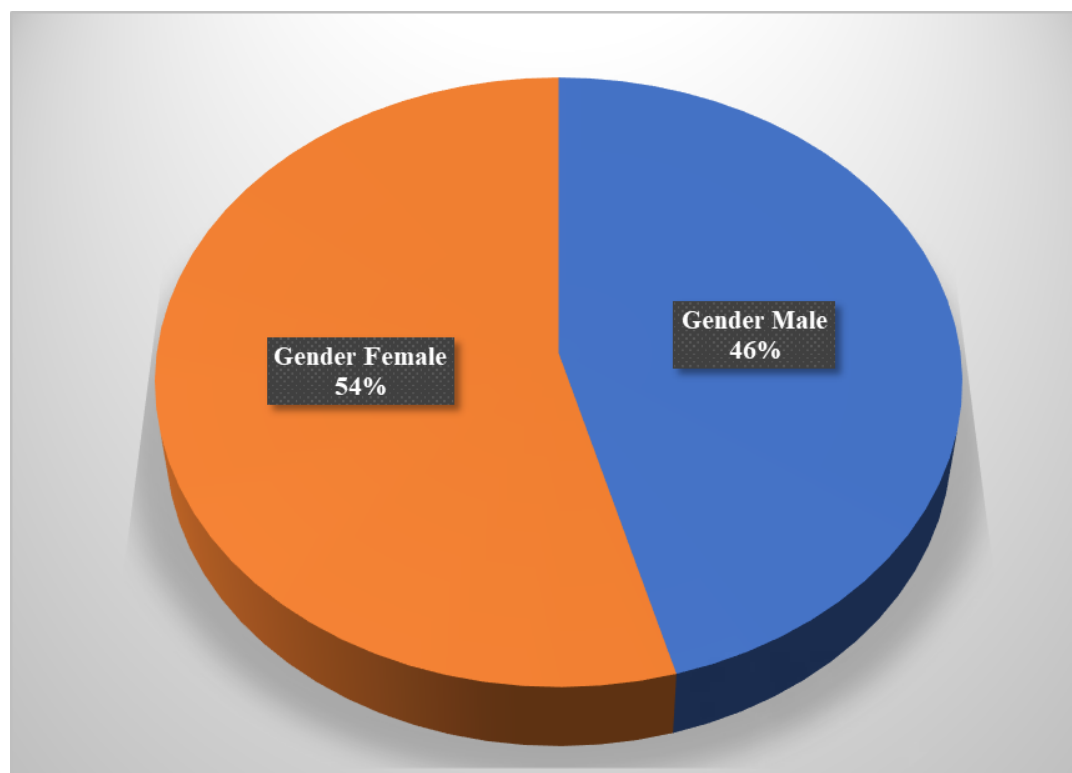


Figure 4: Awareness of leachate impacts based on gender (n = 140). Source: Field survey data, 2024. The figure compares awareness levels between male (n = 64, 45.7%) and female (n = 76, 54.3%) respondents, demonstrating equivalent awareness across gender groups

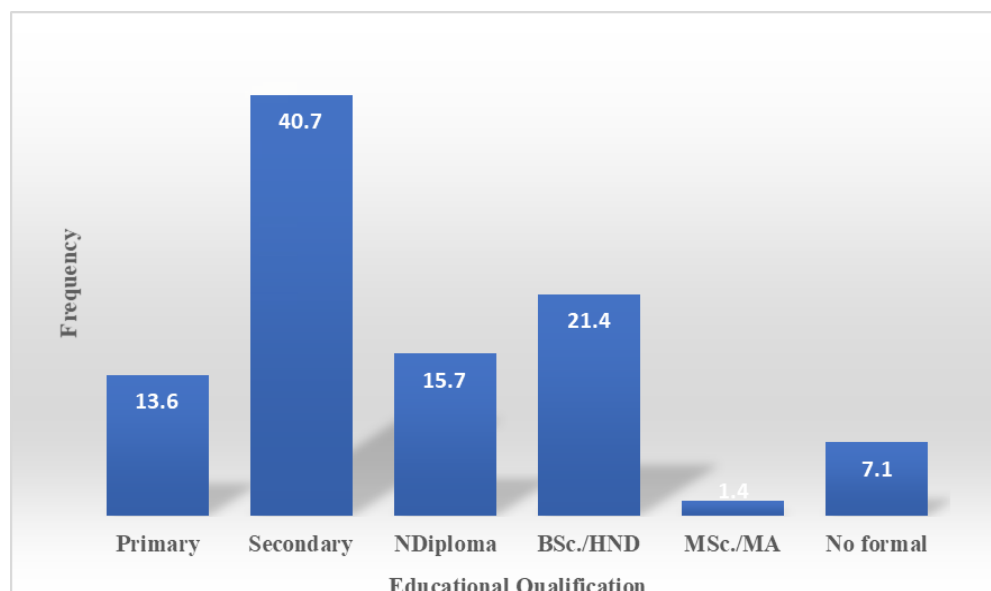


Figure 5: Awareness of leachate by educational qualification (n = 140). Source: Field survey data, 2024. The figure displays awareness levels across six education categories (no formal education, primary, secondary, National Diploma, BSc./HND, MSc./MA), demonstrating a pronounced positive gradient of awareness with increasing educational attainment

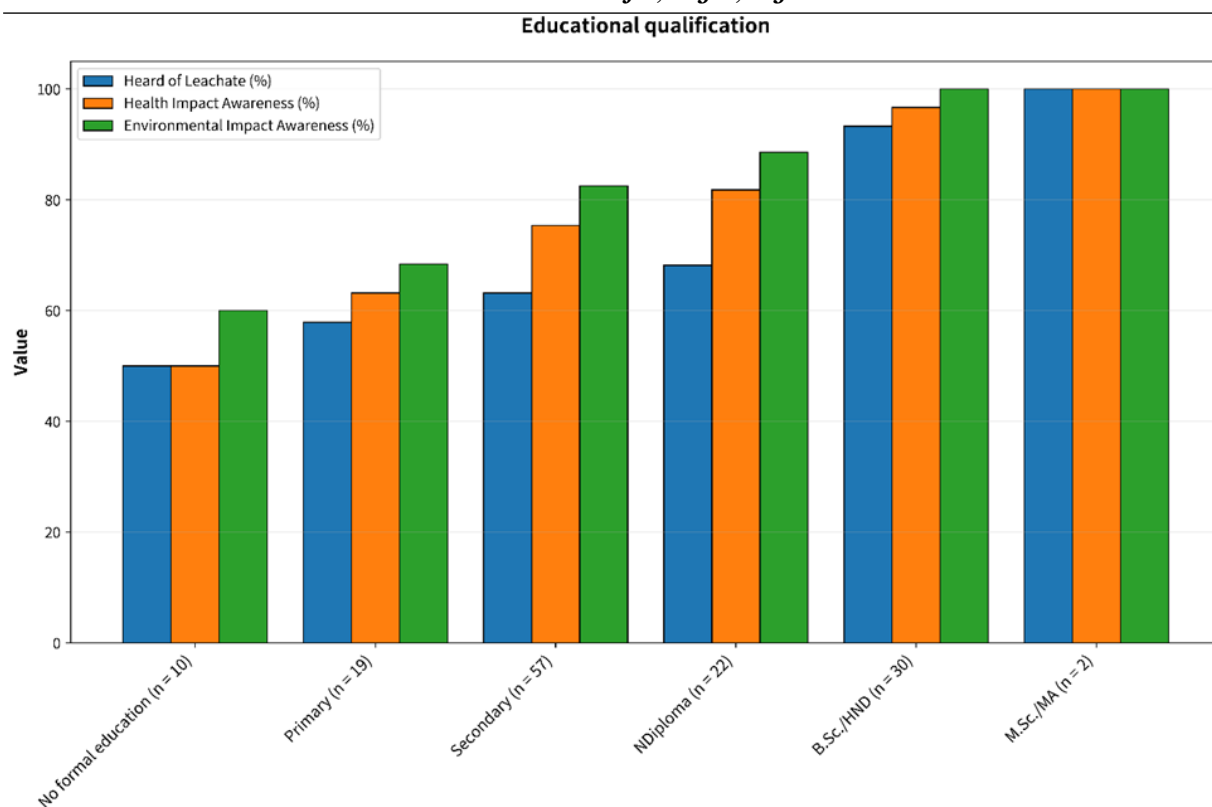


Figure 6: Awareness of leachate and its health and environmental impacts by educational qualification (n = 140). Source: Field survey data, 2024.

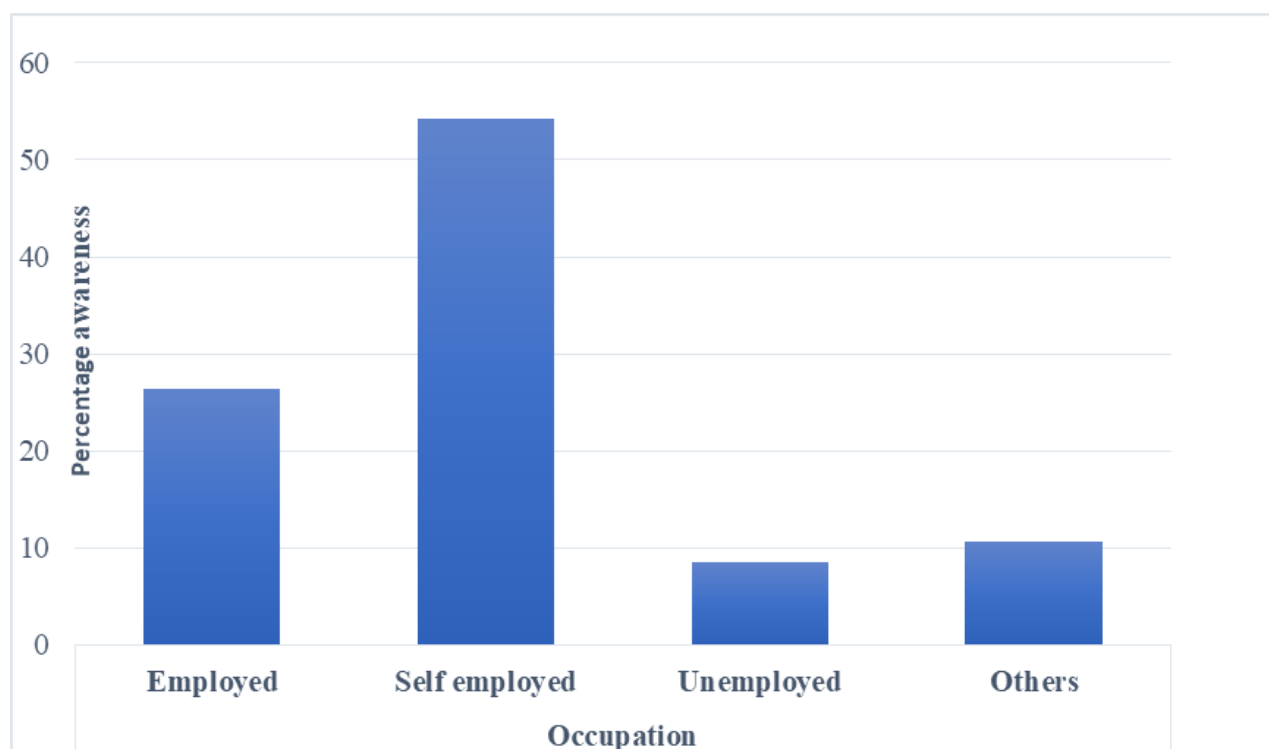


Figure 7: Awareness of leachate impacts by occupation (n = 140). Source: Field survey data, 2024.

## Overall Awareness and Perceived Impacts

Analysis of overall awareness indicators (Table 2) reveals a notable pattern such that while substantial proportions of respondents demonstrated awareness of leachate as a concept (64.3%) and recognized its hazardous components (70%), a significant knowledge gap emerged regarding practical management interventions, with only 35.7% demonstrating familiarity with technical mitigation strategies. This disparity suggests that community members possess experiential awareness of leachate problems but lack understanding of technical solutions. Health impact awareness was notably high (78.6%), with 76.4% reporting personally observed health effects in their communities, indicating strong lived experience of health consequences. Environmental impact recognition was even more pronounced (84.3% awareness; 85.7% reporting direct observations), suggesting visible environmental signs (odour, water discoloration, flooding) effectively communicate landfill impacts to community residents. Psychological impact awareness was comparatively lower (52.9% awareness), yet 63.6% reported observed psychological effects, indicating that psychological distress may be underrecognized as a landfill-related health consequence despite its significant prevalence.

Table 2: Respondents' key response rate on leachate awareness and perceived impacts

(n = 140). Source: Field survey questionnaire, 2024.

| Item                                            | Awareness (%) | Observed (%) |
|-------------------------------------------------|---------------|--------------|
| Awareness of leachate (landfill runoff)         | 64.3          | —            |
| Health impacts of leachate                      | 78.6          | 76.4         |
| Environmental impacts of leachate               | 84.3          | 85.7         |
| Psychological impacts of leachate               | 52.9          | 63.6         |
| Leachate contains toxic pollutants/heavy metals | 70.0          | —            |

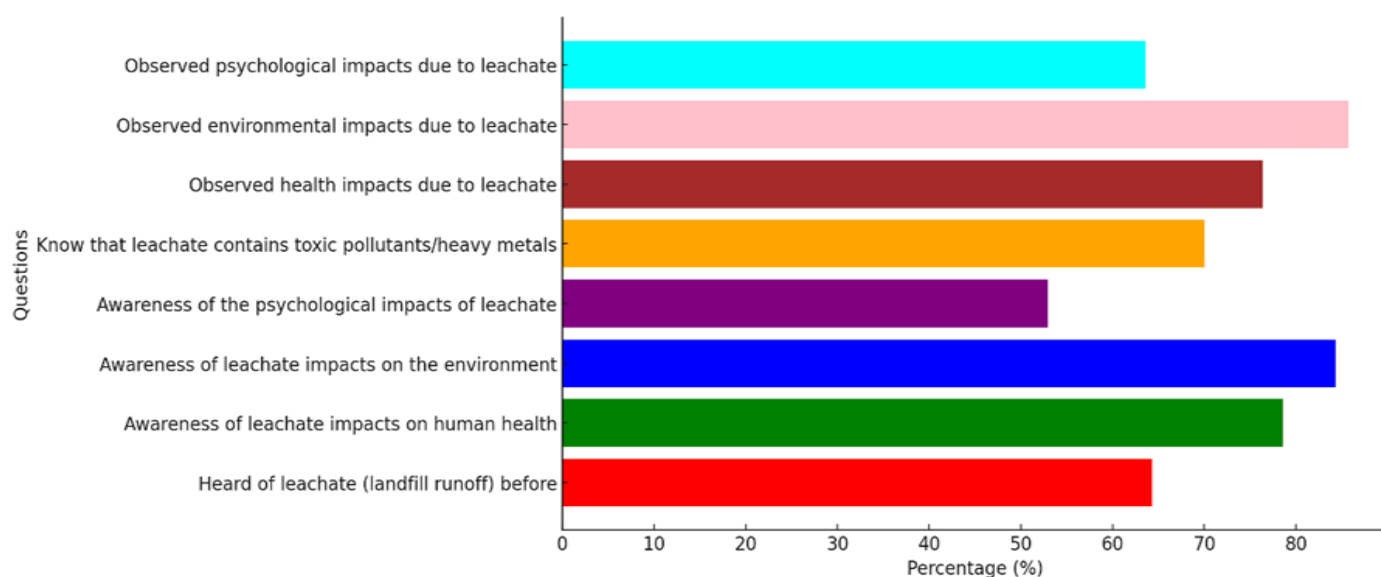


Figure 8: Responses of residents on perception of leachate from Solous Landfill (n = 140). Source: Field survey questionnaire, 2024. The figure displays Likert-scale responses regarding perceptions of leachate impacts across health, environmental, and psychological domains, showing predominance of negative perceptions reflecting concern about landfill-related risks.

### Focus Group Discussion Findings

The focus group discussions involved two groups of eight participants each, totalling 16 participants. The two focus groups revealed strong female representation (81.3%), with most married (87.5%) and possessing semi-formal education (62.5%) (Table 3). All participants (100%) reported negative experiences living near the landfill, with 81.3% citing groundwater pollution, mosquito proliferation, unpleasant odours, and flooding as major concerns. Knowledge assessment among focus group participants (Figure 9) revealed moderate self-reported leachate knowledge, with 56.3% claiming good knowledge of leachate and its impacts while 43.8% reported no or minimal knowledge. This more moderate knowledge level among FGD participants compared to survey questionnaire respondents likely reflects the purposive inclusion of diverse community members, including those less engaged with environmental information. Despite knowledge variations, the focus group discussions revealed unanimous concern (100%) regarding health risks associated with landfill proximity and universal recognition of absent or inadequate management

practices. This unanimous concern despite knowledge variability suggests that direct lived experience and visible environmental evidence provide compelling evidence of risk even among those lacking formal environmental knowledge, supporting the finding from quantitative analysis that experiential awareness transcends formal knowledge.

Despite knowledge variations, unanimous concern (100%) existed regarding health risks and absent management practices. Focus group participants articulated specific health and environmental concerns related to landfill proximity (Figure 10). Water pollution emerged as the primary concern affecting 68.8% of participants, reflecting community recognition of groundwater contamination risk and the critical importance of water quality to community health. Participants additionally cited persistent offensive odours (81.3%), mosquito proliferation linked to stagnant water accumulation (81.3%), and seasonal flooding (81.3%) as major environmental impacts. These environmental concerns directly translate to health risks including waterborne diseases associated with contaminated groundwater and flooding, respiratory impacts from offensive odours, and vector-borne diseases from increased mosquito populations.

Word association analysis (Table 4, Figure 11) revealed universal associations (100%) with waste, leachate/wastewater, landfill, water sources, and relocation. Strong associations existed with government (87.5%), recycling (87.5%), odour (81.3%), and environment (75%), while health registered lower salience (56.3%). This pattern

suggests environmental and infrastructural concerns dominated over personal health considerations. Landfill relocation received unanimous support (100%) as the preferred solution, reflecting limited confidence in management interventions.

Table 3: Demographic profiles of focus group discussion participants (n = 16). Source: Focus group discussion exercise, 2024.

| Demographic Item | Category    | Frequency | Percentage (%) |
|------------------|-------------|-----------|----------------|
| Gender           | Male        | 3         | 18.8           |
|                  | Female      | 13        | 81.3           |
|                  | Total       | 16        | 100            |
| Marital Status   | Single      | 1         | 6.3            |
|                  | Married     | 14        | 87.5           |
|                  | Separated   | 1         | 6.3            |
|                  | Total       | 16        | 100            |
| Education        | Formal      | 2         | 12.5           |
|                  | Informal    | 4         | 25.0           |
|                  | Semi-formal | 10        | 62.5           |
| Total            |             | 16        | 100            |

Table 4: Focus Group Discussion word association results (n = 16 participants). Source: Focus group discussion word association exercise, 2024. Values represent frequency of keyword mentions across two FGD sessions.

| Keyword                      | Frequency | Percentage (%) |
|------------------------------|-----------|----------------|
| Waste                        | 16        | 100.0          |
| Leachate/Wastewater          | 16        | 100.0          |
| Landfill/Dumpsite            | 16        | 100.0          |
| Water (well water, borehole) | 16        | 100.0          |
| Relocation                   | 16        | 100.0          |
| Government                   | 14        | 87.5           |
| Recycling/Bolar              | 14        | 87.5           |
| Odour                        | 13        | 81.3           |
| Environment                  | 12        | 75.0           |
| Health                       | 9         | 56.3           |

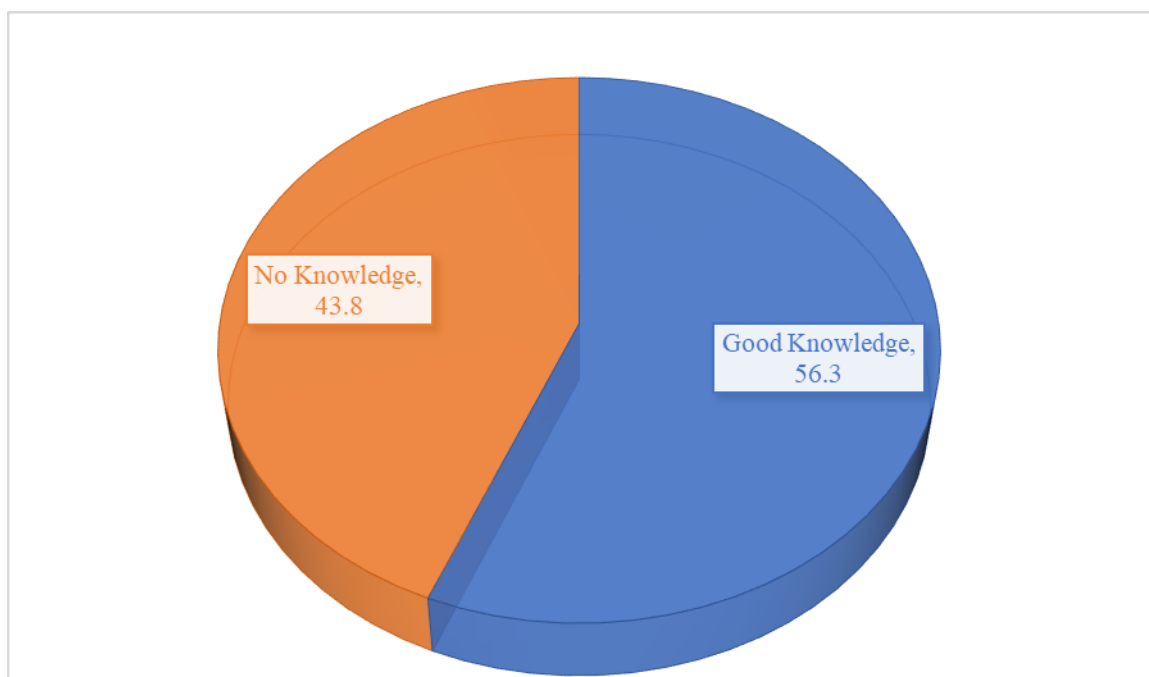


Figure 9: Public knowledge and awareness of leachate among FGD participants (n = 16). Source: Focus group discussion knowledge assessment, 2024. The figure presents self-reported knowledge levels regarding landfill leachate, showing that while over half claimed good knowledge, a substantial minority acknowledged limited or no knowledge of leachate characteristics and impacts

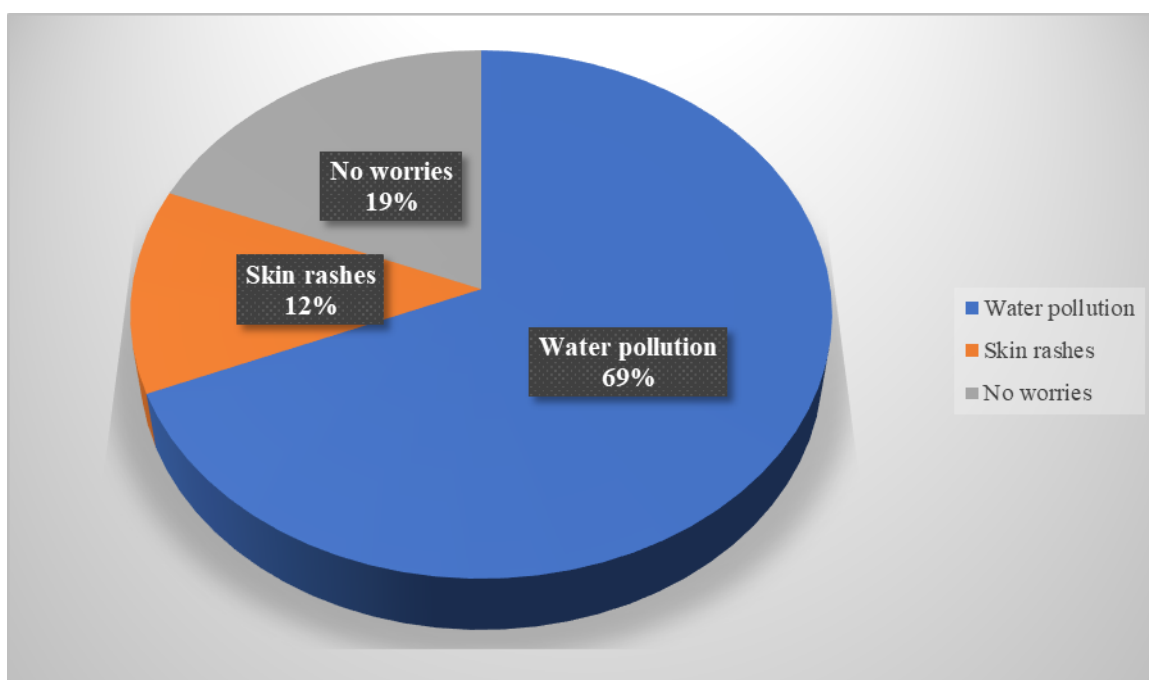


Figure 10: Perceived health and environmental impacts of landfill leachate (n = 16 FGD participants). Source: Focus group discussion thematic analysis, 2024.

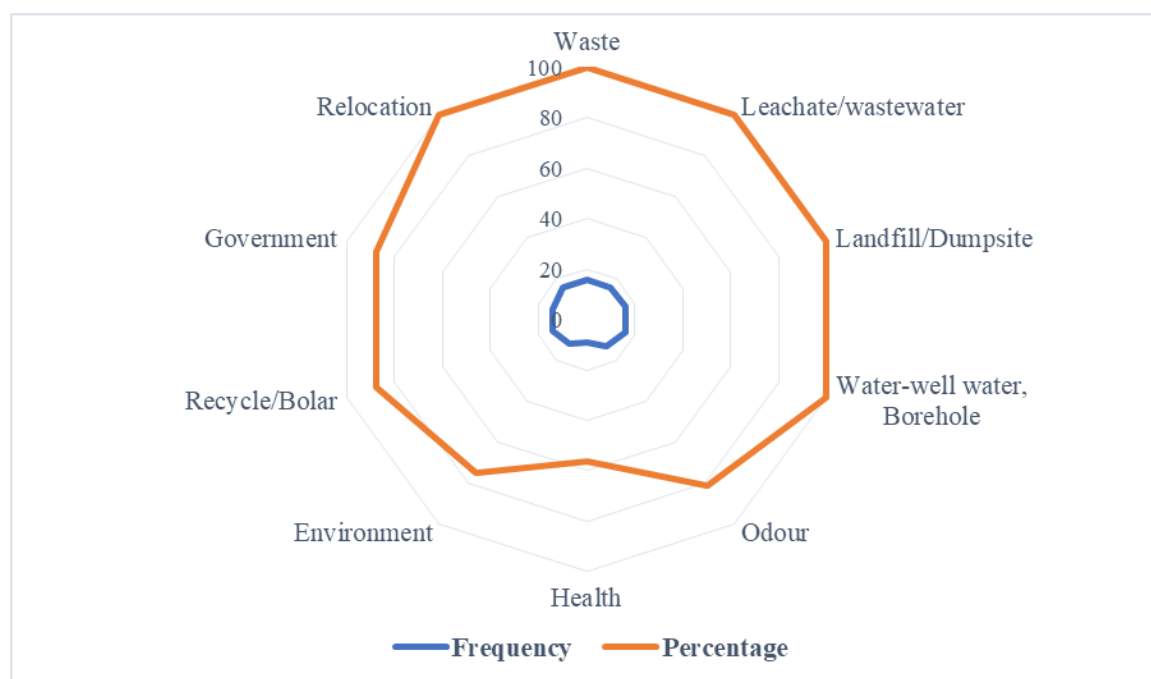


Figure 11: Word association analysis chart (n = 16 FGD participants). Source: Focus group discussion word association exercise, 2024.

## Statistical Analysis

Pearson correlation analysis revealed positive correlations between awareness domains: health and environmental impact awareness ( $r = 0.635$ ,  $p < 0.01$ ), health awareness and perceived health risks ( $r = 0.448$ ,  $p < 0.01$ ), and observed health and environmental effects ( $r = 0.254$ ,  $p = 0.002$ ). The strongest correlation occurred between observed environmental impacts and environmental awareness ( $r = 0.83$ ,  $p < 0.001$ ), demonstrating that direct experience substantially reinforces awareness. Chi-square analysis between public knowledge and risk perception yielded non-significant results ( $\chi^2 = 0.250$ ,  $df = 1$ ,  $p = 0.617$ ), suggesting factors beyond formal knowledge, particularly lived experience, shape risk perceptions. Educational level showed statistically significant association with health impact awareness ( $p < 0.05$ ), while age correlated with psychological impact recognition ( $p < 0.05$ ). Gender demonstrated no significant association with awareness ( $p > 0.05$ ).

## Discussion

### Community Awareness, Knowledge Gaps, and Risk Perception

The study reveals that 64.3% of Solous residents were aware of leachate contamination, with 70% recognizing its hazardous components, aligning with findings from Mataloni *et al.* (2016) and Yatoo

However, a substantial gap exists between hazard recognition and understanding of management practices, with only 35.7% demonstrating familiarity with technical mitigation strategies. This knowledge deficit corroborates Che *et al.* (2013) who identified persistent deficiencies in public understanding of leachate control technologies across developing countries.

High levels of health impact recognition (78.6%) and reported direct health effects (76.4%) are consistent with Ogbuehi *et al.* (2022) and Alao (2025). Widespread environmental impact observation (85.7%) aligns with Siddiqua *et al.* (2022), while recent investigations by Oyeboode *et al.* (2023) and Alao (2025) documented leachate migration threatening groundwater systems in Lagos and comparable contexts where aquifers serve as primary drinking water sources.

Strong correlations between awareness domains ( $r = 0.635$  for health-environment perception,  $p < 0.01$ ;  $r = 0.83$  for observed impacts-awareness,  $p < 0.001$ ) demonstrate that residents possess integrated understandings of landfill-related risks shaped primarily by lived experience rather than formal education (Etea *et al.*, 2021; Okorundu *et al.*, 2024). Demographic analysis confirmed education and age as primary determinants of risk perception, supporting

Al-Khatib *et al.* (2015) and Roy *et al.* (2023), while gender's non-significance reflects shared community exposure experiences (King, 2020). It is noteworthy that while Pearson correlations confirmed strong associations between awareness domains, the chi-square test between public knowledge of leachate and overall risk perception yielded a non-significant result ( $\chi^2 = 0.250$ ,  $df = 1$ ,  $p = 0.617$ ). This apparent inconsistency is explained by the nature of the variables tested: the chi-square assessed binary categorical knowledge (aware vs. unaware) against a categorised perception variable, whereas Pearson correlations captured continuous, multi-dimensional awareness–experience relationships. The non-significance suggests that abstract knowledge of leachate as a concept does not alone predict risk perception; rather, it is the direct sensory and lived experience of its effects odour, water discolouration, and illness episodes which primarily drives community risk judgement (Etea *et al.*, 2021). This finding has important implications for risk communication, indicating that information campaigns alone are insufficient without complementary environmental improvements that residents can observe and verify.

### **Comparative Analysis: Proximity-Health Relationships and Awareness Patterns**

The Solous findings align closely with evidence from other developing country urban contexts. Comparable proximity health gradients have been documented in South Asia: Shammi *et al.* (2023) reported significantly higher prevalence of diarrhea (32.1% within 50m vs. 22.8% at 50-300m), allergies (30.2% vs. 18.1%), and asthma (11.3% vs. 3.1%) in Khulna, Bangladesh. In Chittagong, residents near open landfills reported eye irritation (38.2%), hepatitis (27.9%), and headaches (23.5%) (Paul *et al.*, 2025). Pakistani studies documented elevated risks of multiple diseases among residents within 100m compared to those beyond 500m (Akmal & Jamil, 2021).

Environmental impact awareness in Lagos (85%) parallels findings from Bangladesh (74% odor concern; 80.5% odor-health link) and South Africa (76% health awareness, 82% environmental concern) (Shammi *et al.*, 2023; Njoku *et al.*, 2019). This convergence across diverse geographical contexts suggests that experiential knowledge transcends formal education in generating community concern. Within Nigeria, studies from Ibadan documented leachate characteristics indicating active contaminant release into groundwater (Olagunju *et al.*, 2020; Afolabi *et al.*, 2022), supporting the Solous exposure pathway findings.

### **Psychological Impacts and Expanded Health Dimensions**

A notable contribution of this study is systematic documentation of psychological impacts affecting 63.6% of respondents, corroborating Ta *et al.* (2025) and Pastor *et al.* (2024) in Asian contexts. This exceeds the 45% psychological stress reported in South Africa (Njoku *et al.*, 2019), potentially reflecting differences in exposure intensity or cultural expressions of distress. Mental health dimensions are typically overlooked in landfill assessments prioritizing physical morbidity (Vrijheid, 2000), suggesting that existing evaluations systematically underestimate total community health burdens.

### **Socioeconomic Vulnerability and Governance Implications**

The Solous demographic profile which is characterized by low-to-middle income households and long-term residence aligns with studies across Bangladesh, Pakistan, and South Africa. Critically, Khulna studies demonstrate that income and employment status do not protect against exposure-related health risks when environmental proximity is the primary determinant (Shammi *et al.*, 2023), highlighting environmental justice dynamics where marginalized populations bear disproportionate burdens (Martin *et al.*, 2020).

Strong community preferences for landfill relocation over technical management interventions, revealed through FGDs, align with findings from South Africa (Njoku *et al.*, 2019), indicating profound institutional distrust across developing nations. This pattern has critical policy implications: technically sound interventions are unlikely to succeed without transparent governance, participatory decision-making, and demonstrated accountability. The unanimous preference for relocation reflects community perceptions that existing institutions lack both capacity and commitment to implement effective solutions.

### **Policy and research implications**

The consistent proximity-health associations across Lagos, Khulna, Chittagong, Johannesburg, and Pakistani cities necessitate enforceable setback distance regulations exceeding the commonly proposed 100-500m, as health and psychological impacts are not limited to populations in close proximity alone. Municipal authorities must integrate minimum setback requirements into urban planning frameworks and restrict informal settlement development in landfill buffer zones.

Beyond spatial planning, the convergence of evidence indicates that inadequate solid waste

management represents a shared challenge requiring integrated responses combining technical infrastructure improvements with transparent governance, community participation, and targeted education providing actionable knowledge about leachate management and accountability mechanisms rather than generic awareness campaigns. Participatory approaches centering community knowledge are essential for rebuilding institutional trust and achieving sustainable outcomes.

Future research should prioritize longitudinal designs establishing causal relationships, standardized assessment tools enabling robust cross-national comparisons, systematic inclusion of mental health indicators alongside physical health metrics, and investigations into effective participatory governance models. The consistency of findings across diverse developing countries contexts demonstrates that landfill-related environmental health impacts constitute a global challenge requiring coordinated action grounded in environmental justice principles.

## Conclusion

This study concludes that community awareness of landfill leachate at Solous is interconnected, with knowledge of health, environmental, and psychological impacts often occurring together. Visible signs of pollution, such as odour and water contamination, trigger environmental concerns, while demographic factors like education, age, and occupation influence residents' perceptions of risk. Both men and women displayed similar awareness levels, though younger and better educated individuals were more attuned to psychological impacts, while older and locally engaged residents focused more on practical issues. Marital status did not significantly affect awareness once age and community experience were considered. The study also found correlation between education and heightened awareness of leachate's effects. Focus group participants, especially local commercial workers, expressed concerns about visible pollution but lacked detailed technical knowledge. This aligns with other studies showing that sensory cues often shape risk recognition, highlighting the need for targeted education alongside visible mitigation measures. Additionally, occupational roles influenced awareness, with self-employed individuals having higher exposure and firsthand experience of leachate impacts, while formally employed individuals showed greater theoretical knowledge. The study revealed a preference for landfill relocation over management efforts, suggesting a distrust in existing waste management practices. To address this, it is essential to strengthen leachate management systems at Solous

Landfill by introducing better waste segregation, effective leachate collection systems, and the installation of proper landfill liners to prevent groundwater contamination. A robust approach to managing leachate will help reduce the harmful effects on both human health and the environment.

Future research should employ longitudinal and biomarker-based designs to establish causal links between leachate exposure and health outcomes, complemented by GIS-integrated exposure-response modelling for regulatory application. Standardised, cross-nationally comparable assessment tools would strengthen the global evidence base needed to inform WHO and UNEP policy on community health protection near solid waste facilities, while intervention studies evaluating education programmes, infrastructure improvements, and transparency mechanisms would guide evidence-based policy implementation. Particular attention should be directed toward gender-differentiated impacts and the specific vulnerabilities of children, pregnant women, and elderly residents, whose exclusion from the present adult-focused study limits a complete characterisation of the total health burden attributable to landfill leachate exposure in communities like Solous.

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