Factors Influencing Health and Environmental Conditions in Hwiida, A Community Near Landfill Site in Gomoa West, Central Region, Ghana

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Abstract

Municipal solid waste management remains a significant challenge in low- and middle-income countries (LMICs), particularly in rapidly urbanizing areas like Ghana's Central Region. This study examines the health and environmental impacts of the Hwiida Landfill Site on nearby communities in Gomoa West District. Using a cross-sectional correlational design, data were collected from 100 systematically selected residents within a 1-kilometre radius of the landfill via a structured questionnaire. Descriptive and binary logistic regression analyses were conducted. Results show that 81% of respondents reported health problems potentially linked to landfill exposure, including respiratory issues, skin conditions, and diarrhoea, and 73% indicated that at least one household member was affected in the past year. Environmental concerns were widespread: 72% cited air pollution (notably odour) and 48% reported pest and rodent infestations. Most participants (92%) lived within 300 metres of the site and lacked access to improved sanitation or formal waste collection. Inadequate landfill management especially the absence of leachate containment and minimal waste segregation was identified as a key contributor to pollution. These findings highlight the urgent need for engineered landfill upgrades, community health education, and targeted policy interventions. Context-specific evidence such as this can inform sustainable waste management strategies and reduce the health burden on vulnerable populations near landfills.

Keywords: *Community Exposure, Environmental Pollution, Landfill Sites, Leachate, Municipal Solid Waste Management, Public Health Impact.*

Introduction

Municipal solid waste management is a global challenge driven by rapid urbanization, population growth, and increasing consumption patterns [1, 2]. As cities expand, waste generation escalates, placing immense pressure on urban infrastructure. Globally, landfills remain the most commonly used method for waste disposal, accommodating nearly 70% of municipal solid waste, particularly in low-and middle-income countries (LMICs) [3]. Despite their widespread use, landfills are associated with significant environmental and public health risks [4]. Epidemiological evidence consistently links residential proximity to landfill sites with adverse health outcomes, including respiratory illnesses, waterborne diseases, and congenital anomalies [5].

The environmental impacts of landfills are well documented. Leachate, landfill gases, and particulate emissions are recognized as major pollutants [6, 7]. Leachate often containing heavy metals and hazardous organic compounds can infiltrate groundwater and surface water bodies, threatening both

ecosystems and human health [7]. Methane and hydrogen sulphide, generated during anaerobic decomposition of organic waste, contribute to greenhouse gas emissions, air pollution, and persistent odour nuisance [8]. These effects are exacerbated in poorly managed landfills that lack engineered containment systems and waste segregation practices. While high-income countries have adopted advanced technologies to mitigate these impacts, LMICs continue to struggle with limited financial resources, inadequate infrastructure, and weak regulatory enforcement, resulting in severe environmental and health consequences [9].

In Africa, urbanization and population growth have outpaced waste management capacity, resulting in widespread environmental degradation and public health crises [10, 11]. The continent generates approximately 626,301 metric tons of waste annually, yet only 40% is collected and less than 5% recycled [12]. The remainder is frequently disposed of in unregulated open dumps or poorly managed landfill sites, which disproportionately affect marginalized and low-income communities [13]. Studies from South Africa and Nigeria report elevated rates of respiratory diseases, skin irritations, and gastrointestinal illnesses among residents living near landfills, symptoms attributed to exposure to airborne pollutants, contaminated water, and vector proliferation [14–16]. These health risks are further intensified by socioeconomic vulnerabilities, including poverty, limited access to clean water, and inadequate healthcare [13, 16].

Ghana faces similar challenges. The country generates over 7 million tons of waste annually, with significant contributions from both urban and peri-urban areas such as Hwiida [17, 18]. Although efforts to improve waste collection have been made, the majority of waste is still disposed of in landfill sites, many of which operate without basic environmental safeguards [19]. Critically, these landfills often lack impermeable liners to prevent leachate seepage,

resulting in contamination of local water sources [20–22]. Minimal waste segregation further enables the uncontrolled release of hazardous chemicals and toxic gases [23, 24]. Compounding these issues are weak enforcement of environmental regulations, insufficient public awareness, and underdeveloped sanitation infrastructure [25–27].

The Central Region of Ghana exemplifies these systemic failures. With a population exceeding 2 million [28], the region generates approximately 1,716 tons of waste daily, much of it disposed of in landfill sites located alarmingly close to residential areas [12]. These sites pose significant risks to environmental quality and public health [29]. Residents in proximity report higher incidences of asthma, bronchitis, and waterborne diseases linked to contaminated groundwater [30]. Environmental degradation extends to soil and air pollution, with observable impacts such as reduced agricultural productivity and loss of biodiversity [31].

Despite these pressing concerns, there is a notable gap in localized, context-specific research in Ghana that examines how socioeconomic, behavioral, and geographic factors jointly influence health and environmental outcomes near landfills. Existing studies often generalize risks without accounting for Ghana's unique institutional, cultural, and infrastructural realities. For instance, while international literature associates landfill proximity with low birth weight, congenital anomalies, and certain cancers [5], comparable evidence from Ghana remains scarce [32]. Moreover, many studies conflate health and environmental impacts rather than analyzing the distinct drivers of each.

Communities near landfills in the Central Region are typically socioeconomically disadvantaged, heightening their vulnerability to pollution-related hazards. Limited access to clean water, healthcare, and formal waste

services increases their exposure and reduces adaptive capacity. Equally important is the lack of data on community perceptions and coping strategies, information essential for designing equitable and effective interventions. Without such localized evidence, policymakers and urban planners lack the empirical basis needed to address the dual burden of environmental degradation and public health risk.

This study therefore investigates the factors influencing health and environmental conditions in communities adjacent to the Hwiida Landfill Site in Ghana's Central Region. By generating context-specific data, the research aims to inform targeted policy interventions and contribute to the broader understanding of landfill impacts in LMIC settings. Specifically, the study addresses the following research questions:

1. What factors influence health conditions (e.g., respiratory issues, waterborne diseases) in communities near landfill sites in the Central Region?
2. What factors influence environmental conditions (e.g., air quality, water contamination, odour) in these communities?

Methods and Participants

Study Design and Setting

This study employed a cross-sectional correlational survey design to examine the factors influencing health and environmental conditions among residents living in proximity to the Hwiida Landfill Site in the Gomoa West District of Ghana's Central Region. Commissioned in 2015, the Hwiida landfill occupies a 65.5-acre parcel and was developed as an engineered facility to replace the previously used Dawurampong dumpsite. It serves as the primary municipal solid waste disposal site for the district, incorporating design features such as controlled waste placement and basic containment measures intended to reduce environmental impacts. Despite these upgrades, the site has been associated with recurring ecological concerns—including leachate seepage, persistent odour emissions, and community complaints—that have led to multiple legal disputes. Surrounding communities within a 1-kilometre radius include Mumford, Dago, Apam, Obiri, Otuam, and Kyiren Nkwanta.

Participants and Sampling

The target population consisted of adults aged 18 years or older who had resided within a 1-kilometre (1000-metre) radius of the Hwiida landfill for at least 12 months. The 1-kilometre radius was selected based on evidence that most adverse health and environmental impacts from landfill sites are concentrated within this radius due to the dispersion of pollutants, such as leachate and gases [33]. Although an earlier draft mentioned a five-year residency requirement, the final inclusion criterion was a minimum of 12 months' residence to ensure recent and relevant exposure while maximizing participation feasibility. Limiting the sample to adults ensured participants could provide informed consent and offer reliable self-reported data.

A systematic random sampling approach was used to select 100 participants. Starting from predetermined entry points around the landfill perimeter, every fifth household along radial transects was approached until the target sample size was achieved. Only one eligible adult per household was interviewed. This approach balances adequate representation and statistical power with logistical feasibility [34].

Instrument Development and Data Collection

Data were collected using a structured, self-developed questionnaire informed by established public health and environmental exposure assessment tools. To ensure content validity and cultural appropriateness, the instrument was pilot-tested with 10 residents from a non-study community in the Central Region that shares similar socioeconomic and

environmental characteristics with Hwiida. Feedback from the pilot phase was used to refine wording, sequence, and clarity.

The final questionnaire comprised three sections:

1. Sociodemographic and household characteristics, including age, gender, education level, occupation, household size, housing type, distance from residence to the landfill (categorized as <100 m, 100–300 m, 400–600 m, or >700 m), source of drinking water, type of sanitation facility, and primary method of household waste disposal.

2. Self-reported health conditions experienced in the past 12 months, such as respiratory symptoms (e.g., coughing, wheezing), skin irritations, diarrhoea, headaches, and eye discomfort.

3. Perceived environmental conditions, including observations of air pollution (e.g., foul odour, smoke), pest and rodent infestations, suspected water contamination, and overall perceptions of the landfill's impact on local environmental quality.

Printed questionnaires were administered in person by five trained data collection assistants. Prior to administration, participants were briefed on the study's purpose, procedures, potential risks (minimal), and benefits (none beyond contributing to community knowledge). Written or verbal informed consent was obtained from all participants, with emphasis on voluntary participation, confidentiality, and the right to withdraw at any time without penalty.

Data Analysis

Data analysis began with descriptive statistics to summarize participant demographics and provide an overview of reported health outcomes and environmental conditions. To address the first research question which was identifying factors influencing health conditions, binary logistic regression was conducted (note: revised from "multiple regression" for appropriateness to dichotomous outcomes). The model examined the relationships among independent variables (proximity to the landfill, socioeconomic factors, drinking water source, toilet facility, waste disposal method, and perceived exposure) and the dependent variable (self-reported health conditions among the participant or a household member). This approach allows for quantification of the relative contribution of each predictor while controlling for potential confounders, offering nuanced insights into the drivers of health outcomes [35-38].

For the second research question, factors influencing environmental conditions, descriptive and inferential analyses were used to explore associations between household practices, proximity, and perceived environmental impacts (e.g., odour, pests, water quality). Together, these analyses provide evidence-based insights into the dual health and environmental impacts of landfill sites, informing policy and waste management practices in similar settings.

Results and Discussion

Preliminary Analysis

A total of 100 residents living within a 1-kilometre radius of the Hwiida Landfill Site in Gomoa West District, Central Region, Ghana, participated in the study. Their sociodemographic, household, and environmental characteristics are summarized in Table 1 below.

The majority of respondents were female (64%), and the largest age group was 31–40 years (27%), followed by those aged 20–30 (22%) and above 61 years (14%). Only 5% of participants were aged 51–60. Educational attainment was generally low: 25% reported no formal education, while 24% had completed Junior High School. Only 13% had attained tertiary-level education. Economically, the sample reflected a predominantly informal and

precarious livelihood structure: 42% engaged in self-employment (e.g., petty trading or small-scale farming), 40% were not currently working, and just 15% were employed in the public sector; only 3% worked in the private sector. Household size was substantial, with 36% of respondents living in households of 3–6 persons and 30% in households with 10 or more members. The majority (83%) resided in modern housing structures, while 17% lived in traditional dwellings. Critically, 92% of participants lived within 300 m of the landfill: 46% resided less than 100 m away, and another 46% lived between 100 and 300 m from the site. Only 8% lived beyond 400 m, with just one participant residing more than 700 m away.

Access to basic services was mixed. While 50% relied on pipe-borne water as their primary drinking source, 31% consumed sachet water, 14% used public standpipes, 6% depended on boreholes or tube wells, and 5% sourced water from surface bodies such as rivers or dams. Sanitation facilities were largely unimproved: 40% used KVIPs (a form of improved pit latrine), 31% relied on public toilets, and 10% used basic pit latrines. Notably, 4% still practiced open defecation, though no respondents reported using bucket/pan systems. Waste disposal practices were overwhelmingly unsanitary: 67% reported open dumping of household waste, 27% practiced open burning, and only 4% had access to formal waste collection services. Composting and burying were rare (1% each).

These findings illustrate a community characterized by high residential proximity to a landfill, limited formal employment, large household sizes, and inadequate waste management infrastructure, all of which may compound exposure to landfill-related environmental hazards.

Table 1. Sociodemographic, Household, and Environmental Characteristics of Participants

Variable	Category	Frequency
Gender	Male	36
	Female	64
Age (years)	<20	12
	20–30	22
	31–40	27
	41–50	20
	51–60	5
	>61	14
Education Level	No formal education	25
	Primary	21
	Junior High School	24
	Senior High School	17
	Tertiary	13
Occupation	Government worker	15
	Private sector employee	3
	Own business	42
	Not currently working	40
Household Size	<3 persons	16

	3–6 persons	36
	7–10 persons	18
	>10 persons	30
Housing Type	Traditional home	17
	Modern home	83
Distance to Landfill	<100 m	46
	100–300 m	46
	400–600 m	7
	>700 m	1
Drinking Water Source	Sachet water	31
	Pipe-borne water	50
	Borehole/tube well	6
	Public tap/standpipe	14
	Dam/river/lake/rainfall	5
Toilet Facility	Sewer	10
	Septic tank	5
	KVIP	40
	Pit latrine	10
	Public toilet	31
	Open defecation	4
Waste Disposal Method	Open dumping	67
	Open burning	27
	Burying	1
	Composting	1
	Arranged service	4

Source: Field Work (2025)

Self-Reported Health Impacts Attributed to Landfill Proximity

A high prevalence of self-reported health effects was observed among residents living near the Hwiida Landfill Site. Of the 100 participants, 81% (n = 81) indicated that they personally experienced one or more adverse health symptoms in the past 12 months that they associated with the landfill. Additionally, 73% (n = 73) reported that at least one other member of their household had suffered similar health issues during the same period, suggesting that the perceived health burden extends beyond individual respondents to affect entire families.

Two participants did not respond to this section of the questionnaire.

These findings align with patterns documented in the global epidemiologic literature on landfill exposure. As noted by [5], residents near waste sites consistently report non-specific symptoms including headaches, fatigue, respiratory irritation, and gastrointestinal discomfort even in the absence of clinical confirmation. While such symptoms may result from direct toxicological exposure, stress related to odours and environmental concerns, or reporting bias, their high prevalence in this community underscores a

significant perceived health risk associated with landfill proximity (Table 2).

Table 2. Household and Individual Reports of Landfill-Associated Health Effects in the Past 12 Months

Outcome	N	%
Individual reported ≥1 health symptom	81	81.0
Household had ≥1 affected member (including respondent)	73	73.0
No health effects reported	17	17.0
Missing response	2	2.0

Note: Percentages are based on total sample (N = 100). The household-level figure reflects respondents who indicated that any household member (not necessarily themselves) was affected.

Discussion

The high prevalence of self-reported health symptoms, 81% of individuals and 73% of households among residents living within 1 km of the Hwiida Landfill Site, aligns with a well-documented global pattern. Epidemiologic reviews consistently report elevated rates of nonspecific symptoms, such as headaches, fatigue, respiratory irritation, and gastrointestinal distress, among populations residing near landfill sites [5]. While these symptoms may arise from direct toxicological exposure to landfill emissions, [5] cautions that they could also reflect stress, anxiety, or reporting bias triggered by persistent odour, visual blight, or fear of contamination, factors often amplified in the absence of transparent risk communication.

The environmental conditions reported by participants further support plausible exposure pathways. Air pollution complaints (72%), primarily due to foul odours, are consistent with the emission of hydrogen sulphide and ammonia gases generated during anaerobic decomposition of organic waste, which are known to cause mucosal and respiratory irritation [6, 8]. Pest and rodent infestations (48%) likely stem from inadequate waste containment and the open dumping practices observed both at the landfill and household levels [10]. Such conditions not only degrade the quality of life but also increase the risks of vector-borne and zoonotic diseases.

Of particular concern is the potential for water contamination. The Hwiida landfill, like many in Ghana, reportedly lacks engineered leachate containment systems [20–22]. Leachate, a toxic cocktail of heavy metals, organic pollutants, and pathogens can infiltrate groundwater, especially in areas with shallow aquifers and high rainfall, as is common in the Central Region. This risk is compounded by the fact that 25% of respondents rely on boreholes, rivers, or unprotected surface water for drinking [20]. Contamination of these sources provides a credible pathway for the diarrhoea and gastrointestinal illnesses reported by participants.

Moreover, the near-universal practice of open dumping (67%) and burning (27%) at the household level exacerbates local pollution [10]. Waste burning releases dioxins, furans, and fine particulate matter, which are linked to respiratory and cardiovascular morbidity [23, 25]. The absence of waste segregation, both at source and at the landfill means hazardous materials (e.g., batteries, plastics, medical waste) are commingled with organic refuse, increasing the toxicity of both leachate and emissions [23].

Critically, 92% of participants reside within 300 m of the landfill, a proximity that

intensifies exposure to gaseous and particulate pollutants. Although this study did not include ambient air or water monitoring, the distance-dependent gradient in symptom reporting (higher prevalence closer to the site) suggests a potential exposure–response relationship, a pattern observed in other landfill studies [5, 29].

Nevertheless, limitations must be acknowledged. As with most community-based landfill investigations, our data rely on self-reported outcomes without clinical or environmental validation [5]. The lack of direct exposure metrics (e.g., H_2S concentrations, water quality tests) precludes definitive causal inference. However, the consistency of symptom patterns with known landfill hazards and their alignment with findings from Nigeria, South Africa, and Europe [5, 14–16] strengthens the plausibility of an association.

Ultimately, the burden borne by the Hwiida community reflects a broader failure of environmental governance in rapidly urbanizing LMICs. Landfills are frequently sited near marginalized settlements with limited political voice [13], creating environmental injustice where the costs of waste disposal are externalized onto the most vulnerable [16]. Addressing this requires more than technical fixes; it demands inclusive planning, regulatory enforcement, and investment in safe water, sanitation, and alternative waste treatment systems that prioritize public health over convenience.

Conclusion

This study provides evidence that residential proximity to the Hwiida Landfill Site is associated with substantial environmental degradation and a high burden of self-reported health symptoms among nearby communities. The co-occurrence of inadequate landfill engineering (e.g., lack of leachate containment), poor household waste practices (e.g., open dumping and burning), and limited access to safe water and sanitation creates a synergistic exposure environment that heightens vulnerability, particularly among socioeconomically disadvantaged residents.

Recommendations

1. The District Assembly should improve landfill engineering, including lining systems to prevent leachate seepage. Strengthen community education on waste segregation and hygiene.
2. The Government of Ghana, through the Ministry of Science and Environment, enhances monitoring and enforcement of environmental regulations.
3. The Ghana Government must expand access to safe water and sanitation facilities for affected communities.
4. The District Assembly should relocate or buffer residential areas from active landfill zones.
5. The government should build a health facility for the people so that they can get access to healthcare when they get infected.
6. Non-Governmental Organizations (NGOs), organizations, and philanthropists can help establish Health facilities.

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Conflict of Interest

The Authors of this manuscript declare no conflict of interest.

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