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Reasearch Article

Evaluation Of Household Waste Disposal Quality And Associated Factors In Southern Drc (Cities Of Lubumbashi And Kolwezi): A Cross-Sectional Study With Linear Regression Analysis.

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Abstract

Context: Inadequate household waste management is a major public health problem in rapidly growing African cities, particularly in the Democratic Republic of Congo. In Kolwezi and Lubumbashi, rapid urbanization and insufficient sanitation services expose populations to significant health risks.
Objective: Evaluate the quality of household waste disposal in the city of Kolwezi and identify the associated socio-demographic factors.
Methods: A descriptive and analytical cross-sectional study was conducted in 2024 with 5,789 selected households in the cities of Lubumbashi and Kolwezi. A waste disposal quality score (0–10) was constructed. Descriptive, bivariate, and multivariate linear regression analyses were performed.
Results: The majority of households exhibited poor waste disposal quality. The level of education ($\beta = +1.42$; $p = 0.003$), the use of a collection service ($\beta = +2.05$; $p < 0.001$) and the household size ($\beta = -0.31$; $p = 0.041$) were significantly associated with the waste disposal quality score.
Conclusion: The quality of household waste disposal in Kolwezi remains inadequate and heavily influenced by socio-educational and organizational factors. Strengthening environmental education and municipal waste collection services is essential.

Keywords: Household waste management; Environmental health; Waste disposal quality; Urban sanitation; Democratic Republic of Congo.

INTRODUCTION

Household waste management is recognized as a major determinant of environmental health in low- and middle-income countries [1]. According to the World Bank, more than 2 billion tons of municipal waste are generated annually worldwide, much of which is not adequately treated in sub-Saharan Africa [2].

In the Democratic Republic of Congo, uncontrolled waste disposal contributes to the spread of diarrheal diseases, malaria, and acute respiratory infections [3,4]. In Kolwezi, a mining town with a rapidly growing population, sanitation infrastructure remains largely inadequate [5].

This study aims to fill the gap in local data by assessing the quality of household waste disposal and its determinants.

METHODS

Type and framework of the study

Cross-sectional descriptive and analytical study carried out in 2024 in the South of the DRC (cities of Lubumbashi and Kolwezi).

Population and sample

The study included 5789 convenience-selected households that met the following criteria:

- age ≥ 18 years,
- permanent residence in Kolwezi or Lubumbashi,
- informed consent.

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Variables

Dependent variable

- Waste disposal quality (continuous score from 0 to 10)

Independent variables

- age, sex, education level, occupation, household size, municipality of residence, use of a collection service.

Construction of the elimination quality score

The score was constructed from four dimensions (0–2.5 points each):

1.waste disposal site

2.evacuation frequency,

3.management method (sorting vs mixing)

4.use of a collection service.

Statistical analysis

- Descriptive analysis (frequencies, means)
- Simple linear regression followed by multivariate regression
- Significance threshold: $p < 0.05$

RESULTS

Table 1. Sociodemographic characteristics of households (n = 57).

Variable	Modality	n (%)
Sex	Female	4064 (70.2)
	Male	1725 (29.8)
Level of education	Illiterate	1928 (33.3)
	Secondary and +	3891 (66.7)
City	Lubumbashi	3757 (64.9)
	Kolwezi	2032(35.1)

The population studied is predominantly female and characterized by a low level of education, a recognized factor of environmental vulnerability.

Socio-demographic characteristics and role in waste management

Household waste management in the surveyed households is primarily the responsibility of women. As illustrated in Figure 1 , mothers are responsible for waste management in 38.6% of households, followed by fathers (26.3%), domestic workers (24.6%), and daughters (10.5%).

This female predominance underscores the central role of women in domestic activities related to sanitation, a finding widely reported in urban African contexts. Similar observations have been made in Ghana and Senegal, where women are the main actors in domestic hygiene practices [6,7].

Guerrero et al. (2013): Emphasize that the low level of education in developing countries limits the technical understanding of the health risks associated with waste [8-10].

Kaza et al. (2018): Note that rapid urbanization in sub-Saharan Africa often outpaces educational and infrastructural capacities, creating areas of environmental vulnerability [2].

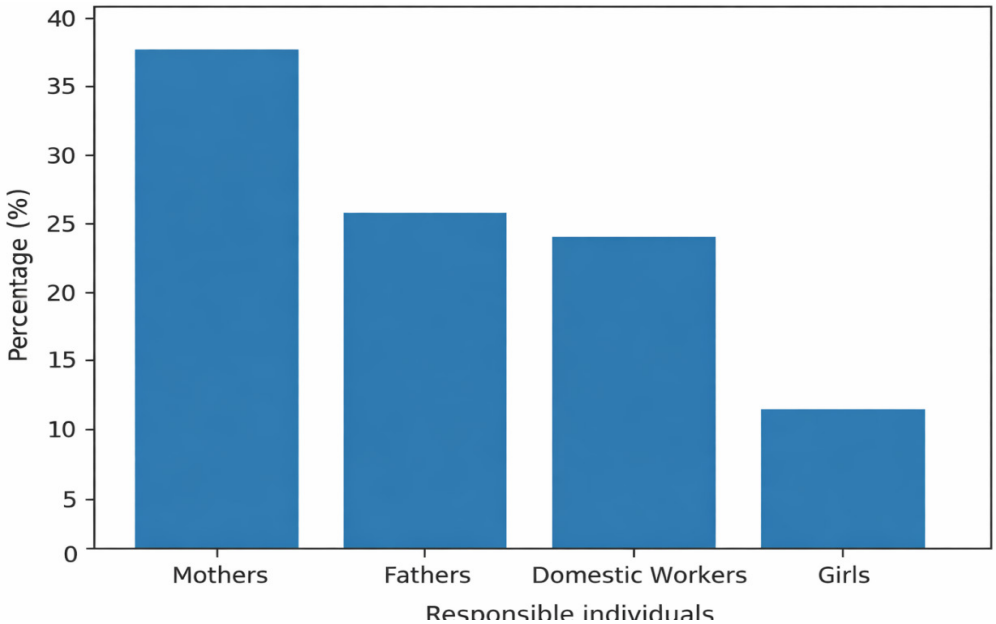
WHO (2017): Recalls that populations with low levels of education are most exposed to vector-borne diseases due to unsanitary conditions [11]. This has the following consequences: Educational capital is recognized as a fundamental social determinant influencing the health and environmental behaviors of populations. In urban and peri-urban contexts of low- and middle-income countries, a low level of education is frequently associated with inadequate management of household waste, contributing significantly to unsanitary living conditions and increased exposure to vector-borne diseases. Several studies have shown that populations with low levels of education have limited knowledge regarding the health risks associated with waste accumulation and vector proliferation, resulting in practices such as illegal dumping, disposal of waste in gutters and waterways, and open burning [6, 12].

Insufficient knowledge of hygiene and sanitation contributes to the persistence of non-biodegradable solid waste, particularly plastics, which retain rainwater and provide ideal breeding grounds for mosquitoes that transmit malaria, dengue fever, and other arboviruses. Studies conducted in sub-Saharan Africa have demonstrated a significant correlation between household education levels, the quality of waste management, and vector density in the domestic environment [13,14]. According to the World Health Organization, unsanitary environments resulting from poor waste management are a major driver of vector-borne and waterborne disease transmission in disadvantaged urban areas [15]. Low levels of education also influence community dynamics in waste management. In many impoverished neighborhoods, a lack of awareness and training limits the collective understanding of sanitation issues, reducing participation in municipal and community waste collection programs. This situation fosters the emergence of informal, poorly regulated systems that are often inefficient and a source of chronic unsanitary conditions [16]. Education thus appears as a key factor in community mobilization and the sustainability of solid waste management interventions [17].

Furthermore, poor household waste management linked to low levels of education places considerable pressure on public health systems [18]. The increased incidence of vector-borne diseases leads to higher health expenditures, lost productivity, and increased socioeconomic vulnerability for households, contributing to a vicious cycle of poverty, disease, and limited access to education [19]. The World Bank emphasizes that preventable diseases linked to unsanitary conditions represent a major economic cost for rapidly growing African cities [20].

Low levels of education are thus a structural factor exacerbating poor household waste management and increased exposure to vector-borne diseases[21]. Strengthening health and environmental education, integrated into urban waste management policies, appears to be a key strategic lever for improving sanitation, reducing the burden of vector-borne diseases, and promoting sustainable urban development in vulnerable contexts[22].

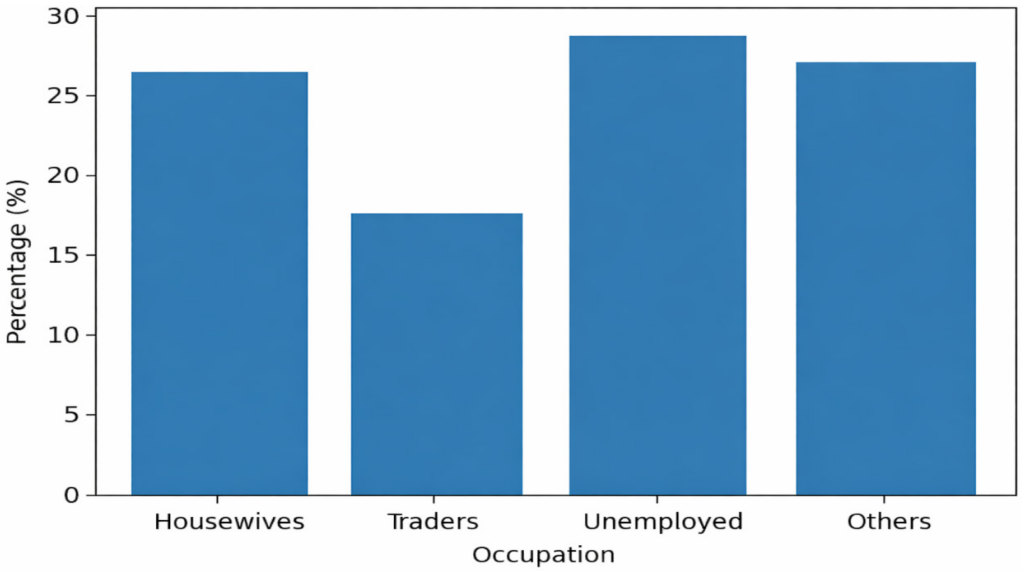
Figure 1. Distribution of individuals responsible for waste management.



Socio-professional situation of households

Figure 2 shows the distribution of occupations of household representatives. The unemployed represented 29.0% of the sample, followed by housewives (26.3%), informal sector workers grouped in the "other" category (27.1%) and traders (17.5%). The socio-professional structure, marked by economic insecurity and low levels of education, limits household access to formal waste collection services and encourages the use of informal practices [23]. In African urban contexts, several studies show that low-income and poorly educated households are structurally excluded from organized waste management systems, which perpetuates unsanitary living conditions [13,14]. Furthermore, the strong involvement of women in daily waste management, well-documented in Africa, does not necessarily translate into better practices when economic and educational constraints persist [24,25]. The accumulation of waste resulting from these socio-economic and gender inequalities promotes the proliferation of disease vectors, increasing the risk of malaria and other environmentally related diseases in disadvantaged neighborhoods [26]. These results highlight the need for integrated approaches combining improved education, economic empowerment and gender considerations to sustainably strengthen waste management and reduce health risks in resource-limited countries.

Figure 2. Occupation of Household Representatives



Types of waste produced and level of environmental awareness

Figure 3 illustrates the types of waste produced in the surveyed households. A high proportion of respondents (68.4%) were unable to specify the exact nature of the waste produced, reflecting a low level of environmental awareness.

Among the identified waste items, used clothing (14.0%), organic waste (10.5%), and plastics (7.0%) were the most frequently cited. This limited capacity for waste identification constitutes a major obstacle to the implementation of source separation, as already observed in several African cities [27] (Kouamé et al., 2018).

The high proportion of respondents unable to identify the nature of the waste they produce reflects a low level of environmental awareness, a major obstacle to source separation and proper household waste management [28]. In resource-limited countries, this lack of knowledge promotes the mixing of organic and inorganic waste and the use of informal disposal methods, with negative consequences for the environment and public health [13, 29]. These results highlight the need to strengthen environmental education for households to improve knowledge of waste types and reduce the health risks associated with unsanitary conditions.

Figure 3. Types of Waste Produced in Households.

Analysis of the quality of waste disposal

Analysis of the waste disposal quality score revealed significant disparities based on sociodemographic characteristics. Households with a secondary or higher education level had a significantly higher average score than illiterate households ($p = 0.002$). Similarly, using a collection service was associated with a substantial improvement in disposal quality ($p < 0.001$).

Table 2. Average waste disposal quality score according to certain characteristics.

Variable	Average score ± ET	p
Illiterate	3.1 ± 1.4	
Educated	5.2 ± 1.6	0.002
Without collection	2.9 ± 1.3	
With collection	6.1 ± 1.5	<0.001

The quality score is significantly higher among educated individuals (5.2 vs. 3.1) and those benefiting from a collection service (6.1 vs. 2.9). Access to the service is the most significant differentiating factor.

The significantly higher waste disposal quality score among educated individuals confirms that educational capital promotes the adoption of more appropriate sanitation practices through a better understanding of health risks [30,31]. [13,14,32]. The lack of collection services promotes informal waste disposal, contributing to unsanitary conditions and increasing the burden of environmental diseases, particularly vector-borne and diarrheal diseases, in resource-limited countries [7].

Table 3. Multivariate linear regression of factors associated with disposal quality

Variable	β	IC95%	p
Education level	+1.42	[0.55 – 2.29]	0.003
Collection service	+2.05	[1.12 – 2.98]	<0.001
Household size	-0.31	[−0.61 – −0.01]	0.041
City	-0.48	[−1.12 – 0.16]	0.14

Higher education levels and access to a waste collection service significantly improve the quality of waste disposal, while larger households exhibit more inadequate practices. Multivariate regression confirms three key factors: Education (beta = +1.42): Positive effect. Waste collection service (beta = +2.05): Major positive effect. Household size (beta = -0.31): Negative effect (larger households result in lower quality).

Multivariate regression shows that education level has a significant positive effect on the quality of waste disposal (β = +1.42), confirming that education improves understanding of health risks and promotes the adoption of more appropriate practices, as observed in several urban contexts [33,34]. Access to a formal collection service appears to be the most decisive factor (β = +2.05), highlighting that the availability of infrastructure is a key lever for improving waste management and reducing exposure to environmental diseases, regardless of individual household characteristics [35,36]. Conversely, the negative effect of household size (β = −0.31) suggests that larger households produce more waste and encounter greater difficulties in managing it, thus exacerbating unsanitary conditions and health risks in resource-limited urban areas [37,38].

Conceptual framework of the analytical model

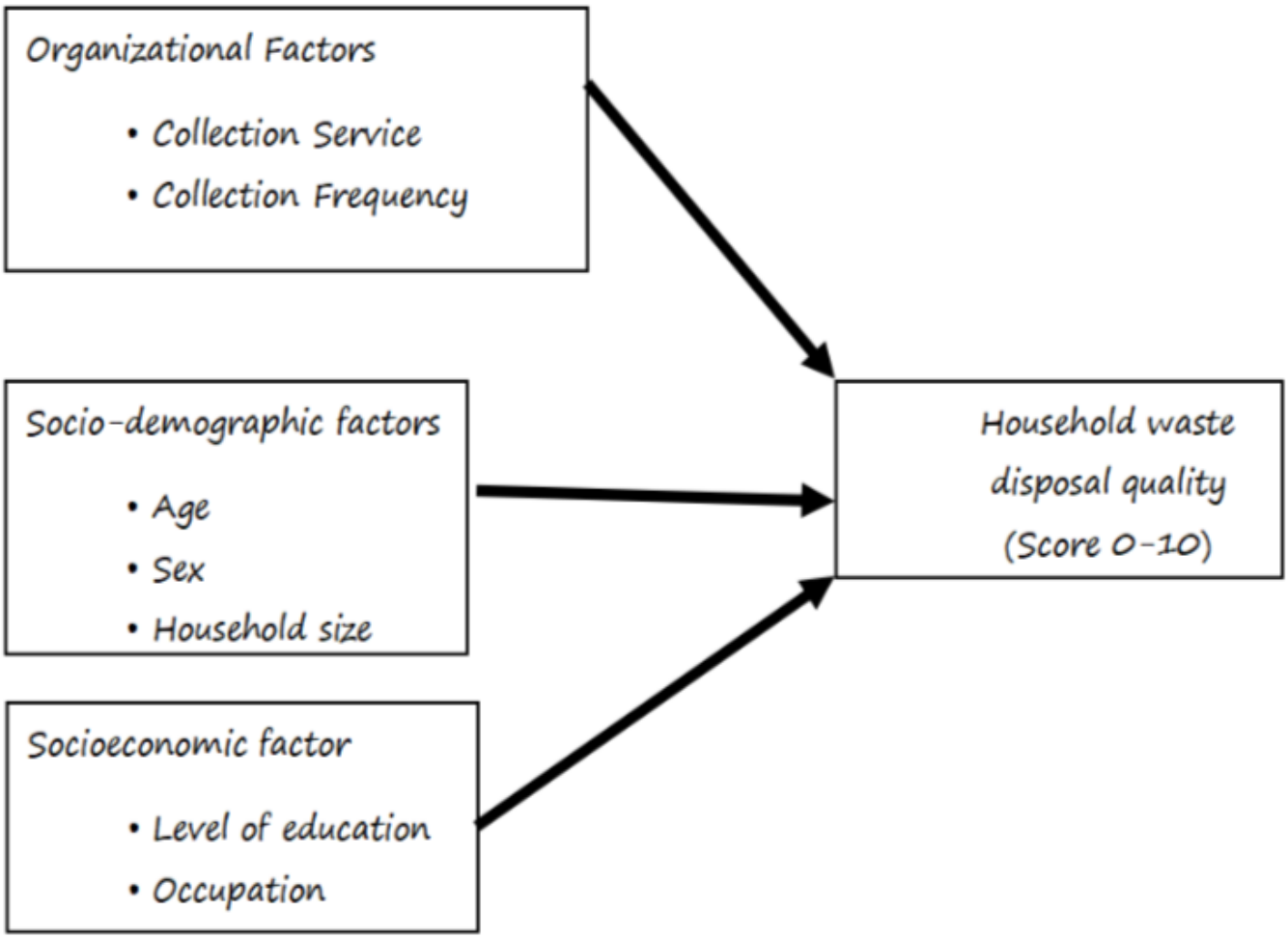
The conceptual framework of the study is presented in **Figure 4.** It illustrates the hypothetical relationships between the different groups of independent variables and the dependent variable, namely the quality of household waste disposal.

Sociodemographic factors (age, sex, and household size), socioeconomic factors (education level and occupation), and organizational factors (existence of a collection service and frequency of waste removal) were considered as potential determinants of household waste disposal quality. These variables were integrated into a linear regression model to identify their independent effects on the overall disposal quality score.

The study demonstrates that the quality of disposal results from an interaction between individual capabilities (education), domestic constraints (household size) and institutional supply (collection service).

Figure 4. Conceptual framework of the linear regression model analyzing factors associated with the quality of household waste disposal in Kolwezi.

The diagram illustrates the relationships between sociodemographic, socioeconomic, and organizational factors and the household waste disposal quality score.



Justification of the regression model

The use of multivariate linear regression relies on the continuous nature of the waste disposal quality score (scale of 0 to 10). This type of modeling makes it possible to estimate the specific effect of each explanatory factor while controlling for potential confounding variables, in accordance with methodological recommendations in environmental health[39].

The conceptual framework presented in **Figure 4** highlights the multidimensional nature of household waste management in Kolwezi. The regression results confirm that organizational factors, particularly access to a collection service, have the most significant influence on the quality of disposal, ahead of socio-demographic and socio-economic factors.[40]

This conceptual framework is consistent with the models proposed by Whiteman A et al., which emphasize that the effectiveness of waste management systems in low-income countries depends primarily on the organization of services and institutional involvement, rather than individual characteristics alone [41]. The results confirm that household waste management in Kolwezi remains largely inadequate, echoing observations made in other African cities.

The positive association between education level and quality of waste disposal is consistent with the work of **Guerrero et al. (2013)** [6], which shows that education directly influences environmental behaviors [42]. The crucial role of collection services aligns with the findings of **Wilson et al. (2015) [16]** on the importance of formal municipal systems in low-income countries [43,44]. The negative relationship with household size has also been reported in Abidjan and Nairobi, where household overcrowding limits the adoption of adequate sanitation practices [45].

CONCLUSION

This study highlights the generally inadequate quality of household waste disposal in the cities of Kolwezi and Lubumbashi, reflecting a worrying environmental health situation. The results show that waste management is strongly influenced by socio-educational and organizational factors, particularly education level, access to formal collection services, and household size. Multivariate analysis confirms that access to collection services is the most significant factor influencing disposal quality, ahead of educational attainment, while larger households exhibit more inadequate practices. Households' limited ability to identify the types of waste produced reveals a significant lack of environmental awareness, limiting source separation and promoting informal disposal methods. These results underscore the need for integrated approaches combining strengthened collection services, environmental education, and consideration of social vulnerabilities to sustainably improve waste management and reduce health risks in urban areas of the Democratic Republic of Congo.

Strengths and limitations of the study

This study is based on a large sample covering two major cities in the southern Democratic Republic of Congo, strengthening the robustness of the results. The use of a composite waste disposal quality score and multivariate linear regression allowed for the identification of independent effects of the main determinants. However, the cross-sectional nature of the study limits any causal inferences, and self-reported data may be subject to reporting bias. Furthermore, convenience sampling may restrict the generalizability of the results. Despite these limitations, the study provides relevant local data to inform waste management and public health policies.

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