

Household waste storage and waste disposal: factors associated to safe practices in Ndanu Locality in Kinshasa, Democratic Republic of the Congo

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ABSTRACT

Unsafe storage and indiscriminate disposal of household waste can have serious implications for the health of the urban dwellers. Possible actions include a campaign to strengthen the household awareness of their responsibility as producer of the waste and promote pro-environmental behaviour towards its handling. Building such a campaign requires some knowledge of barriers and opportunities to enhance people's attitude towards a safe environment; therefore we conducted a cross-sectional survey involving face-to-face interviews with the household heads or their delegates to identify factors associated with the insalubrity in an administrative locality in the capital city Kinshasa.

The majority of the households were male headed (66%). Almost three quarters of the participants were partnered, 39% had attained an upper level of education, 57 out of 282 were unemployed, housewives, without any professional occupation or still studying. Interestingly in the same proportion as the civil servants (16%), 15% reported as being senior executive.

Our findings suggest that in the study area safe waste management tends to depend on the gender of the household head, his/her professional occupation and the household socio-economic status (SES).

We conclude that the municipality should work toward raising the awareness of the population for an efficient management of the household waste, and also building landfill stations along with setting up a sanitation service and/or brigade to monitor and reinforce related policies connected to a salubrious environment.

KEYWORDS;-Household waste, storage, disposal, Sub-Saharan Africa, Democratic Republic of the Congo

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I. INTRODUCTION

Waste management, which falls under the competence of the urban authority, requires a regulatory policy on the behavior of the dwellers. Unsafe storage and indiscriminate disposal of household waste can have serious implications for the health of the urban dwellers. According to the World Health Organization (WHO), the unhealthy environment causes millions of deaths a year [1]. In the developing world the situation is acute; however, each city has its particularities. Kinshasa, a city of about 11 million inhabitants that continues to urbanize in a totally chaotic way, faces problems of run-off water and waste sanitation. The heavy rainfall facing the city does not spare its dwellers from the macabre hygiene conditions and an unhealthy environment left behind by run-water. Failure to manage the household waste only makes the challenges tougher for the municipality.

Possible actions include a campaign to strengthen the household awareness of their responsibility as producer of the waste and promote pro-environmental behavior towards its handling [2,3,4]. Building such a campaign requires some knowledge of barriers and opportunities to enhance people's attitude towards a safe environment; therefore we conducted a cross-sectional survey involving face-to-face interviews with the household heads or their delegates to identify factors associated with the insalubrity in an administrative locality in the capital city Kinshasa.

Appropriate action that could stop the problem in its tracks has been delayed. Household waste disposal methods do not seem to be changing; the exponential growth of the population does not correspond to the creation of infrastructure to cope with the calamity.

While tackling the city's sanitation challenges is an immense task, some actions can be taken at the neighborhood level pending the much awaited intervention of the municipality. Possible actions include a campaign to strengthen the household awareness on their responsibility as producer and key actor in the potential waste management. Building such a campaign requires some knowledge of possible motivations and

barriers; therefore we conducted a small scale study to identify factors associated with the insalubrity in the Ndanu Locality in Limete Commune of the capital city Kinshasa.

II. MATERIALS AND METHODS

II.1 SAMPLING METHOD

In order to ensure randomness, a 3-step sampling method was used to select the households to be surveyed.

The first step consisted of selecting randomly a number of streets from a complete list of all the streets in the Ndanu Locality. In the second stage, within each street selected in the first stage and after an exhaustive census, dwelling plots were randomly selected for the investigation, taking into account the sampling step obtained by dividing the number of plots surveyed by the quota of the sample size allocated to the street.

At last in the third stage within each dwelling plot drawn in the second-stage, the households to be interviewed were selected at random.

II.2 DATA COLLECTION TECHNIQUE

The data collection was carried out at the home of the participant by a face-to-face interview using a pre-established, structured questionnaire. The electronic questionnaire programmed on Android smartphones was administered to either the household head or his/her representative, who had resided in the Ndanu Locality for at least six months at the time of the survey and who gave an oral consent to participate in the study.

II.3 DATA MANAGEMENT

Data were entered instantaneously during the survey using a standardized data structure created on Open Data Kit (ODK) and installed on the smartphone. ODK synchronized constantly with a Google drive space set up centrally for transfer, cleaning and storage of the data.

II.4 VARIABLES

II.4.1 INFORMATION ABOUT THE HOUSEHOLD HEAD

Education attained which entails the last degree or certificate obtained if any; Gender (male or female); Living arrangement categorized as Single (Never married, separated, divorced or widowed) or Partnered (married or living together); and Professional occupation of the household head.

II.4.2 HOUSEHOLD LIVING STANDARDS

Household monthly income; household ownership of durable assets; size of the dwelling (number of rooms occupied); and the number of people in the household (household size). These variables were built into a household Wealth index intended to reflect a measurement of the living standard or Socio-economic status, which was later divided into quintiles.

II.4.3 DEPENDENT VARIABLES

Two waste management parameters were used as outcome variables: the waste storage method and waste disposal method.

II.5 DATA ANALYSIS

The information collected using ODK were transferred into R [5] for analysis.

Data were summarized using count (n) and percentage (%) for categorical variables.

The two categorical response variables were each cross-tabulated with each of the socio-demographic factors and a chi-square (χ^2) test for independence was performed to determine their univariate degree of association. Furthermore, a logistic regression model was fitted with Waste Storage Method as response variable. All the socio-demographic factors were entered into the model to determine which ones would be independently associated to household waste storage. The anti-log of the estimates and 95% confidence (CI) were calculated to obtain the Odds Ratios (OR).

III. RESULTS

A total of 282 households participated in this study. Socio-demographic and occupational characteristics of the household heads participating in the study are summarized in **Table 1**. The majority of the households were male headed (66%). Almost three quarters of the participants were partnered, 39% had attained an upper level of education, 57 out of 282 were unemployed, housewives, without any professional occupation or still studying. Interestingly in the same proportion as the civil servants (16%), 15% reported as being senior executive.

The average number of persons in a household (household size) is 6.5 (SD=2.99) ranging from 1 to 30 with median at 6 persons.

Table 1. Summary of Sociodemographic and professional Characteristics in the participating Household Heads

Characteristic	N = 282 ¹
Respondent quality	
Household Head	132 (47%)
Another Member	150 (53%)
Gender	
Male	185 (66%)
Female	97 (34%)
Education attained	
Lower	172 (61%)
Upper	110 (39%)
Living arrangement	
Single	73 (26%)
Partnered	209 (74%)
Occupation	
Unemployed	57 (20%)
Trader/Business	51 (18%)
Casual Worker	85 (30%)
Civil Servant	46 (16%)
Senior Executive	43 (15%)
Wealth Index	
Lowest	57 (20%)
Lower	58 (21%)
Middle	54 (19%)
Upper	56 (20%)
Highest	57 (20%)
Waste Storage	
Unsafe	104 (37%)
Safe	178 (63%)
Waste Disposal	
Indiscriminate	70 (25%)
Buried-Burnt-Compost	114 (40%)
Paid Evacuation	98 (35%)

¹Statistics presented: n (%)

Most households (63%) stored their household garbage safely in a plastic or metal container, the others deposited it on the ground of the dwelling plot, piled up in a corner or threw it away directly into the river, ravines or in the street corners.

Table 2. Summary of the Characteristics of the Household Heads by Waste Storage Method

Characteristic	Waste Storage		p-value ²
	Unsafe 104 (37%) ¹	Safe 178 (63%) ¹	
Respondent quality			0.20
Household Head	43 (41%)	89 (50%)	
Another Member	61 (59%)	89 (50%)	
Gender			0.10
Male	75 (72%)	110 (62%)	
Female	29 (28%)	68 (38%)	
Education attained			0.20
Lower	69 (66%)	103 (58%)	
Upper	35 (34%)	75 (42%)	
Wealth Index			0.001
Lowest	24 (23%)	33 (19%)	
Lower	32 (31%)	26 (15%)	
Middle	14 (13%)	40 (22%)	
Upper	22 (21%)	34 (19%)	
Highest	12 (12%)	45 (25%)	
Living arrangement			0.91
Single	26 (25%)	47 (26%)	
Partnered	78 (75%)	131 (74%)	
Occupation			0.071
Unemployed	22 (21%)	35 (20%)	
Trader/Business	18 (17%)	33 (19%)	
Casual Worker	38 (37%)	47 (26%)	
Civil Servant	18 (17%)	28 (16%)	
Senior Executive	8 (7.7%)	35 (20%)	

¹Statistics presented: n (%)

²Statistical tests performed: chi-square test of independence

Nearly 35% of households used paid private collection, but the majority handled their garbage within the dwelling plot, and the remainder 25% disposed of the waste indiscriminately.

The study participants were asked about the perception of public awareness and the recovery of household waste. More than eight out of ten people (85.5%) believe that public awareness would be an effective solution, and nearly three out of four participants thought that recycling household waste would reduce insalubrity, with an equally large proportion (17%) of respondents answering "don't know" to this question.

Cross-tabulation of the factors and the waste storage method is presented in **Table 2**. The occupation of the household head and Wealth index seem both associated to safe storage of the garbage within the dwelling plot. For the method of waste disposal, the cross-tabulation is shown in **Error! Reference source not found..**

Table 3. Summary of the Characteristics of the Household Heads by Waste Disposal Method

Characteristic	Waste Disposal			p-value ²
	Indiscriminate 70 (25%) ¹	Buried-Burnt-Compost 114 (40%) ¹	Paid Evacuation 98 (35%) ¹	
Respondent quality				0.41
Household Head	28 (40%)	55 (48%)	49 (50%)	
Another Member	42 (60%)	59 (52%)	49 (50%)	
Gender				0.85
Male	44 (63%)	76 (67%)	65 (66%)	
Female	26 (37%)	38 (33%)	33 (34%)	
Education attained				0.13
Lower	45 (64%)	75 (66%)	52 (53%)	
Upper	25 (36%)	39 (34%)	46 (47%)	
Wealth Index				<0.001
Lowest	16 (23%)	23 (20%)	18 (18%)	
Lower	10 (14%)	35 (31%)	13 (13%)	
Middle	17 (24%)	25 (22%)	12 (12%)	
Upper	18 (26%)	21 (18%)	17 (17%)	
Highest	9 (13%)	10 (8.8%)	38 (39%)	
Living arrangement				0.94
Single	17 (24%)	30 (26%)	26 (27%)	
Partnered	53 (76%)	84 (74%)	72 (73%)	
Occupation				0.92
Unemployed	14 (20%)	25 (22%)	18 (18%)	
Trader/Business	13 (19%)	20 (18%)	18 (18%)	
Casual Worker	22 (31%)	36 (32%)	27 (28%)	
Civil Servant	10 (14%)	20 (18%)	16 (16%)	
Senior Executive	11 (16%)	13 (11%)	19 (19%)	

¹Statistics presented: n (%)

²Statistical tests performed: chi-square test of independence

The summary of the logistic regression model in **Figure 1** show that a household headed by a female is more than twice likely to store the waste safely than the ones headed by male counterparts OR 2.3 [95% CI; 1.24 to 4.37]; The highest Wealth Index quintile stored their garbage significantly safer than the Lowest quintile OR=2.6 [95% CI: 1.1 to 6.3]. The same the households headed by Senior executive are almost three times likely to store their garbage better than the unemployed.

IV. DISCUSSION

The current study aimed to identify factors associated with garbage related insalubrity in the Ndanu Locality in Limete Commune of the capital city Kinshasa, from the household perspective.

We found that 35% of households paid for the waste to be collected by contractors and a lower portion of households disposed of their garbage indiscriminately compared to results from a study conducted elsewhere in the country [2] that 50% of households dumping their waste in the streets, and another study from different parts of the world had reported 39% disposing of the household waste in the gutter, streets, holes and in nearby bushes[6]. Ideally, the percentage of households paying for the collection of their garbage should be increased. In general we can expect more than half of households to use paid collection in low-income settings [7]. That way an orderly deposit at a landfill can prevent the risky disposal of the garbage. Lema et al. [8] found the lack of access to door to door solid waste collection to contribute to improper solid waste management.

Our findings suggest that safe waste management tends to depend on the gender of the household head, his/her professional occupation and the SES of the household. The professional occupation and SES are linked to each other, in the sense that educated people tend to have good jobs and enjoy a high standard of living. It is challenging to establish how households vary by SES, therefore we used a proxy calculation to determine the Wealth Index of the households; although it appears that only the top end is clearly separated from the rest.

Vyas et al. [9] discussed a resource intensive way of achieving a better separation that we did not attempt to carried out in the limited data available to us.

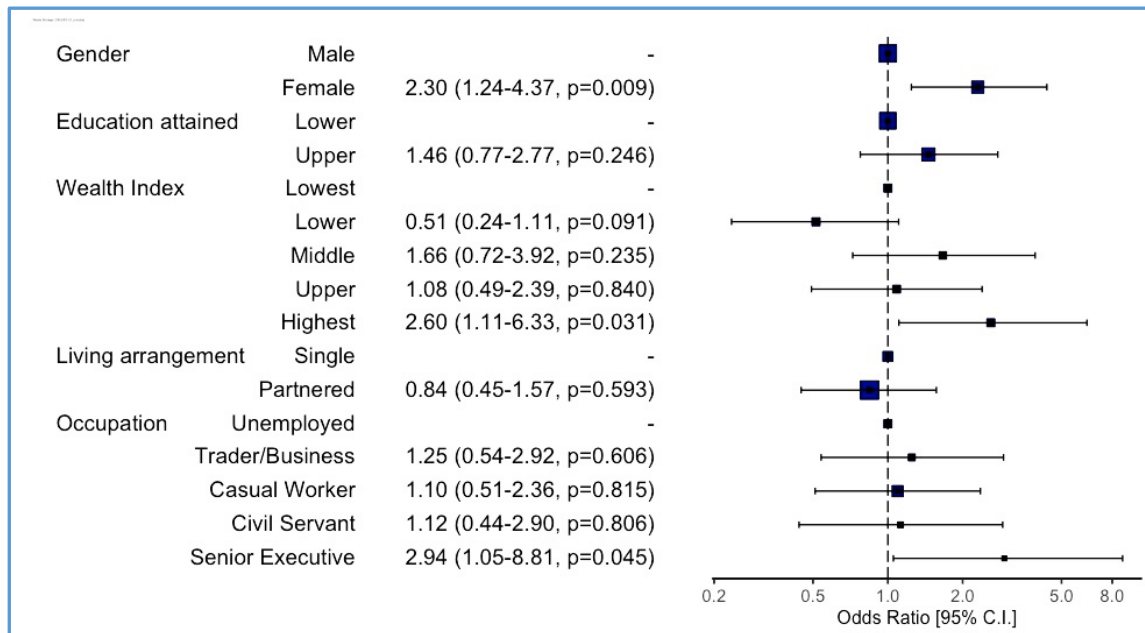


Figure 1. Summary of Logistic Regression Model of Waste Storage Method on the Sociodemographic and Economic factors

The finding on the gender is supported by a study that suggested that female tend to manage well household waste [10] but not by another which found being female associated with indiscriminate disposal of household waste [8]. It appeared only when controlled for other socio-demographic and economic factors; in that case differences in analysis methods would result in such a situation.

The results of this study do not suggest directly any influence of the education attained on the waste management as suggested by a number of studies from elsewhere [6,11,12]; again, the absence of association is probably not surprising. The mechanism through which education influences the safe handling of household waste is more complex; it is more likely to pass through other factors built into the SES.

Suggestions have been put forward for improving the household waste management, including increase public awareness, intervention by effective propaganda [2,3,4] and increased income. Increasing the income, like the education, is a long term goal; for immediate results intervention with a set of education messages should work perfectly well in improving households attitudes towards safe waste management.

V. CONCLUSION

Our study shows that there is a need to impact on household sanitation and, moreover, sanitation in the Ndanu district by raising awareness among households. The better educated and those with an adequate standard of living can manage their waste in a healthy way. We recommend to the municipality to work toward raising the awareness of the population for an efficient management of household waste, and also build landfill stations along with setting up a sanitation service and/or brigade to monitor and reinforce related policies connected to a salubrious environment. and eventually recycling or transformation into compost should be considered to add value to the waste produced in households across the city..

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