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''Factors Associated With Poor Waste Management Practices At Kisangani's Central Market''

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ABSTRACT

The aim of this study was to describe waste management practices at Kisangani's central market and associated factors.

A cross-sectional analytical study was conducted among 403 users of the Kisangani central market during the period from 01 July 2023 to 02 September 2023.

It was found that 80.40% of respondents had poor waste management practices. There was an association between waste management practices and marital status, respondent category, category of goods sold, knowledge of the definition of waste, management mechanism in place and availability of management materials and equipment.

The proper management of waste from Kisangani's central market by its users is proving to be a serious public health problem, and several factors are involved.

Insufficient financial resources to make garbage cans available at all vendors' stalls, and the ineffectiveness of the hygiene committee, are hampering waste management at Kisangani's central market, which calls for an effective management policy introduced by the market's managers, and sufficient financial resources to alleviate the problem.

Key words: Associated factor, users, management, waste, market

I. INTRODUCTION

Worldwide, an estimated 11.2 billion tonnes of waste are generated every year. The growing volume and complexity of waste associated with the modern economy and rapid urbanization pose a serious risk to ecosystems and human health [1].

In 2019, France collected 38.9 million tonnes of household and similar waste, 80% of which was recovered or recycled for other purposes. [2]

The first principle of the Rio Declaration states: "Human beings are at the center of concerns for sustainable development. They have the right to a healthy and productive life in harmony with nature" [3].

The issues surrounding urban waste management around the world, and by extension the planning and management of the urban environment, are among the most complex to be addressed by public health environmental managers because of their effects on human health. [2]

Globally, population growth, combined with economic growth and associated consumption behaviors have led to a significant increase in solid waste production. [4]

In sub-Saharan Africa, poor waste management in general is at the root of a public health problem, especially as it is the dominant factor in the creation of nests for the production of health-threatening vectors such as mosquitoes, flies, cockroaches, mice etc. Subjected to galloping, unplanned urbanization, cities in developing countries appear to be potential health risk areas. Inadequate disposal or untreated waste can cause serious health problems for the populations surrounding the disposal area [5].

Indeed, the storage of waste in open containers and plastic bags is associated with the presence of houseflies or mosquitoes correlated with the incidence of diarrhea or malaria [5].

This phenomenon is more critical in developing countries, which do not always have the means to manage household waste properly. At the same time, the composition of this waste has shifted from an organic profile (food waste) to complex materials (end-of-life products, plastics and packaging) that present major health and environmental risks. As a result, household waste management is at the confluence of economic production activities and the imperatives of protecting people's living environment. [6] In 2019, Sogansa et al in Benin found that over 80% of household waste was poorly managed. [7] Avougla et al in 2023 in northern Togo, in their study of urban waste management, revealed that 66.28% of

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households dumped household waste along streets, in gutters and on open spaces. [8]

In the Democratic Republic of Congo, waste management is a major challenge, the result of a very poor institutional framework supporting this field.

A study carried out in Bukavu on the socio-sanitary impact of poor waste management in the Shabunda central market found that 100% of their respondents had no knowledge of the dump and public latrines in this market. [9] Another CAP study conducted at the Kadutu market in Bukavu found that 86.1% of respondents were aware of the risks associated with poor waste management. [10]

In its study of the regional profile of the urban sector, the Democratic Republic of the Congo's Ministry of Urban Planning and Habitat revealed that the city of Kisangani was facing problems of poor solid and liquid waste management, air pollution from traffic and pollution of waterways, and that this poor management could affect the entire population. The report showed that the rate of garbage disposal was 43.2%, so there was a problem with urban waste management. [11]

In the city of Kisangani, a study carried out in 2023 on the management of rubbish in municipal markets showed that the management of waste produced in the various municipal markets remains catastrophic, with users staying together with or on top of the rubbish. This situation would expose vendors, buyers and managers to serious health risks that could even cause epidemics in the city and could be the cause of several dirty hand diseases. [12]

The aim of this study is to contribute to the improvement of the waste management system by determining the factors associated with poor waste management practice at Kisangani's central market.

II. MATERIALS AND METHODS

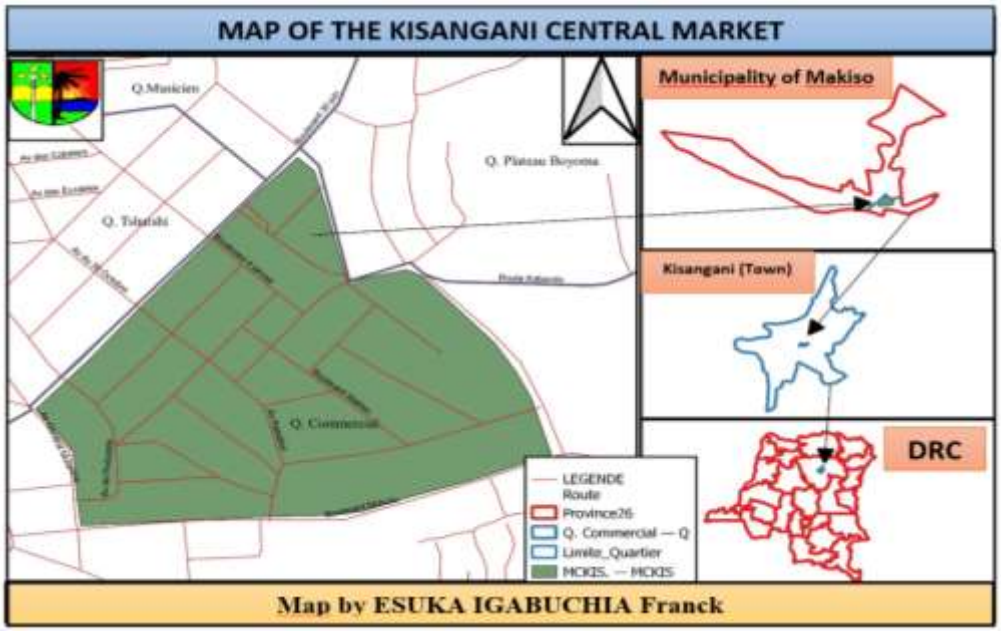
2.1. Study setting

Our study was carried out in the city of Kisangani, a city with an estimated population of 1,366,000. (Wikipedia)

The setting chosen for this study was the Marché central de Kisangani. This site was chosen because of its easy geographical accessibility, its size and its huge footfall compared with all the other markets in Kisangani.

It is geographically located in the commune of Makiso, in the center of the city of Kisangani.

It is the crossroads for people from all over the city, as transport stops for all communes are located here.



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2.2. Study population

Our study population comprised all merchants, customers, members of the hygiene committee and managers of the Kisangani central market.

2.3. Survey period

The survey took place between July 01, 2023 and September 02, 2023.

2.4. Type of study

This is an analytical cross-sectional study.

2.5. Sampling

2.5.1. Sample size

Simple random sampling helped us draw our sample size by applying Schwartz's formula below:

$$n = \frac{Z^2_{1-\alpha/2}\, P(1-P)}{d^2}$$

Considering the expected proportion of users of the Kisangani central market, which is unknown (p=50%), the Z coefficient at 99% (1.96), the tolerated margin of error at 5% and the expected non-response rate of 5%, our sample size was 403 subjects.

The sample was divided between vendors, customers, members of the hygiene committee and managers of the Kisangani central market.

2.5.2. Sampling technique

We used convenience sampling, which was carried out as follows: 5 managers and 8 members of the hygiene committee were interviewed at their places of service, 195 vendors were interviewed at their stalls, and 195 customers were interviewed next to the stalls where they were located. For reasons of vendor representativeness, the market was stratified into five groups, according to the type of items sold: vegetable group, meat and poultry group, second-hand goods group, sundries group, then restaurants. This corresponds to around 39 subjects among vendors and 39 subjects among customers in each stratum.

2.5.3. Inclusion criteria

To be included in the study, subjects had to belong to the following user categories:

- Vendor working in the Kisangani central market present on the day of the survey and available to answer our questionnaire;
- Person present at the Kisangani central market on the day of the survey as a customer and available to answer our questionnaire;
- Market hygiene committee member present on the day of data collection and available to answer our questionnaire.
- Market manager present on the day of data collection and available to answer our questionnaire.

2.6. Variables of interest

Dependent variable : Waste management practice

It was considered good when the respondent answered 60% of the correct answers on good waste management practices, bad when the respondent did not reach 60%.

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Independent variables :

- Socio-demographic characteristics: age, gender, level of education, marital status, category of merchandise sold, respondent category.
- Users' level of knowledge about waste management: this is considered GOOD if the respondent answers at least 80% of the questions, MEDIUM if the respondent answers between 50% and 79% of the questions, and POOR if the respondent answers less than 50% of the questions correctly. In addition, knowledge of the definition of waste, the risks and illnesses associated with poor waste management.
- Respondents' assessment of waste management: waste management mechanism put in place by Kisangani central market managers, availability of materials (dustbins, wheelbarrows, public dumps, etc.), causes of poor waste management, etc.

2.7. Data collection technique

We used guided interviews with a survey form pre-established on the Kobotoolbox software and downloaded into the ODK collect application to collect the data.

2.8. Data analysis

Data analysis was carried out using STATA 13 software, first globally, then by stratum to compare information and search for associated factors.

Proportions were used to describe the level of knowledge, practices and opinions of respondents on the waste management mechanism in place, as well as the socio-demographic characteristics of market users. Age, which had shown symmetry, was presented in the form of the mean and its standard deviation, while seniority was asymmetrical in the form of the median and interquartile range. Pearson's chi-square was used to demonstrate the link between waste management practices on the one hand, and socio-demographic characteristics, respondent knowledge and respondent judgments on the other.

2.9. Ethical considerations

We received approval from the University of Kisangani's ethics committee, and a research form was issued by the Faculty of Medicine and Pharmacy. The research form was approved by the town hall and the management of the Kisangani central market. Informed consent was obtained from respondents before each interview. Confidentiality and anonymity were guaranteed.

III. RESULTS

3.1. Socio-demographic parameters

Table I shows the socio-demographic characteristics of the respondents.

Table I. Distribution of respondents according to socio-demographic parameters

Variable	Frequency (n=403)	Pourcentage
Age range	30.47 (11.09)	56.58
11-29	228	34.24
30-49	138	9.18
≥50	37	
Sex		
Female	267	66.25
Male	136	33.75
Study level		
None	56	13.90
Primary	96	23.82
Secondary	180	44.67
Superior/university	71	17.62
Marital status		

Single	218	54.09
Married	135	33.50
Divorced	19	4.72
Widowed	31	7.69
Respondent category		
Member of the hygiene committee	8	1.99
	5	1.24
Market manager	195	48.39
Customer	195	48.39
Vendor	Length of service= 5 (10-3)	
Category of merchandise sold		
Vegetables	78	19.35
Thrift store	78	19.35
Restaurants	78	19.35
Meat/Poultry/Fish	78	19.35
Other items	91	22.58

This table shows that the average age of our respondents was 30.47 years, with the majority in the 11 to 29 age bracket, predominantly female, most with secondary education and all single. The median age according to seniority was 5 years.

3.2 Knowledge of waste management

3.2.1. Level of knowledge

Table II shows the respondents' level of knowledge.

Table II. Distribution of respondents' level of knowledge by category

Knowledge level	Frequency (n=403)	Pourcentage
Low	326	80.89
Medium	73	18.11
Good	4	0.99

Table II shows that the majority of our respondents had a low level of knowledge, with only 0.99% displaying a good level of knowledge.

3.2.2. Knowledge of risks and illnesses associated with waste mismanagement

Table III shows the distribution of respondents' knowledge of the definition of waste, and the risks and illnesses associated with waste mismanagement in Kisangani's central market.

Table III. Distribution according to knowledge of risks linked to waste mismanagement

Variable		Frequency (n=403)	Pourcentage
Knowing the definition	YES	65	16.13
	NO	338	83.87
Risk awareness			
	YES	352	87.34
	NO	51	12.66
Knowledge of diseases	YES	251	62.28
	NO	152	37.72

Table III shows that more than half of our respondents do not know the definition of waste, most of them have a good knowledge of the risks associated with poor waste management, and the

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majority know about the diseases caused by poor waste management.

3.3.Waste management practices

Table IV assesses respondents' waste management practices by category.

Table IV. Distribution of respondents by practice

Practice	Frequency (n=403)	Pourcentage
Good	79	19.60
Poor	324	80.40

Table IV shows that the majority of respondents had poor waste management practices.

3.4. Respondents' opinion of waste management at Kisangani central market

Table V shows respondents' assessment of waste management at Kisangani's central market.

Table V. Respondents' assessment of waste management

Variable	Frequency (n=403)	Pourcentage
Management mechanism in place		
Effective	210	52.11
Ineffective	193	47.89
Sufficient equipment and materials		
YES	131	32.51
NO	272	67.49
Causes of mismanagement		
Lack of penalties	73	18.11
Ignorance of users	44	10.92
Ineffective hygiene committee	23	5.71
Lack of waste disposal sites	103	25.56
Lack of funding	160	39.70

Table V reveals that more than half of our respondents considered the management mechanism put in place by market managers to be effective, but the majority found the materials and equipment used for waste management at Kisangani's central market to be inadequate. The table also shows that the majority of respondents attributed the poor waste management observed at Kisangani's central market to a lack of funding, followed by a lack of waste dumps, while only a minority attributed it to the ineffectiveness of the hygiene committee.

3.5. Bi-variate analysis

3.5.1. Association between practice and socio-demographic parameters

Table VI shows the associations between variables representing respondents' socio-demographic characteristics and their waste management practice.

Table VI. Association between practice and socio-demographic parameters

	PRATIQUE DE GESTION DES DECHETS			
VARIABLE	**GOOD n(%)**	**POOR n(%)**	**TOTAL n(%)**	**P-Value**
AGE RANGE				
11-29	42 (53.16)	186 (57.41)	228 (56.58)	
30-49	30 (37.97)	108 (33.33)	138 (34.24)	0.736
≥50	7 (8.86)	30 (9.26)	37 (9.18)	
TOTAL	79 (100.00)	324 (100.00)	403 (100.00)	
SEX				

FEMALE	48 (60.76)	219 (67.59)	267 (66.25)	
MALE	31 (39.24)	105 (32.41)	136 (33.75)	0.249
TOTAL	79 (100.00)	324 (100.00)	403 (100.00)	
LEVEL OF EDUCATION				
NONE	8 (10.13)	48 (14.81)	56 (13.90)	
PRIMARY	17 (21.52)	79 (24.38)	96 (23.82)	
SECONDARY	39 (49.37)	141 (43.52)	180 (44.67)	0.612
HIGHER/UNIVERSITY	15 (18.99)	56 (17.28)	71 (17.62)	
TOTAL	79 (100.00)	324 (100.00)	403 (100.00)	
MARITAL STATUS				
SINGLE	31 (39.24)	187 (57.72)	218 (54.09)	
MARRIED	32 (40.51)	103 (31.79)	135 (33.50)	**0.035***
DIVORCED	6 (7.59)	13 (4.01)	19 (4.71)	
WIDOWED	10 (12.66)	21 (6.48)	31 (7.69)	
TOTAL	79 (100.00)	324 (100.00)	403 (100.00)	
CATEGORY OF RESPONDENTS				
HYGIENE COMMITTEE MEMBER	0 (0.00)	8 (2.47)	8 (1.99)	
MARKET MANAGER	0 (0.00)	5 (1.54)	5 (1.24)	
CUSTOMER	11 (13.92)	184 (56.79)	195 (48.39)	**0.000***
VENDOR	68 (86.08)	127 (39.20)	195 (48.39)	
TOTAL	79 (100.00)	324 (100.00)	403 (100.00)	
CATEGORY OF GOODS SOLD				
VEGETABLES	11 (13.92)	67 (20.68)	78 (19.35)	
FRIPERIE	28 (35.44)	50 (15.43)	78 (19.35)	
RESTAURANTS	18 (22.78)	60 (18.52)	78 (19.35)	**0.000***
MEAT/POULTRY/FISH	1 (1.27)	77 (23.77)	78 (19.35)	
OTHER ITEMS	21 (26.58)	70 (21.60)	91 (22.58)	
TOTAL	79 (100.00)	324 (100.00)	403 (100.00)	

Table VI shows that the practice of waste management at Kisangani's central market was statistically related to marital status, respondent category and category of goods sold.

3.5.2. Association between respondents' knowledge, management mechanism and waste management practice

Table VII shows the correlation between waste management practice and respondents' knowledge, the management mechanism in place and the availability of waste management materials.

Table VII. Association between respondents' knowledge, management mechanism and waste management practice

	WASTE MANAGEMENT PRACTICE			
VARIABLE	**GOOD n(%)**	**POOR n(%)**	**TOTAL n(%)**	**P-Value**
KNOWLEDGE OF WASTE				
YES	24 (30.38)	41 (12.65)	65 (16.13)	
NO	55 (69.62)	283 (87.35)	338 (83.87)	**0.000***
TOTAL	79 (100.00)	324 (100.00)	403 (100.00)	
KNOWLEDGE OF RISKS				
YES	7 (8.86)	44 (13.58)	51 (12.66)	
NO	72 (91.14)	280 (86.42)	352 (87.34)	0.258

TOTAL	79 (100.00)	324 (100.00)	403 (100.00)	
KNOWLEDGE OF DISEASES				
YES	45 (56.96)	206 (63.58)	251 (62.28)	
NO	34 (43.04)	118 (36.42)	152 (37.72)	0.276
TOTAL	79 (100.00)	324 (100.00)	403 (100.00)	
LEVEL OF KNOWLEDGE				
LOW	67 (84.81)	259 (79.94)	326 (80.89)	
MEDIUM	12 (15.19)	61 (18.83)	73 (18.11)	0.444
GOOD	0 (0.00)	4 (1.23)	4 (0.99)	
TOTAL	79 (100.00)	324 (100.00)	403 (100.00)	
WASTE MANAGEMENT MECHANISMS IMPLEMENTED				
EFFECTIVE	57 (72.15)	153 (72.15)	210 (52.11)	
INEFFECTIVE	22 (27.85)	171 (52.78)	193 (47.89)	**0.000***
TOTAL	79 (100.00)	324 (100.00)	403 (100.00)	
EQUIPMENT AND MATERIALS				
AVAILABLE	42 (53.16)	89 (27.47)	131 (32.51)	
NOT AVAILABLE	37 (46.84)	235 (72.53)	272 (67.49)	**0.000***
TOTAL	79 (100.00)	324 (100.00)	403 (100.00)	

This table reveals that knowledge of what waste is, the availability of materials (dustbins, wheelbarrows, etc.) and equipment (PPE), and the effectiveness of the mechanism set up to manage waste from Kisangani's central market, are closely linked to waste management practices.

IV. DISCUSSIONS

4.1. Socio-demographic characteristics

Our study revealed that 56.58% of our respondents were in the 11 to 29 age bracket, with an average age of 30.47 years. Our results differ from those found by Modesta Banda in her study of the social factors associated with inappropriate waste disposal in the Lilongwe central market [13], who found 36% in the 36-45 age bracket, and those of Ndachetere M.J et al, who in their study of the waste management problem in the Kadutu central market in Bukavu [10] found a majority frequency of 42.4% in the 31-45 age bracket. This difference would be due to the fact that in our sample was large compared to theirs and young people in this age bracket are more active in commercial activities.

The results of our study revealed that 66.25% of our respondents were female. Our results are similar to those of Rafiu Babatunde IBRAHIM et al. in their study on the evaluation of environmental sanitation practices in selected markets in Akure, Nigeria, who found that 67.5% of their respondents were female [14], but differ from those of Kitoga Mwenyi Josué et al. in their study on the socio-sanitary incidence of waste mismanagement in the central market of Shabunda and its surroundings [9], who found that 70% of their respondents were male.

This difference can be explained by the fact that women are more involved in commercial activities than men in our study area.

Our study showed that 44.67% of our respondents had a secondary education. Our results differ from those of Awa Kanté in her study of waste management in the Banankabougou market in commune VI of the Bamako district [15], who found that 61.1% of respondents had never attended school. This difference may be due to the fact that the literacy rate in our area is higher than in his.

Our results show that 45.41% of respondents were single. Ndachetere M.J et al [10] found that 70.8% of their Bukavu respondents were married. This may be explained by the low socio-economic level of our mostly young respondents, which does not allow them to be officially married.

4.2. Knowledge of waste management

This study showed that 80.89% of our respondents had a low level of knowledge. This observation is largely different from the results found by Anthony C. Iwu1 et al in their study of waste management practice by vendors in the central market of Owerri, in the town of Imo, Nigeria [16], who revealed that 47.4% of their respondents had an average level of knowledge and 33.4% who had a good level of knowledge. They are similar to the results of NM Naim et col in their

study of food waste management knowledge, attitudes and practices among food vendors at Universiti Putra Malaysia, Serdang, Selangor in Malaysia, had found 70% of their respondents with an average level of knowledge. [17]

Our study revealed that 87.34% of respondents had knowledge of the risks associated with poor waste management. Our results are in line with those of Ndatachere et al [11] who found in their study that 86.1% of respondents agreed that they had knowledge of the risks associated with waste mismanagement in the market.

The results of our study show that 62.28% of our respondents had knowledge of the health consequences of poor waste management at Kisangani's central market. They are lower than the results found by Modesta Banda revealing that 98.4% of her respondents had knowledge about the diseases that can come from the consequences of poor waste management within the said market. [13]

4.3. Practices

This study revealed that 80.40% of our respondents had poor waste management practices at Kisangani's central market. This observation is far superior to the results found by Anthony C. Iwu1 et al in Nigeria, who revealed that 44.8% had inappropriate waste management practices. [16] NM Naim et al, on the other hand, had found in their study that 68% of their respondents practiced waste management moderately well. [17]

4.4. Respondents' assessment of waste management

This study reveals that 47.89% of our respondents judged the management mechanism set up by market managers for waste management to be ineffective, 67.49% judged the materials and equipment used for waste management to be inadequate, and 39.70% cited the lack of funding followed by the lack of dumps for waste (25.56%) and the ineffectiveness of the hygiene committee (5.71%) as the main causes of waste management at Kisangani central market. Kitoga et al found in their study that 80% of their subjects had attributed poor waste management to the lack of dumps and public latrines (80%), followed by the non-involvement of territorial industries (15%) in waste management at Shabunda central market, of which they are also beneficiaries. [9]

4.5. Factors associated with poor waste management

Our study showed that the practice of waste management at Kisangani central market was statistically linked to marital status, the category of respondents, the category of goods sold, knowledge of what waste is, the availability of materials (dustbins, wheelbarrows, etc.) and equipment (PPE), and the effectiveness of the mechanism set up to manage waste from Kisangani central market.

Our results differ from those of MN Naim et al in their study, which found instead a statistically significant test between vendors' waste management practices and their ages. [17] Anthony C. Iwu et al, on the other hand, found in their study that good waste management practice was linked to the respondents' level of education and knowledge.

We believe that the fact of not knowing what waste is would greatly influence its management, as the absence of appropriate garbage cans and landfill sites for depositing waste would lead users to throw it anywhere. Users can be informed about the consequences of poor waste management, but if the management mechanism put in place by the central market managers is not effective, including the introduction of taxes allocated for this purpose, and the absence of sanctions against those who go against them, waste will always be poorly managed.

CONCLUSION

The practice of good waste management by users of Kisangani's central market is proving to be a serious public health problem, and several factors are involved.

Having a good level of knowledge about waste management is not enough to influence its practice, so users need to be made aware of the environmental and health risks that can result from poor waste management.

Insufficient financial resources to make waste garbage cans available at all vendors' stalls, combined with the ineffectiveness of the hygiene committee, are hampering waste management at Kisangani's central market, which calls for an effective management policy from the market's managers and sufficient financial resources to alleviate the problem.

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