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ASSESSMENT OF KNOWLEDGE, ATTITUDES AND WASTE MANAGEMENT PRACTICES AMONG WASTE HANDLERS CASE STUDY OF KIGALI CITY, RWANDA

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Abstract: **This research investigates the knowledge, attitudes, and practices related to municipal solid waste (MSW) management among waste handlers in two sectors of Kigali, Rwanda—Gisozi and Kinyinya. The study addresses a significant gap in literature concerning MSW handlers in Rwanda, particularly in the context of increasing global waste due to urbanization, industrialization, and changing lifestyles.**

A cross-sectional survey was conducted involving 120 waste handlers, with a representative sample of 92 selected using a modified Cochran formula. Data collection methods included structured questionnaires, face-to-face interviews, and observational techniques. The analysis was carried out using SPSS version 26, with Pearson's chi-squared test applied to explore relationships between variables at a significance level of $p<0.05$.

Findings indicate that 77.17% of the waste handlers have general knowledge about MSW management, and 50% are familiar with various disposal methods. However, 79.35% are unable to distinguish hazardous from non-hazardous waste. Despite this, a significant majority demonstrate positive attitudes: 79.35% are willing to follow safety protocols, and 81.10% recognize their social responsibility in proper waste disposal.

In terms of practices, 79.35% wear personal protective equipment (PPE) occasionally, while 10.87% wear it rarely, and 5.43% do not wear it at all. Waste disposal methods are primarily unsegregated: 75% of handlers deliver mixed waste to the Nduba dumping site, 6.52% resort to burning, and 3.26% dispose of waste in the environment.

The study identifies education level, age, and work experience as key factors influencing knowledge, attitudes, and practices. It recommends implementing regular training and awareness programs to enhance MSW handlers' understanding and adoption of environmentally and socially responsible waste management practices.

Keywords: **Knowledge, Attitudes, Waste Management, Waste Handlers.**

I. INTRODUCTION

Globally, solid waste generation has surged due to factors such as urbanization, industrialization, population growth, intensified economic activity, and evolving lifestyles (Alam & Ahmade, 2013; Bhat et al., 2023). Projections suggest that global solid waste production will reach 3.88 billion tons annually by 2050, up from 2.24 billion tons currently. In 2012 and 2016, figures stood at 1.3 and 2.01 billion tons respectively (Bhat et al., 2023; Victoire et al., 2020). This increase in waste is not matched by adequate waste management infrastructure or funding, particularly in low-income countries, leading to environmental degradation and public health risks. In Liberia, for example, poor policy frameworks and a lack of integrated waste management systems contribute to significant environmental and health challenges (David et al., 2020). Alam and Ahmade (2013) highlight the pollution of water, air, and soil from indiscriminate dumping and link over 22 human diseases to poor municipal solid waste management (MSWM). Alarmingly, waste handlers in developing countries work under

unsafe conditions with limited protection, leaving them highly vulnerable to health hazards (Alam & Ahmade, 2013). In contrast, industrialized nations have reduced such risks through better practices and strict regulations, a gap exacerbated in developing regions by poor knowledge, limited enforcement, and lack of training (Gebremedhin, 2016; Kaphle et al., 2022).

Research indicates that engineered sanitary landfills, incineration, and recycling are widely used MSWM techniques (Bhat et al., 2023; David et al., 2019, 2020). Best practices include source separation, efficient collection, composting, and public education campaigns, which reduce landfill use and environmental damage (Bhat et al., 2023). Knowledge, Attitude, and Practice (KAP) studies reveal mixed results. For example, in Tehran, 65% of residents had good MSWM knowledge, 57% had positive attitudes, but only 33.1% demonstrated adequate practices (Zand et al., 2022). The study showed education, age, gender, and employment influenced these outcomes and recommended increased training and stricter regulation.

In Ethiopia, a study among waste handlers found high levels of awareness (60.8%) and positive attitudes (75.9%), yet only 37.2% practiced proper safety measures. Health risks included exposure to pathogens and toxic substances, with inadequate data and weak occupational health provisions being major concerns (Gebremedhin, 2016). Deress et al. (2019) similarly found knowledge, attitude, and practice gaps among medical waste handlers and emphasized the need for routine training.

Rwanda, one of Africa's most rapidly urbanizing countries, faces similar challenges. Kigali generates up to 800 tons of waste daily, half of which goes to the Nduba open-air dump site (Sebarenzi, 2019). Studies highlight poor landfill management, inadequate treatment skills, and limited-service coverage in urban areas (Sebarenzi, 2019; Victoire et al., 2020), underscoring the urgent need for comprehensive waste management reform. The main objective of this study was to assess the knowledge, attitude and waste management practices among MSW collectors in Gisozi and Kinyinya Sectors of Gasabo district in Kigali City.

II. RESEARCH METHODOLOGY

Research Design

Our research study employed a cross- sectional study to evaluate the level of knowledge, attitude and practices of waste handlers.

Research Area

The current research study was conducted in Gisozi and Kinyinya sectors of Gasabo district of Kigali City.

Sample Size

The sample size was obtained using a Cochran's formula(Kaphle et al., 2022): $n_0 = \frac{(pq)z^2}{e^2}$

n_0=a random sample for large population

z=1.96 for a 95% confidence level

p = 0.5 (estimated population proportion)

q= 1 – p

e=0.05 or 5% the desired level of precision

Based on the above formula, n_0 = (1.96)2 (0.5) (0.5)) / (0.05)2 = 385.

However, given that the sample size was drawn from a small population (120 waste handlers), we used a modified Cochran Formula below:

$$n = \frac{n_0}{1 + (n_0 - 1)/N}$$

Where n_0 is Cochran's sample size recommendation; N the population size, and n is the new, adjusted sample size.

Applying the modified formula we get: n=385 / (1 + (384 / 120)) = 91.66=92

Therefore, the sample size in this study was 92 waste handlers which is exactly the sample size obtained using Yamane's Formula for a smaller population:

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$$n = \frac{N}{1 + N(e^2)}$$

n=sample size; N=population size (smaller) and e=precision level (5%)

In Kinyinya sector, a sample of 54 waste handlers were selected whereas in Gisozi sector they were 38 waste handlers who participated in the study.

III. RESEARCH RESULTS

1. Demographic Characteristics of Respondents

Table 1: Social and demographic information of the MSW collectors in Gisozi and Kinyinya Sectors of Gasabo district in Kigali City (n=92)

Characteristics	Frequency	Percentage
Age (years)		
<18	0	0%
19-25	12	13.04%
26-30	30	32.60%
31-35	41	44.56%
36-40	6	6.52%
> 40	3	3.26%
Gender		
Male	68	73.91%
Female	24	26.09%
Education level		
None	21	22.83%
Primary	58	63.04%
Secondary	13	14.13%
Tertiary	0	0.00%
Marital status		
married	62	67.39%
Single	28	30.43%
Divorced	2	2.18%
	Monthly income (RWF)	
15,000	73	79.35%
20,000	19	20.65%
Work experience (years)		
>2 years	59	64.23%
2 years	21	22.83%
<2 years	12	13.04%
Type of employment		
Full time	92	100%
Part-time	0	0.00%

Source: primary data, 2025

From the results presented in table 1, about 90.2% of the MSW collectors are in the age between 19 and 35 years old. Only 6.52% were found to be aged 36-40 years old. The same table shows that 73.91% of the waste handlers are males while 67.39% are married. The number of single MSW collectors represents 30.43%. A proportion of about 22.83% did not attend any school level, 63.04% completed primary school level while 14.13% have some secondary school level (ordinary level).

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IV. PRESENTATION OF THE FINDINGS

Knowledge of the waste handlers regarding the MSWM

The table 2 presents the knowledge of the waste handlers regarding the MSW management and hazards. From this table, about 77.17% of the respondents claim to know what MSW management is while only 20.65% do not know and 2.17% are not sure whether they know or do not know. A half of the respondents affirmed to be knowledgeable about different MSW disposal methods. On the other hand, 33.70% of the respondents said not knowing any disposal method while 16.30% are uncertain. A proportion of approximately 42.39% are knowledgeable of health risks resulting from waste collection whereas 29.35% are not aware at all against 28.26% who claimed to be not sure.

In terms of hazards, 79.35% of the respondents have said that all solid wastes are hazardous while 20.65% admitted they are not hazardous. Regarding the safety measures that should be taken while handling waste, the current study has found that 63.04% of the MSW collectors responded to have an idea while 26.08% do not have any idea at all and 10.87% remained unsure. On the question whether wearing PPE can reduce the risk of infection, 59.78% of the interviewed MSW collectors said "yes" against 31.52% who provided an answer as "no" and 8.69% of uncertainty. In terms of knowledge about different type of personal protective equipment, 94.56% said to be aware against 5.43% who said not being aware. A significant portion of 67.39% said to be knowledgeable of color coding as a method of SW segregation while 25.00% of all respondents are not aware and 3.26% are not sure (uncertainty).

Approximately 53.26% of the participants to the study indicated that they don't know the importance of waste segregation at the source against 35.87% who are aware and 10.87% who are not sure.

Table 2: Presents the Knowledge of the Waste Handlers Regarding the MSW Management and Hazards

Question	Yes		No		Uncertain	
	n*	%	n*	%	n*	%
Do you know anything about MSWM?	71	77.17	19	20.65	2	2.17
Do you know anything about MSW disposal methods?	46	50.00	31	33.70	15	16.30
Do you know any health risks associated with waste collection?	39	42.39	27	29.35	26	28.26
Are all solid wastes hazardous?	73	79.35	19	20.65	-	-
Do you have any idea about safety measures that should be taken while handling waste?	58	63.04	24	26.08	10	10.87
Can wearing PPE reduce the risk of infection?	55	59.78	29	31.52	8	8.69
Do you know different type of personal protective equipment?	87	94.56	15	5.43	-	-
Do you know color coding as a method of SW segregation?	62	67.39	27	25.00	3	3.26
Do you know the importance of waste segregation at the source?	33	35.87	49	53.26	10	10.87

Source: primary data, 2025

n*: Waste handlers who responded to the question

Attitudes of the waste handler's vis-a-vis MSWM

The table 3 illustrates the perceptions, opinions and attitudes of the MSW collectors towards safety protocols while collecting waste, consideration of waste collection as a high-risk job, willingness to attend training sessions on safety and health safety precautions, and proper waste disposal to prevent spread of the viral disease.

Table 3: illustration of the perceptions, opinions and attitudes of the MSW collectors

Question	Respondent's response	Frequency	%
Do you believe that waste collection is a high-risk job?	Strongly agree	38	41.31
	Agree	31	33.70
	Neutral	0	0.00
	Disagree	23	25.00
	Strongly disagree	0	0.00

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How important do you think it is to follow safety protocols while collecting waste?	Very important	73	79.35
	Important	19	20.65
	Not important	0	0.00
Would you be willing to attend training sessions on safety and health related to waste collection?	Yes	92	100.00
	No	0	0.00
As a waste collector, do you have social responsibility to dispose wastes properly to prevent spread of the viral disease?	Yes	75	81.10
	No	12	12.97
	Don't know	5	5.40
Can proper MSW disposal prevent disease transmission?	Yes	74	79.99
	No	10	10.81
	Don't know	8	8.65
Can wearing PPEs help reducing the risks of waste-related infections?	Yes	81	87.56
	No	7	7.57
	Don't know	4	4.32
Do you think the Kigali City authorities are doing enough towards workers protection and health?	Yes	27	29.35
	No	43	46.74
	don't know	22	23.91

Source: Primary data, 2025

According to the findings presented in table 3, about 41.31% of the respondents strongly agree that waste collection is a high-risk job against 33.7% who agree with this assertion. Regarding the safety protocols while collecting waste, 79.35% expressed their willingness to follow safety protocol if availed by their managers, emphasizing that safety protocols are very important in reducing health risks. This is supported by their unanimity (100%) to attend training sessions on safety and health related to waste collection. In fact, when MSW collectors were asked whether they received training throughout their work, only 12 (13.04%) of them confirmed to have received training during their 3 years work experience. The majority of the participants 81.10% showed positive attitudes towards social responsibility to dispose wastes properly to prevent spread of the viral disease and protect both public and environment. Approximately 87.56% answered that wearing PPEs help reducing the risks of waste-related infections while a significant proportion of 46.74% think that the Kigali City authorities are not doing enough towards workers protection and health.

Current MSWM practices used by the waste handlers

The figure 2 provides an overview of the current MSWM practices used by the waste handlers during the process of MSW management in the City of Kigali. The study has found that 73 (79.35%) of the waste handlers wear sometimes PPEs while collecting and /or transporting waste. In addition, 10 (10.87%) wear PPEs rarely while 5 (5.43%) do not wear PPEs at all. What is surprising is that 5.43% of the waste handlers never put on any type of the PPEs while none (0.00%) was found to wear the basic full PPEs package (overcoat, gloves, masks and safety shoes. In addition, those wearing sometimes the PPEs, they either put on overcoat (81.52%) or gloves (3.26%) or safety shoes (9.78%) and never masks (0.00%) and they do it mostly whenever they have information about potential visits by the local authorities and or/ external visitors. This raises a serious concern over the workplace safety and the necessity of enhancing constant PPE use to decrease regular occupational risks and hazards.

This calls for the companies' managers and municipal authorities to prioritize and enforce the waste handlers and health and safety on a daily basis. Regarding waste disposal methods, 11.96% collect MSW dumped in an open space or in plastic sacs, 78.26% deposit wastes in dust bins placed in different locations and then take them to the landfill (official dump site) located in Nduba Sector in Gasabo district of Kigali City. About 6.52% of the respondents affirmed to burn the collected wastes while 3.26% throw them into the environment (water bodies, gullies, etc.). Municipal solid waste sorting practice is something unusual among the waste handlers. Approximately, 69 respondents (75%) collect mixed wastes, 15.22% try to separate waste into biodegradable and non-biodegradable waste while the segregation of the collected waste into recyclable

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and non-recyclable waste and hazardous and non-hazardous waste is practiced by 5.43% and 4.35% respectively. Regarding the hygiene practice, 52.17% of the interviewed waste handlers take a shower after their daily work while 31.52% wash their hands after work. Only 16.30% wash and change their clothes at least once a week.

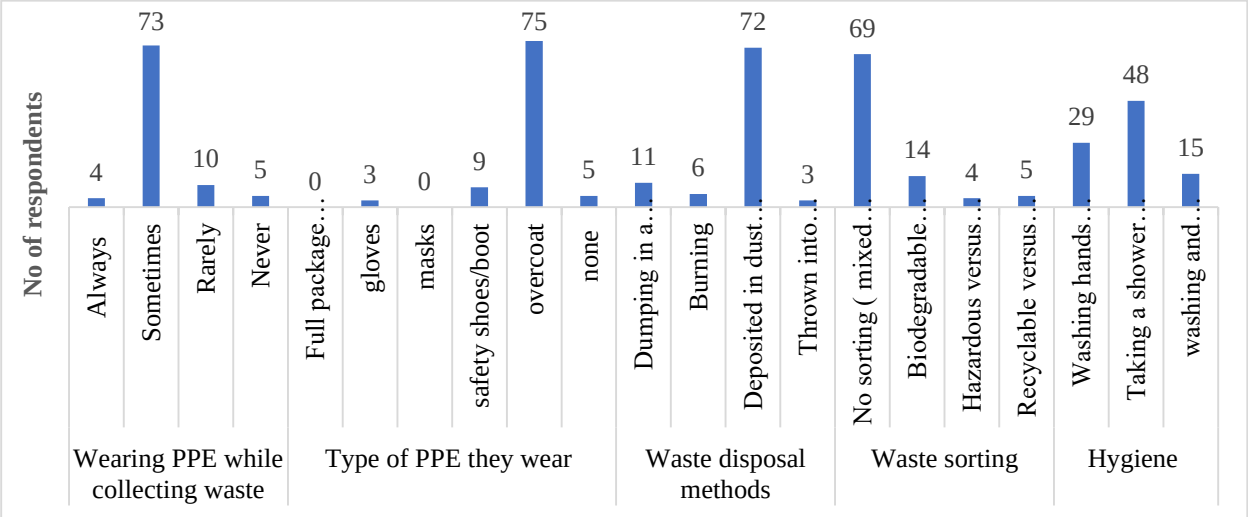

Fig.1: Current MSWM practices used by the waste handlers

Source: Primary data, 2025

V. DISCUSSION

The high percentage of males involved in waste collection (73.91%) aligns with previous studies, which reported a gender distribution of 34% females to 66% males (Zand et al., 2022; Abd et al., 2018), with 94.0% of waste collectors being male. This contrasts with findings from a study conducted in Ethiopia, where 69.7% of respondents were female (Gebremedhin, 2016). Approximately 67.39% of the MSW collectors in Gisozi and Kinyinya are married, while 30.43% are single. The prevalence of married individuals can be rationalized by their familial responsibilities.

The findings are congruent with those reported in a study conducted in Tehran (Zand et al., 2022). Approximately 22.83% of participants did not attend any formal schooling, 63.04% completed primary education, and 14.13% attained some secondary education (ordinary level). These results differ from those reported in studies conducted in Nigeria (Adogu et al., 2015), where the authors noted that 60.3% of respondents achieved a tertiary level of education, 19.9% completed secondary education, and 11.4% finished primary school. However, similar results were documented by Gebremedhin (2016) in Addis Ababa, where illiterate respondents constituted 37.2%, those with combined primary and secondary education represented 26.1%, and 36.7% attended only grades 1-4. The high prevalence of illiteracy and/or low educational attainment among waste handlers may elucidate their responses to inquiries regarding knowledge, attitudes, and waste management practices.

The findings which address knowledge and attitudes regarding MSW management practices, alongside Figure 1, reveal that participants exhibited a combination of knowledge and misconceptions. Approximately 77.17% of respondents asserted that they are knowledgeable about MSW management, while only 20.65% indicated they are unaware, and 2.17% remained uncertain. Half of the respondents claimed familiarity with various MSW disposal methods; however, 33.70% of respondents expressed a lack of knowledge regarding any disposal method, and 16.30% were uncertain. Collectively, these two categories of waste handlers account for 50% of all surveyed individuals, highlighting a significant knowledge deficit. This knowledge gap can be attributed to two primary factors: the predominance of illiteracy and/or low educational levels among waste handlers, and the deficiency in training as articulated by the MSW collectors themselves. Notably, only 12 individuals (13.04%) reported having received training during their three years of work experience, and all expressed a willingness to participate in training sessions pertaining to safety and health in relation to waste collection.

A proportion of approximately 42.39% expressed to be aware of health risks associated with waste collection whereas 29.35% were not aware at all against 28.26% who claimed to be not sure. In terms of hazards, 79.35% of the respondents have said that all solid wastes are hazardous while 20.65% admitted they are not hazardous. Regarding the safety measures that should be taken while handling waste, the current study has found that 63.04% of the MSW collectors responded to

have an idea while 26.08% do not have any idea at all and 10.87% remained unsure. On the question whether wearing PPE can reduce the risk of infection, 59.78% of the interviewed MSW collectors said "yes" against 31.52% who provided an answer as "no" and 8.69% of uncertainty. In terms of knowledge about different type of personal protective equipment, 94.56% said to be aware against 5.43% who said not being aware. A significant portion of 67.39% said to be knowledgeable of color coding as a method of SW segregation while 25.00% of all respondents are not aware and 3.26% are not sure (uncertainty). Approximately 53.26% of the participants to the study indicated that they don't know the importance of waste segregation at the source against 35.87% who are aware and 10.87% who are not sure. The same concerns were recently pointed out in a study conducted in Pakistan(Bhat et al., 2023; Syed et al., 2023).

Similarly, the majority of the participants in this study (81.10%) showed a positive attitude towards social responsibility to dispose wastes properly to prevent spread of the viral disease and protect both public and environment. Approximately 87.56% answered that wearing PPEs help reducing the risks of waste-related infections. The findings of the current study are consistent with those reported by (Syed et al., 2023). However, a significant proportion of 46.74% think that the Kigali City authorities are not doing enough towards workers protection and health. About 41.31% of the respondents strongly agree that waste collection was a high-risk job against 33.7% who agree with this assertion. Regarding the safety protocols while collecting waste, 79.35% expressed their willingness to follow safety protocol if availed by their managers, emphasizing that safety protocols are very important in reducing health risks. (Balushi & Yahyaee, 2024) reported that individual attitudes were directly proportional to the people's knowledge level and team work spirit influence.

The study has found that 73 (79.35%) of the waste handlers wear sometimes PPEs while collecting and /or transporting waste. In addition, 10 (10.87%) wear PPEs rarely while 5 (5.43%) do not wear PPEs at all. What is surprising is that 5.43% of the waste handlers never put on any type of the PPEs while none (0.00%) was found to wear the basic full PPEs package (overcoat, gloves, masks and safety shoes). In addition, those wearing sometimes the PPEs, they either put on overcoat (81.52%) or gloves (3.26%) or safety shoes (9.78%) and never masks (0.00%) and they do it mostly whenever they have information about potential visits by the local authorities and or/ external visitors. The findings of the present study, though different in statistics, they are comparable with those reported by (Abd et al., 2018) in Alexandria in Egypt or Addis Abeba in Ethiopia.

Only 16.30% wash and change their clothes at least once a week. (Gebremedhin, 2016) noted that the low level of safe occupational health practices was a consequence of the low level of education and lack of trainings provision to the waste handlers. A significant correlation was found between knowledge, best practices and education level, respondents' age, and their work experience. For example, the test statistics $\chi 2$ calculated values (11.4 and 9.4 respectively for education and age) for the knowledge type questions are greater than $\chi 2$ tabulated value of 5.991 at $p<0.05$ and at the degree of freedom (df) of two (2). This suggests that the hypothesis that the education level and knowledge type questions are independent is rejected and conclude that there is a relationship between these variables. This means that the education level and age of the waste handlers positively influence the awareness level of the health risks, safety measures, importance of wearing PPEs or implementing the best waste management practices among the municipal solid waste handlers of Kigali City. Similarly, for waste disposal practices type questions, the $\chi 2$ calculated values of 6.69; 8.55 and 11.70 respectively for education level, age and work experience are greater than the $\chi 2$ tabulated value of 5.991, suggesting a positive correlation between the studied variables. Other relevant studies reported the same observations.

VI. CONCLUSION

This research study has assessed the knowledge, attitude and waste management practices among MSW collectors in Gisozi and Kinyinya Sectors of Gasabo district in Kigali City. It was found that 77.17% of the MSW collectors have some knowledge about MSW management, 50% are knowledgeable about different MSW disposal methods and 42.39% are aware of health risks associated with waste collection. However, 79.35% are unable to differentiate hazardous from nonhazardous wastes. About 75% of the respondents agree that waste collection is a high-risk job, 79.35% are willingness to follow safety protocol while 81.10% showed a positive attitude towards social responsibility to dispose wastes properly. The number of waste handlers wearing sometimes PPEs represents 79.35% while 10.87% wear PPEs rarely and 5.43% do not wear PPEs at all. Approximately, 5.43% of the waste handlers never put on any type of the PPEs while at work and none was found to wear the basic full PPEs package. An estimate of 75% collect mixed wastes to Nduba dumping site, 6.52% burns the collected wastes while 3.26% throw them into the environment. Finally, the main variables which had a significant influence on the knowledge, attitudes, and waste management practices among MSW collectors are education level, age and work experience.

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