A WATER QUALITY-BASED PREDICTIVE TOOL FOR DISASTER MANAGEMENT OF WATERBORNE INFECTIONS DURING DROUGHT EVENTS

WORK PACKAGE 4: PRE- AND POST-INTERVENTION ASSESSMENT OF AN EDUCATIONAL PROGRAM ON HYGIENE KNOWLEDGE AND PRACTICES AMONG MUNICIPAL WASTE AND SANITATION WORKERS IN NELSON MANDELA BAY

Final Report to the
Water Research Commission

by

Alive Ntunja[1], Wilma ten Ham-Baloyi[2], June Teare[1] and Paula Melariri[1]
[1] Environmental Health, Nelson Mandela University, Gqeberha, South Africa,
[2] Nursing Sciences, Nelson Mandela University, Gqeberha, South Africa

WRC report no. 3229/5/25
ISBN 978-0-6392-0743-8

October 2025

WATER RESEARCH COMMISSION

This is one of a series of reports completed under WRC project no. C2022/2023-00834. The other reports are:

- Overview of work packages (WRC report no. 3229/1/25)
- Work package 1: Integrated ecological assessment of vegetation, physico-chemical properties and schistosomiasis intermediate host snail distribution in freshwater bodies (WRC report no. 3229/2/25)
- Work package 2: Prevalence, associated risk factors and diagnostic biomarkers of schistosomiasis among school-going children in Nelson Mandela Bay Municipality (WRC report no. 3229/3/25)
- Work package 3: Bacteriological assessment of water sources and retrospective analysis of diarrhoeal prevalence in Nelson Mandela Bay (WRC report no. 3229/4/25)

EXECUTIVE SUMMARY

BACKGROUND

Municipal waste and sanitation workers (street sweepers, latrine cleaners, and waste transporters) play a crucial role in maintaining public health by providing a safe and clean environment. They accomplish this by performing tasks such as sweeping streets, collecting domestic waste regularly, pit latrine cleaning, cleaning public toilets, and operating waste collection trucks. Nonetheless, they play an important role in mitigating health-related challenges by ensuring a clean and healthy environment through correct waste collection and disposal practices. Therefore, safe waste collection is a critical undertaking that safeguards the health and living conditions of individuals worldwide. However, their hygiene-related knowledge and practices remain low due to a lack of educational intervention programmes on hygiene.

AIMS

The aim of the project - work package 4 (WP4):

1. To assess the impact of an educational intervention on hygiene knowledge and practices among municipal waste and sanitation workers pre- and post intervention in the study area.

METHODOLOGY

The study used a quasi-experimental study, one group (pre- and post-test) design, using an educational intervention. A total of 201 municipal waste and sanitation workers were conveniently sampled in the study from all five municipal waste depots and six wastewater treatment plants in the NMBM. A self-administered, structured, hard-copy questionnaire was used to collect the participants' demographic data and a pre-intervention assessment on hygiene-related knowledge and practices. An educational intervention based on existing literature and national environmental cleaning guidelines and policies was implemented, and after a minimum gap of two months following the intervention, participants were asked to complete the post intervention questionnaire. The collected data was captured in a QuestionPro survey platform and analysed in Microsoft Office 365 (2019 version) and R software (version 4.4.1). The knowledge and practice items were further evaluated for internal reliability using the Cronbach's alpha technique. Inferential statistics were used to analyse and describe the data, including tests such as Pearson's correlations, student t-tests, analysis of variance (ANOVA) and multivariable linear regression analysis

RESULTS AND DISCUSSION

A total of 201 participants, comprising 148 (73.6%) males and 53 (26.4%) females, participated in the study. Of the 201 participants, 95 (47.3%) indicated that they had never heard of hygiene-related diseases. The study participants had poor knowledge and practices regarding hygiene prior to the educational intervention. Based on the paired samples t-test, there was a significant difference post-intervention phase in the mean scores for hygiene knowledge of 4.0 (±4.8), $p<0.001$ as well as hygiene practice scores of 4.3 (±3.4), $p<0.001$. Output obtained from the multivariable linear regression analysis revealed that participants working in Depot (A) (β=-2.82, $p=0.005$) were less knowledgeable about hygiene compared to those in Depot (B) in the pre-intervention phase. Participants who have not heard of hygiene-related diseases (β=-3.05, $p<0.001$) were significantly less knowledgeable about hygiene than their counterparts who have previously heard about hygiene-related diseases. Participants older than 51 years of age had poorer knowledge (b=-0.09, $p=0.919$) regarding hygiene when compared to the participants who were 18-30 years old. Furthermore, only female participants (b=1.44, $p=0.022$) and the Coloured ethnic group (b=1.44, $p=0.050$) had good hygiene practices when handling waste, compared to male participants and those of Black African ethnicity.

GENERAL

The aims of WP4 have been completed. Based on these findings, it is recommended to implement hygiene-orientated training programmes that provide information in a succinct and easily understandable way, while also considering the educational background of waste and sanitation workers.

CONCLUSIONS

Findings highlighted the significant positive impact of an implemented educational intervention programme amongst municipal waste and sanitation workers on improving their knowledge of hygiene-related diseases and hygiene practices when discharging their duties. However, predictor factors such as working environment, educational training background, age, and race significantly influenced the impact of the implemented educational programme. The ongoing implementation of similar initiatives is highly recommended amongst municipal waste and sanitation workers, thus preventing hygiene-related infections amongst the studied population and fostering a healthier environment.

RECOMMENDATIONS

Government bodies, policymakers, Environmental Health Practitioners (EHPs), and researchers should prioritize enhancing hygiene education and practices to mitigate the spread of diarrhoeal diseases, cholera, and other communicable illnesses. See the conclusions and recommendations in Chapter 4 below for more details.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS & ABBREVIATIONS

DHET	Department of Higher Education and Training
ECD	Early Childhood Development
MWSW	Municipal Waste Sanitation Workers
NMBM	Nelson Mandela Bay Municipality
PPE	Personal Protective Equipment
REC-H	Research Ethics Committee: Human
SA	South Africa
SSA	sub-Saharan Africa
STH	Soil-Transmitted Helminths
WHO	World Health Organisation
WTP	Wastewater Treatment Plant

GLOSSARY

Hygiene Practices. Behaviours aimed at maintaining cleanliness and reducing the spread of infectious diseases (e.g., handwashing, safe waste disposal).

Communicable Diseases. Illnesses caused by infectious agents (e.g., bacteria, viruses) that spread directly or indirectly between individuals or populations (e.g., cholera, diarrhoea, malaria).

Sanitation. The provision of facilities and services for the safe disposal of human waste and maintenance of a clean environment to protect public health.

Municipal Waste and Sanitation Workers. Workers involved in waste collection, street sweeping, pit latrine cleaning, and operating waste management systems to ensure community cleanliness and health.

Soil-Transmitted Helminth (STH) Infections. Parasitic worm infections (e.g., roundworm, hookworm) transmitted through contact with soil contaminated by human faeces.

Cholera. An acute diarrheal disease caused by ingestion of water or food contaminated with the bacterium Vibrio cholerae.

Diarrhoeal Diseases. Conditions characterized by frequent loose or watery stools, often linked to poor hygiene, contaminated water, or food.

Childhood Stunting. Impaired growth and development in children due to chronic malnutrition, poor hygiene, or recurrent infections, leading to long-term physical and cognitive deficits.

Educational Intervention. Structured training programs designed to improve knowledge, attitudes, or practices (e.g., hygiene education for sanitation workers).

Sanitation Chain. The sequence of waste management processes, including collection, transportation, treatment, and disposal of waste.

Acute Respiratory Infections. Short-term infections affecting the respiratory tract (e.g., cough, fever), often exacerbated by poor living conditions.

CHAPTER 1: BACKGROUND

1.1 INTRODUCTION

Hygiene practices are a set of behaviours that can improve cleanliness and minimise the spread of infectious diseases (Hillier, 2020). A lack of hygiene practices and inadequate sanitary conditions have a devastating impact on the increased burden of communicable diseases in developing countries such as South Africa, Nigeria, and India (Shrestha *et al*., 2018). Unsafe hygiene practices are important determinants of several infectious diseases, such as diarrhoea, cholera, and dysentery (Kalumbi et al., 2020). In South Africa (SA) a recent cholera outbreak was reported in five provinces between the months of February and June 2023, with a total of 166 confirmed cases and 31 deaths (South African Government, 2023).

Globally it is estimated that over 889 000 deaths are attributed to communicable diseases, which are largely caused by poor hygiene practices (Yaya et al., 2018). At the end of 2000, it was estimated that over 2.4 billion people were without adequate sanitation (Mara, 2003). According to Pruss-Ustun et al. (2019) poor hygiene is also linked to other health outcomes such as soil-transmitted helminth (STH) infections, malaria, trachoma, schistosomiasis, and lower respiratory infections. A cross-sectional study in Nigeria indicated that prolonged exposure of children under the age of five years to unhygienic living conditions has been associated with retarded growth and infectious diseases such as acute respiratory infections (fever and cough), and diarrhoeal diseases amongst children of the same age (He et al., 2018). Furthermore, childhood stunting has long-term effects such as reduced child survival and poor educational performance due to diminished mental ability (Humphrey et al., 2019).

Municipal waste and sanitation workers (MWSW) play a significant role in the sanitation chain, from a point of waste collection to waste transportation and up to a waste dumping site. This sanitation chain also includes street sweepers, latrine cleaners, and waste transporters (Gomathi and Kamala, 2020). Sanitation refers to the process of ensuring a clean and healthy environment through the provision of safe disposal of human waste (Rasyid et al., 2021). Therefore, MWSW occupy a vantage position in ensuring a public service that is fundamental to accessing adequate sanitation and hygiene for all the populace (Philippe *et al*., 2022). Municipal waste and sanitation workers' role is to protect human health by providing a safe and clean environment by sweeping streets, collecting domestic waste regularly, pit latrine cleaning, cleaning public toilets, and operating waste collection trucks (Gomathi and Kamala, 2020). However, according to a cross-sectional study conducted in Bangladesh, there is a lack of hygiene knowledge and practices amongst municipal waste and sanitation workers that would keep them and the community safe when discharging their duties (Alam et al., 2022). Additionally, previous studies indicated that low levels of educational programmes received by waste and sanitation workers on hygiene practices are significantly associated with hygiene-related diseases such as cholera and diarrhoea (Melaku and Tiruneh, 2020; Alam et al., 2022).

Consequently, research findings conducted elsewhere highlight the importance of hygiene training amongst sanitation workers within the NMBM to ensure safe disposal of municipal waste (Melariri et al., 2019). Therefore, a need to train these workers exists. In the NMBM area, no previous studies have been conducted amongst waste and sanitation workers to highlight the impact that hygiene-related educational training would have on their hygiene knowledge and practices. The recommended educational intervention on hygiene presents the potential to improve hygiene-related knowledge and practices amongst MWSW. The study expects to provide an in-depth understanding of the hygiene knowledge and practices of the MWSW and to offer valuable information for compiling mitigation strategies to curb the spread of hygiene-related diseases. Finally, this study is expected to contribute to solving health related problems arising from poor hygiene practices amongst MWSW.

1.2 PROJECT AIMS

The Aim of the project:

1. Assessment of an educational intervention on hygiene knowledge and practices among municipal waste and sanitation workers pre and post intervention in the study area.

1.3 SCOPE AND LIMITATIONS

The study participants were selected using a non-probability sampling approach known as convenience sampling. In addition, the study had a limited sample size, consisting solely of participants from NMBM. Therefore, the results cannot be applied to a broader community of municipal waste and sanitation workers. Furthermore, the study enrolled 244 participants during the pre-intervention but due to loss to follow-up 120 the number of participants in the post-intervention phase was reduced to 201. These challenges could have impacted on the quality and accuracy of the study's results.

CHAPTER 2: METHODOLOGY

2.1 STUDY AREA

The study was conducted at municipal waste depots and wastewater treatment plants (WTP) in NMBM. The NMBM is one of eight metropolitan municipalities in SA, which is situated along the coast of the Indian Ocean in the province of the Eastern Cape and consists of the agricultural towns of Despatch, Uitenhage (now known as Kariega), and Port Elizabeth (presently known as Gqeberha) (Nelson Mandela Bay Metropolitan Municipality, 2015). It has a total area of 1 959 km² with the geographical coordinates being 33.75 (S) and 25.57 (E). The census of 2018 recorded that there are 1.26 million people, with the majority race being Black African (60%), followed by Coloured (24%), White (15%), and Indian or Asian (1%). There are 368 520 households residing in this municipality. According to the NMBM-Integrated Waste Management Plan (2016) 83% of households in the NMB area receive a basic level of waste collection service. Furthermore, organic material (kitchen and garden waste) is the main waste stream being generated in the area, which accounts for 39% of the overall waste and is followed by 37% of recyclables (papers, plastics, metals, and cardboard). All five municipal waste depots (Depots A to E) and six WTP (A to F) within the NMBM (see Figure 4.1) were included. These municipal waste depots and WTPs serve as zones where municipal waste and sanitation workers can gather. **Figure 2.1** below shows the map of the study area.

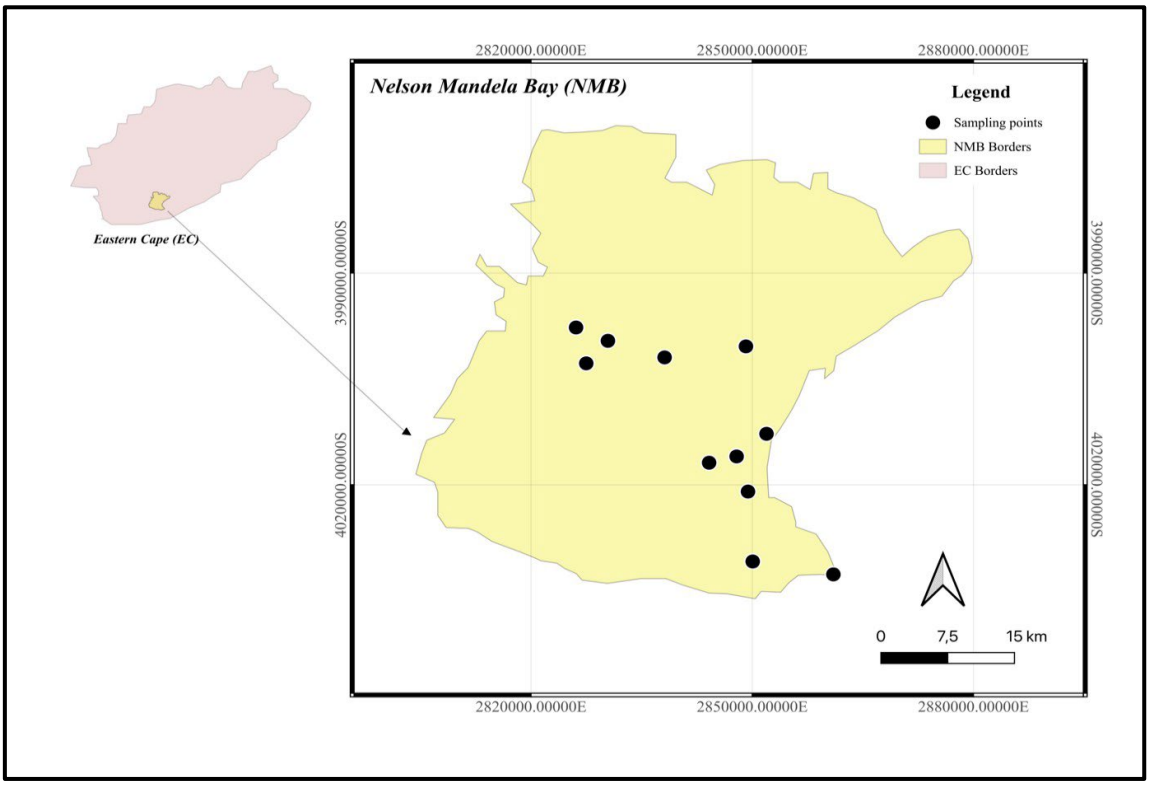

Figure 2. 1: Map showing the study area and sampling points (Source: The map was generated by the researcher using QGIS 3.36 Maidenhead).

2.2 STUDY DESIGN

The study adopted a quasi-experimental research design with pre- and post-intervention assessments on the same study subjects to evaluate the impact of the administered educational intervention (Maciejewski, 2020).

2.3 STUDY POPULATION AND SAMPLING STRATEGY

The study participants were MWSW from all five municipal waste depots and six WTP, which included street sweepers, latrine cleaners, and waste transporters. During the time of the study, the NMBM had an estimated population of 618 MWSW.

Due to the limited numbers of waste and sanitation workers in the study area, random selection was not a feasible option. The first author therefore adopted a convenience sampling technique to select the participants. A convenience sample of all municipal waste and sanitation workers who agreed to participate, who were available during data collection, and who were able to understand and speak English, or isiXhosa (the local languages), were included in the study. Municipal waste and sanitation workers who were on annual vacation, sick leave, or maternity leave and those who were not willing to participate were excluded from the study. The sample size required for this study was calculated using Slovin's formula (Wulandari and Kurniasih, 2019), such that:

$$n = \frac{N}{1+Ne^2}$$

Where n is the sample size required, N is the estimated population size and e is the margin of error (5% margin of error. For this study with a population size of 618 MWSW and a 5% margin of error, equation (1) yields:

$$n = \frac{618}{1+618(0.05)^2} = 243$$

Thus, the minimum sample size required for this study was 243 participants. A total of 244 participants were enrolled during the pre-intervention stage. However, during the post-intervention phase, 43 participants were lost to follow-up due to reasons such as drop-outs, participants' relocation to different depots, not being available during work hours, not being interested in participating in the post-intervention and were later excluded from the analysis stage. The total number of participants were reduced to 201 for both the pre-intervention and post-intervention phases **(Figure 2.2)**.

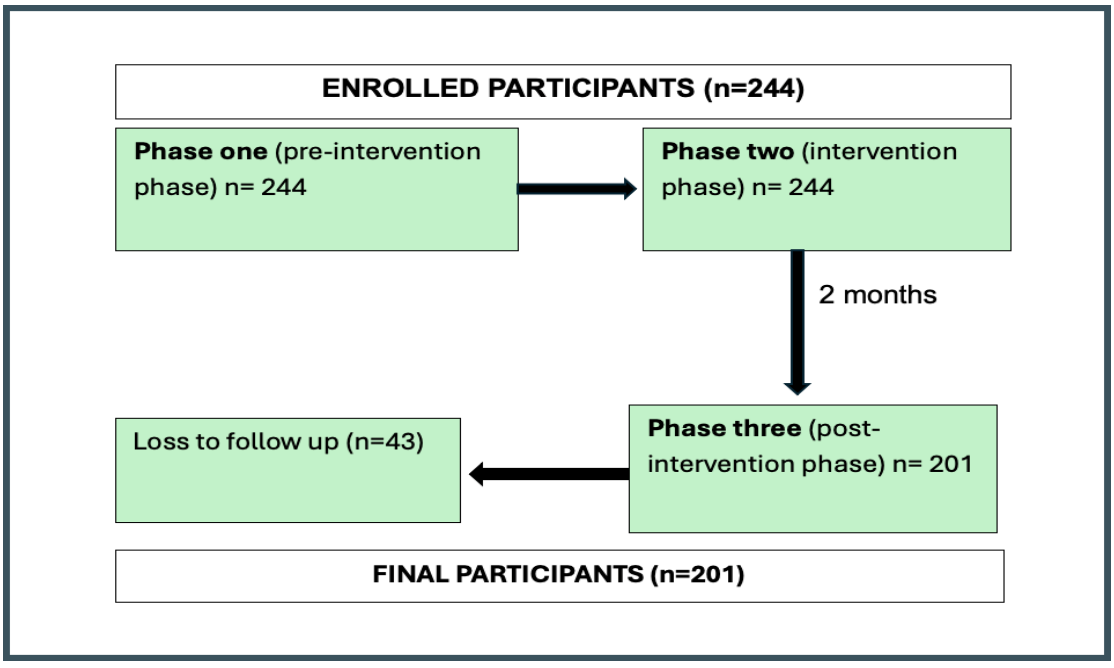

Figure 2. 2: A schematic diagram showing the final number participants considered in this study.

2.4 RECRUITMENT

Once the study setting, approvals, and suitable dates and times for data collection were established, an official letter was distributed inviting the study participants to a 10-minute face-to-face information session about the study aim and objectives. The sessions were held in a pre-arranged venue that was conveniently located at each depot, and the sessions were conducted during normal working hours (6:00 a.m. to 7:30 a.m.) as organised with the research participants.

2.5 QUESTIONNAIRE DESIGN

The data collection instrument used was a self-administered structured questionnaire, adapted from existing questionnaires. The questionnaire consisted of closed-ended questions in three sections (A, B, and C), namely: socio-demographic characteristics (Section A), knowledge (Section B), and practices regarding hygiene (Section C). Most questions were in the form of multiple choice, with a simple “true” or “false” or “unsure” answer and a simple “yes” or “no” or “maybe” answer. The intention was to minimise the guessing by the participants and ensure the integrity of the obtained data or responses. Questions for the questionnaire were adapted from existing questionnaires with a good Cronbach alpha score (of ≥0.8) and supported with hygiene knowledge and practices literature (using articles published in peer-reviewed journals).

2.6 EDUCATIONAL PROGRAMME DESIGN

An educational intervention programme adopted from existing literature and national environmental cleaning guidelines and policies was developed by the first author in agreement with the other authors. The aim of the intervention programme was to enhance the hygiene knowledge and practices of MWSW within the NMBM. The first author commenced Immediately with the intervention programme after the completion of the pre-test. The following intervention methods were implemented: The Microsoft PowerPoint presentation was delivered in English and isiXhosa by the first author. Health education flyers summarising the messages were distributed by the first author with the assistance of the research team to reinforce the information. Posters with similar information were put up by workers’ representatives in their respective locker rooms and in waste collection trucks. During the educational intervention, the first author highlighted the relationship between environmental cleaning and hygiene activities to prevent the spread of hygiene-related diseases. The educational intervention session took the first author 30 minutes to complete.

2.7 DATA COLLECTION

Pre- and post-intervention surveys were conducted using a structured questionnaire in a venue pre-organised by the first author at each depot.

For the pre-test, after the information session and written informed consent had been obtained, the first author, with the assistance of the research assistants (who had no relationship with the participants and were duly trained in the data collection process), handed out a structured questionnaire to collect the pre-intervention data from all 244 study participants who consented to participate in the study. The questionnaire took the participants approximately 35 minutes to complete. Upon completion, the first author, with the assistance of the research team, collected all the completed questionnaires and consent forms and stored them separately in sealed boxes.

For the post-test, after a period of two months, all the participants who were part of the pre-test and intervention were recruited for the post-test, to evaluate the impact of the educational intervention on their hygiene

knowledge and practices. The post-test included the same structured questionnaire and data collection strategy as the pre-test. However, during the post-intervention phase, 43 participants were lost to follow-up. Since this study applied the per-protocol statistical approach to ensure the true efficacy of the implemented intervention amongst the studied participants, all the lost participants were excluded from the study's analysis. Thus, the total number of participants was reduced to 201 for both the pre-intervention and post-intervention phases.

2.8 DATA ANALYSIS

The data obtained from the structured questionnaire was captured by the first author in a QuestionPro (https://www.questionpro.com) survey platform and later verified and analysed using the Microsoft Office 365 (2019 version) and R software (version 4.4.1). The scores for the knowledge and practice factors were calculated by adding the points attained from the participants' answers to the knowledge and practice questions, with one point allocated for a correct answer and no point for a 'not sure' or incorrect answer. The knowledge and practice items were further evaluated for internal reliability using the Cronbach's alpha technique with an alpha value of 0.81 and 0.75 obtained respectively, indicating internal reliability.

Descriptive statistics and inferential statistics were used to analyse and describe the data, including tests such as Pearson's correlation, student t-tests, analysis of variance (ANOVA), and linear regression analysis. Pearson's correlation was calculated to examine the relationships between the hygiene knowledge and practices scores, with a correlation value higher than ± 0.5 considered a strong relationship (Akoglu, 2018). In addition, student t-tests for dependent samples were performed to compare the means of the pre- and post-educational intervention scores, while ANOVAs were performed to assess the differences in the scores across the participants' demographic characteristics. The participants' mean knowledge scores were classified into three categories: 0-9 (poor), 10-11 (fair), and 12-15 (good). The participants' mean practice scores were categorised as 0-6 (poor), 7-8 (fair), and 9-13 (good). The multivariable linear regression analysis was performed to identify factors related to the knowledge and practices of hygiene. A p-value < 0.05 was considered significant.

2.9 ETHICAL CONSIDERATION

The proposed study was conducted in accordance with the Nelson Mandela University (NMU) Research Ethics Committee: Human (REC-H) (H23-HEA-ENV-005), and in compliance with the three core principles of the Belmont Report, which includes respect for persons, beneficence, and justice (Adashi et al., 2018). All participants were informed of their rights, such as their right to privacy and confidentiality, and that participation was completely voluntary, meaning that participants were free to withdraw from the study at any time without giving a reason. Permission to conduct the study was sought from the municipal authorities through informed written consent. Informed, written consent was obtained from the study participants (MWSW) who were duly informed of the research investigation process.

Research documents, such as questionnaires, signed written consent forms, notes, etc., were kept in a secure lockable cabinet, and electronic documents were kept on password-protected computers with access to the research team only. The allocation of study identity codes in the questionnaire were used to ensure anonymity, thereby replacing the use names.

CHAPTER 3: RESULTS AND DISCUSSIONS

3.1 INTRODUCTION

This section outlines the results of the hygiene knowledge and practices of MWSW in the NMBM and the impact of the hygiene-related educational intervention programme implemented during the sampling period on their hygiene knowledge and practices. A total of 244 participants (n=244) were enrolled to participate during the pre-intervention phase, and 43 participants (n=43) were lost to follow-up, resulting in 201 participants (n=201) for the post-intervention phase. Therefore, per-protocol statistical analysis was done to ensure the true efficacy of the implemented intervention amongst the studied participants. As a result, the researcher excluded all the lost participants from the study's analysis. Thus, the total number of participants was reduced to 201 for both the pre-intervention and post-intervention phases. **Figure 3.1** outlines the sample framework per study site.

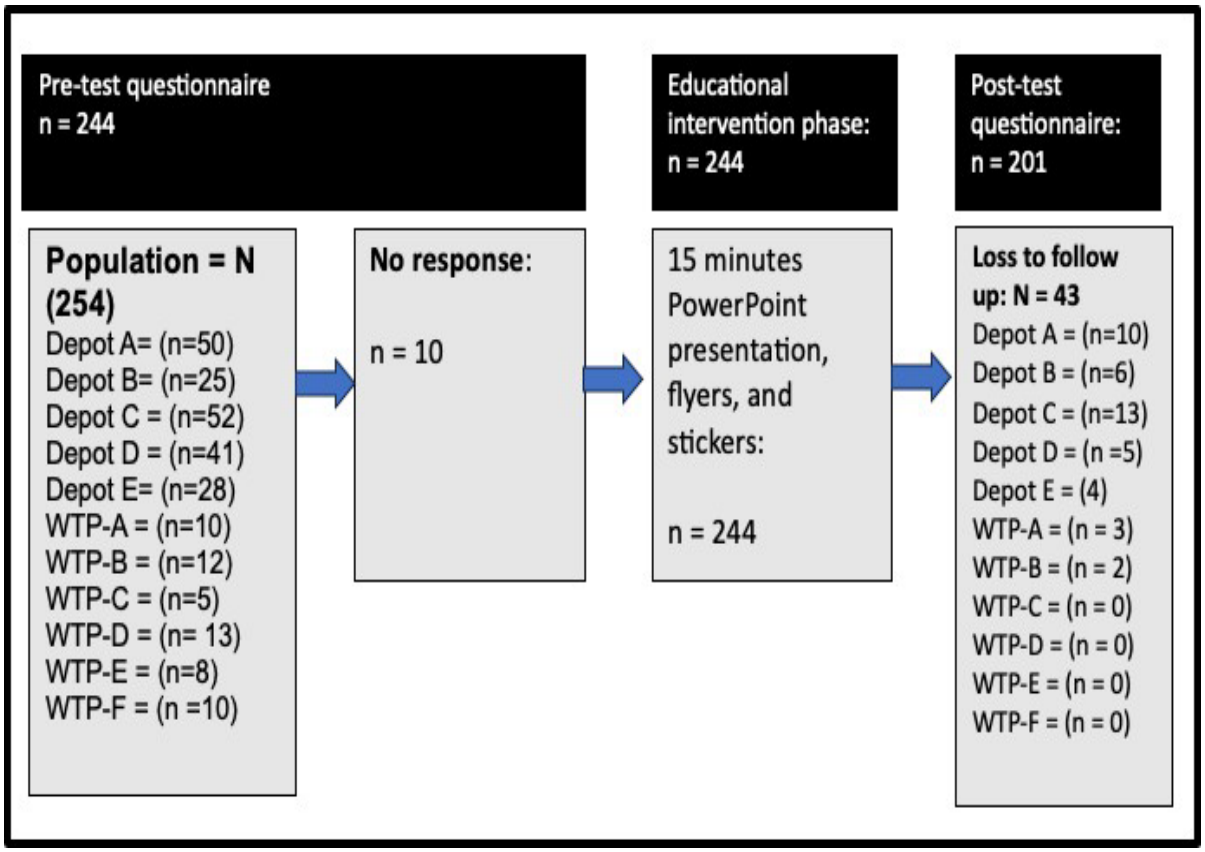

Figure 3.1: Sampling framework per study site.

3.2 DEMOGRAPHIC PROFILE OF THE PARTICIPANTS

Table 3.1 shows the demographic characteristics of the study participants. The majority of the participants, 59 (29.4%), were from Depot C, and 110 (54.7%) of the participants were in the category of waste transporters. Most of the participants, 148 (73.6%) were males, and 71 (35.3%), comprising most of the participants, were 41-50 years of age. Furthermore, most of the participants, 163 (81.1%), were of Black African descent, and 118 (58.7%) had attained an educational level that was below Grade 12.

Table 3.1: Demographic characteristics amongst study participants.

Variable	Count (n=201)	Percentage (%)
Name of the depot		
Depot B	22	10.9
Depot A	48	23.9
WTP-A	6	3.0
Depot C	59	29.4
Depot D	48	23.9
Depot E	18	9.0
Category of waste and sanitation worker		
Sanitation worker	6	3.0
Street sweeper	85	42.3
Waste transporter	110	54.7
Gender		
Male	148	73.6
Female	53	26.4
Age of the respondent		
18-30	32	15.9
31-40	54	26.9
41-50	71	35.3
51+	44	21.9
Ethnic group		
Black African	163	81.1
Coloured	38	18.9
Highest formal education obtained		
Below grade 12	118	58.7
Grade 12	68	33.8

Tertiary level	15	7.5

These demographic findings align with study research done by Melaku and Tiruneh (2020), where over 63% of municipal waste workers were males compared to less than 37% female workers. This might be due to the nature and intensity of their duties, which require a more physically strong individual, as it was observed in the study during the site visit that most of the studied participants were engaged in activities such as carrying, pulling, and pushing waste bins and climbing waste collection trucks. Furthermore, a previous study conducted in Egypt by Awad et al. (2023) supported this evidence that waste collection work requires the physical efforts of males rather than females.

The findings regarding the highest educational level attained by the participants, as shown in Table 5.1 above, are in line with the findings of previous studies, which found that for many generations, municipal waste and sanitation workers had low literacy levels (Azfar et al., 2018; Rajan, 2019; Degavi et al., 2021a). Furthermore, similar findings were reported in a study conducted in Ethiopia amongst municipal waste workers, which found that 214 (56.2%) participants were illiterate and only 31 (8.1%) had achieved secondary and tertiary education (Temesgen et al., 2022).

3.3 PARTICIPANTS' KNOWLEDGE ON HYGIENE

This section outlines the results of hygiene knowledge, which either increases or decreases the possibility of participants and community members to contract hygiene-related diseases. It includes information on awareness regarding hygiene-related diseases, sources of information about these diseases, knowledge about hygiene-related diseases, and the detrimental effects of improper waste disposal. These findings are described and discussed below.

3.3.1 Awareness of hygiene-related diseases

Of the 201 participants, 95 (47.3%) indicated that they had never heard of hygiene-related diseases, while only 80 (39.8%) during the pre-intervention phase indicated that they knew about hygiene-related diseases such as diarrhoea and cholera. Furthermore, 26 (13%) participants showed uncertainty about whether they had heard about hygiene-related diseases or not **(Figure 3.2)**.

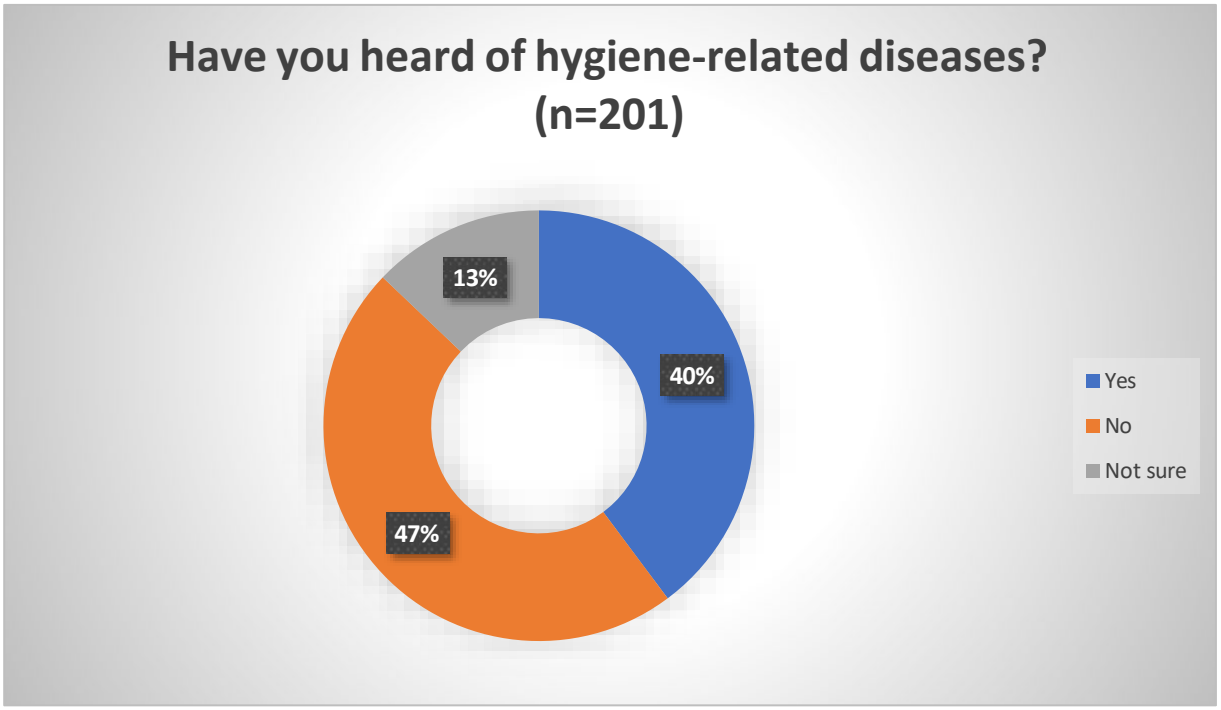

Figure 3.2: Participants' pre-intervention awareness regarding hygiene-related diseases.

The lack of awareness regarding the aetiology, preventative measures, and mode of transmission of hygiene-related infections is one of the risk factors for their endemicity amongst MWSW and the environment. This is in line with the findings of a study conducted in Ethiopia by Temesgen et al. (2022) that waste workers who participated in a hygiene-related training programme had a probability of less than 10% of acquiring diseases connected to hygiene. This is further supported by a study conducted in Bangladesh by Alam et al. (2022) that found that amongst 97% of waste workers who had experienced diseases resulting from their duties, 73% of them never received any hygiene-related training.

3.3.2 Sources of information

Table 3.2 below shows the participants' source of information regarding hygiene-related diseases in the pre- and post-intervention phases. Out of the 80 (39.8%) who claimed to have heard of hygiene-related diseases (see Figure 5.2 above) pre-intervention, only 23 (11.4%) had received awareness regarding these diseases through educational programmes. A total of 31 (15.4%) participants learned about hygiene-related diseases by watching television, and 27 (13.4%) by listening to the radio. However, during the post-intervention phase, all 201 participants indicated that they knew about hygiene-related diseases, with the majority of 192 (96%) participants citing that they knew about hygiene-related diseases from the current research through the educational intervention programme.

Table 3.2: Participants' source of information regarding these diseases pre-and post-intervention.

Where did you hear about hygiene-related diseases?	**Pre-intervention phase (n=201)**		**Post-intervention phase (n=201)**	
	Count	%	Count	%

Educational programme	23	11.4	192	95.5
Television	31	15.4	68	33.8
Radio	27	13.4	51	25.4
Newspaper	14	7.0	28	13.9
Word of mouth (colleagues, friends, or family member)	17	8.5	23	11.4
Hospital/Healthcare	12	6.0	29	14.4
Social media	2	1.0	0	0
Health workshop	1	0.5	0	0

Based on the above results, it should be noted that just a minority of the participants, as previously discussed, indicated educational programmes as a source of knowledge regarding hygiene-related diseases. This warrants a dearth of hygiene-related training programmes available to municipal waste and sanitation workers in the study area. Similar findings were observed in a study conducted in Ethiopia, in which only 19% (109/576) of the study participants had received formal training in hygiene practices (Melaku and Tiruneh, 2020). Furthermore, Shoaib et al. (2024) revealed that only 20% (70/347) of waste and sanitation workers in Bangladesh ever received hygiene-related training programmes.

3.3.3 Knowledge regarding hygiene-related diseases

If one considers the pre-intervention responses to hygiene knowledge regarding hygiene-related diseases, a total of 149 (74.1%) participants during this phase indicated that diarrhoea and cholera are hygiene-related diseases. However, 93 (46.3%) participants, which represents most of the respondents, indicated that blindness is the prevailing symptom related to diarrhoea, and 42 (20.9%) expressed uncertainty. Additionally, 99 (49.3%) participants expressed disbelief in the possibility of preventing hygiene-related diseases, and 109 (54.2%) had an erroneous notion that rubbing one's hands together is more effective in combating microorganisms compared to hand washing. Post-educational intervention, participants exhibited advanced knowledge on hygiene-related diseases, particularly regarding their aetiology, symptoms, and strategies to curb the spread of these diseases. A majority of 149 (74.1%) participants were knowledgeable that blindness is not a common symptom of diarrhoea, and 158 (78.6%) expressed certainty that diseases related to hygiene may be prevented **(Table 3.3)**.

Table 3.3: Responses of participants to questions on knowledge regarding hygiene-related diseases pre-post intervention.

	Pre-intervention		**Post-intervention**		**Improvement (pre-post)**
	count (n=201)	%	count (n=201)	%	%
Diarrhoea and cholera are hygiene-related diseases.					

True*	149	74.1	175	87.1	12.9
False	39	19.4	18	9.0	-10.4
Unsure	13	6.5	8	4.0	-2.5
Blindness is the most common sign of diarrhoea.					
True	93	46.3	28	13.9	-32.3
False*	66	32.8	149	74.1	41.3
Unsure	42	20.9	24	11.9	-9.0
Hygiene-related diseases are not preventable.					
True	99	49.3	36	17.9	-31.3
False*	84	41.8	158	78.6	36.8
Unsure	18	9.0	7	3.5	-5.5
Rubbing your hands together is more effective against microorganisms than hand washing.					
True	109	54.2	54	26.9	-27.4
False*	65	32.3	136	67.7	35.3
Unsure	27	13.4	11	5.5	-8.0
Hand hygiene and hygiene-related diseases do not relate.					
True	103	51.2	33	16.4	-34.8
False*	68	33.8	154	76.6	42.8
Unsure	30	14.9	14	7.0	-8.0

***Desirable responses

The participants' misconceptions about the symptoms of hygiene-related diseases may be attributed to the fact that some participants acquired knowledge of these diseases through informal communication from their family members or acquaintances. Furthermore, the findings above clearly indicate that although some participants had knowledge of hygiene-related diseases, their grasp of the infection's underlying causes and symptoms was unsatisfactory. A study conducted in Nigeria found similar results, showing that despite 81% of waste workers having completed an educational programme, over 88% of them were still unaware of the potential infections they could contract while performing their duties and the fundamental causes of these infections (Ohajinwa et al., 2017). In the study, it was recorded that the participants had limited knowledge about preventive measures for halting the spread of hygiene-related diseases. This might be attributed to an inadequate curriculum that does not sufficiently cover hygiene-related diseases in pre-matric education, a lack of hygiene-related training opportunities, and a scarcity of hygiene-related flyers and pamphlets (Elnour et al., 2015).

The improvement in the knowledge of participants on hygiene-related diseases may be due to the educational content of the intervention programme as well as the distribution of flyers and posters during the study's intervention phase, which served as reinforcement sources of information pertaining to hygiene-related diseases. To support this notion, Elnour et al. (2015) conducted a study in Sudan and found that this type of educational training greatly improved the participants' hygiene knowledge scores post-intervention, especially when it came to hygiene-related diseases. The knowledge scores in the above-mentioned study improved from 12.9% to 42.8% between the pre- and post-intervention phases.

The majority of MWSW have shown a lack of awareness regarding practices associated with hygiene-related diseases. However, the data collected post-educational intervention (distribution of informative flyers, posters, and a PowerPoint presentation on hygiene-related diseases) showed a significant increase in participants' hygiene knowledge, regarding the hygiene-related diseases' aetiology, mitigation strategies, and clinical symptoms.

3.3.4 Waste management and its detrimental impact on the environment and human health

A total of 113 (56.2%) participants knew that it is important to safely dispose of municipal waste, and 149 (74.1%) understood that unsafe waste disposal is a threat to environmental hygiene. In addition, 149 (74.1%) individuals were cognisant of the fact that disposing of waste in open areas might have detrimental effects on human health.

Moreover, during the pre-intervention phase, 51 (25.4%) participants, which constitutes a quarter of the study population, showed a lack of knowledge regarding the significance of PPE use when handling waste. However, in the post-educational intervention phase, this number dropped to only 20 (10%) participants, representing a -15.4% improvement in score. Therefore, a negative improvement in knowledge score was required to indicate that the participants now have a better understanding of the significance of PPE use to curb the spread of hygiene-related diseases. Regarding the question, "the importance of toilet use is privacy only''. The pre-intervention phase elicited the anticipated answer from the fewest individuals (13.4%) who identified that the importance of latrine is not for privacy use only. On the other hand, most participants, 133 (66.2%), responded correctly in the post-intervention phase, where their responses indicated that latrine use is not just for privacy, with an improvement of 52.7% in the overall score **(Table 3.4)**.

Table 3.4: Responses of participants to questions on knowledge regarding waste management and its detrimental impact on the environment and human health when unsafely disposed.

	Pre-intervention		**Post-intervention**		**Improvement (pre-post)**
	Count (n= 201)		Count (n=201)	%	%
It is not important to properly dispose municipal waste.					
True	68	33.8	34	16.9	-16.9
False*	113	56.2	161	80.1	23.9
Unsure	20	10.0	6	3.0	-7.0
Improper waste disposal is a threat to environmental hygiene.					

True*	149	74.1	179	89.1	14.9
False	36	17.9	10	5.0	-12.9
Unsure	16	8.0	12	6.0	-2.0
Waste disposal in open places can have a harmful effect on human health.					
True*	149	74.1	184	91.5	17.4
False	26	12.9	14	7.0	-6.0
Unsure	26	12.9	3	1.5	-11.4
It is important to use protective clothing when performing my duties.					
True*	139	69.2	175	87.1	17.9
False	51	25.4	20	10.0	-15.4
Unsure	11	5.5	6	3.0	-2.5
The importance of toilet use is privacy only.					
True	135	67.2	59	29.4	-37.8
False*	27	13.4	133	66.2	52.7
Unsure	39	19.4	9	4.5	-14.9

***Desirable responses

Surprisingly, participants were knowledgeable regarding waste management and its detrimental impact on human health and the environment when improperly managed at the pre-educational intervention phase. These findings were in line with those of Golandaj and Kallihal (2021), where over 95% of waste workers in certain regions of Northern Karnataka in India indicated that improper waste disposal can lead to disease transmission. These findings on waste management clearly show that MWSW had a comprehensive understanding of their job responsibilities. The participants' awareness of the subject matter could be attributed to the ongoing and long-term supervision of municipal waste management by depot managers (Elnour et al. 2015). However, contradictory findings were observed in a previous study conducted in KwaZulu-Natal province amongst healthcare sanitary staff, with over 58% of participants showing unsatisfactory knowledge regarding the importance of medical waste management (Olaifa et al., 2018). Regarding the findings on the decrease in knowledge related to the significance of PPE use when handling waste, similar findings were discovered in a study conducted in Nepal amongst informal waste workers, who mostly used safety gloves (PPE) to protect themselves from the cold (Sapkota et al., 2020). These findings reveal that the participants lacked extensive knowledge regarding the significance of PPE use in terms of preventing hygiene-related diseases.

3.4 PARTICIPANTS HYGIENE PRACTICES

This section outlines the results of hygiene practices, which either increase or decrease the possibility of participants and community members contracting hygiene-related diseases. It includes information on the use

and disposal of PPE and hygiene practices to curb the transmission of these diseases. These findings are described and discussed below.

3.4.1 Use and disposal of PPE

Considering participants' responses pre- and post-intervention regarding the use and disposal of PPE such as gloves and facemasks, a total of 160 (79.6%), which constitutes the majority of the sample size, showed fairly good practices regarding the use of PPE by consistently wearing safety gloves when handling waste. There was a notable increase of 11.4% in this aspect post-educational intervention programme.

During the pre-intervention phase, it was reported that 118 (58.7%) participants acknowledged disposing of gloves and masks in the river after using them, and 71 (35.3%) individuals admitted to combining regular waste with gloves, facemasks, and tissue in an open bag. Nonetheless, post-educational programme, an improvement ranging from 22.9% to 38.8% in safe disposal practices of PPE amongst the participants was recorded in the study **(Table 3.5)**.

Table 3.5: Pre-post intervention responses to the questions relating to the use and disposal of PPE.

	Pre-intervention		**Post-intervention**		**Improvement (pre-post)**
	count (n=201)	%	count (n=201)	%	%
I wear gloves when handling waste					
Yes*	160	79.6	183	91.0	11.4
No	37	18.4	12	6.0	-12.4
Maybe	4	2.0	6	3.0	1.0
I dispose of PPE such as, gloves and masks in the river after use.					
Yes	118	58.7	42	20.9	-37.8
No*	71	35.3	149	74.1	38.8
Maybe	12	6.0	10	5.0	-1.0
I dispose of my facemask, gloves, and tissue in a tightly closed bag, separate from regular trash.					
Yes*	118	58.7	164	81.6	22.9
No	71	35.3	31	15.4	-19.9
Maybe	12	6.0	6	3.0	-3.0

*Desirable responses

The findings related to the use of gloves by the participants when handling waste were in line with a study conducted amongst municipal waste workers in Tanzania, which found that over 93% of participants used PPE such as safety gloves and footwear during waste collection (Mamuya and Badi, 2019). This was further in line

with a study conducted by Elnour et al. (2015) in Sudan, which found that more than 67% of healthcare sanitary staff wore their safety gloves when handling hazardous waste. This may be attributed to the requirement for participants to wear safety gloves as part of their operating procedure when handling waste. However, contradictory findings were observed in a study conducted in Southwestern Ethiopia amongst healthcare waste workers, where more than 61% of participants admitted to not wearing any type of PPE when handling waste (Ketema et al., 2023).

Furthermore, the findings related to disposal practices of PPE after use were in line with the study conducted by Elnour et al. (2015) in Sudan. The study found that even though the majority (67%) of healthcare waste and sanitation workers wore safety gloves when handling waste, almost half (45%) of the participants had poor practices regarding proper segregation and disposal of waste (including PPE). Therefore, it is evident that although most participants showed a desirable practice by wearing safety gloves when handling waste, they lacked training and practicum on the safe disposal of PPE after being used.

3.4.2 Hygiene-practices to curb the spread of hygiene-related diseases

A total of 110 (54.7%) participants acknowledged defecating in an open space sometimes during the pre-intervention phase. Out of 201 participants, 129 (64.2%) individuals reported taking actions to safeguard their colleagues and family members from acquiring diseases related to hygiene. Meanwhile, during the post-educational intervention phase, 173 (86%) participants reported the same. Moreover, pre-intervention, 76 (37.8%) participants acknowledged to not removing protective clothing immediately after discharging their duties, 83 (41.3%) admitted eating and smoking while handling waste, and 129 (64.2%) dried wet hands on their work outfit. Furthermore, 55 (27.4%) participants, at the pre-educational intervention phase of the study, admitted that they do not bath after returning home from work. Nonetheless, an overall improvement of up to 44.8% in good hygiene practices amongst municipal waste and sanitation workers was discovered in the study **(Table 3.6)**.

Table 3.6: Pre-post responses to the questions on practices to curb the spread of hygiene-related diseases.

	Pre-intervention		**Post-intervention**		**Improvement (pre-post)**
	Count (n=201)	%	Count (n=201)	%	%
I am defecating in an open space sometimes.					
Yes	110	54.7	34	16.9	-37.8
No*	80	39.8	162	80.6	40.8
Maybe	11	5.5	5	2.5	-3.0
I have taken actions to prevent my fellow colleagues and family from getting hygiene-related diseases.					
Yes*	129	64.2	173	86.1	21.9
No	57	28.4	16	8.0	-20.4

Maybe	15	7.5	12	6.0	-1.5
I remove protective clothes worn when sweeping streets or collecting waste or latrine cleaning immediately when I am done.					
Yes	109	54.2	150	74.6	20.4
No	76	37.8	31	15.4	-22.4
Maybe	16	8.0	20	10.0	2.0
I do not eat or smoke when I am working.					
Yes*	111	55.2	165	82.1	26.9
No	83	41.3	28	13.9	-27.4
Maybe	7	3.5	8	4.0	0.5
I wash my hands using water only.					
Yes	136	67.7	52	25.9	-41.8
No*	54	26.9	141	70.1	43.3
Maybe	11	5.5	8	4.0	-1.5
I dry wet hands on my work outfit.					
Yes	129	64.2	38	18.9	-45.3
No*	63	31.3	153	76.1	44.8
Maybe	9	4.5	10	5.0	0.5
I bath after returning home from work.					
Yes*	134	66.7	177	88.1	21.4
No	55	27.4	16	8.0	-19.4
Maybe	12	6.0	8	4.0	-2.0

*Desirable responses

Defecation of MWSW in an open space poses a significant threat to public health, especially amongst the populace residing near open sites or bushes (Amato et al., 2022). Although this risky behaviour could be attributed to a lack of hygiene-related training programmes implemented on the subject matter, it could also be significantly influenced by the deprived accessibility to ablution facilities. For instance, during the site visit, it was found that participants were only able to access the ablution facilities at the beginning of the morning shift (5:00 to 6:00 am) when they went to their respective depots to register their attendance for work. However, this was contradictory to a study conducted in Egypt, where the majority (80%) of waste collectors had access to water sources and ablution facilities (Awad et al., 2023). In the post-intervention phase, 162 (80.6%)

participants acknowledged refraining from defecating in open areas, indicating a significant improvement of 40.8%.

In response to the question on whether participants remove their protective clothing worn when handling waste immediately after completing their duties, it was recorded that most individuals acknowledged not doing so immediately pre-educational intervention. This may be attributed to the poor condition of the lockers provided, leading participants to opt for changing out of their waste collection clothes upon returning home. Additionally, a study conducted by Awad et al*.* (2023) in Egypt amongst waste collection workers also indicated that participants did not have access to lockers in good condition to store their protective clothing. Interestingly, in the post-educational intervention phase, 150 (74.6%) participants in the present study were reported to promptly remove their protective clothing (PPE) after completing tasks such as sweeping the street, collecting waste, or cleaning ablution facilities.

Almost half (41.3%) of the participants pre-intervention acknowledged eating and smoking while working. This is in line with a study conducted by Awad et al*.* (2023) that found that more than 85% of waste collectors in Egypt were observed eating, and 91% were drinking tea while discharging their duties. As previously mentioned, these findings may be attributed to a lack of access to resting areas as well as inadequate access to ablution facilities equipped with soap and sanitary towels for hand drying. A total of 136 (67.7%) individuals washed their hands using only water. However, a study in Ethiopia amongst solid waste workers found contradictory findings, with over 86% of individuals observed washing their hands with water and soap after handling waste (Gebremedhin, 2016).

More than a quarter of participants were not bathing after coming back from work during the pre-intervention phase. This might be due to a lack of understanding amongst waste and sanitation workers about the need to bath after work to protect oneself and others from the potential of acquiring hygiene-related infections (Jayakrishnan et al., 2013). This notion was further emphasised in a study conducted by Sobo and Ganyo (2019), which found that 18% of municipal trash workers in Ghana refrained from showering after work due to their disbelief in its effectiveness in preventing the transmission of hygiene-related diseases amongst themselves.

3.5 KNOWLEDGE AND PRACTICES SCORES OF PARTICIPANTS

In terms of hygiene-knowledge and practice mean scores of the participants' pre- and post-educational intervention phases, in the pre-intervention phase, the mean knowledge score was 10.2 (±3.9), indicating a fair knowledge of hygiene amongst the participants, while the mean practice score was 7.3 (±3.7), indicating a fair practice amongst the participants. In the post-intervention phase, the mean knowledge score improved to 14.2 (±2.4), while the practice mean score improved to 10.7 (±2.1) **(Figure 3.2)**.

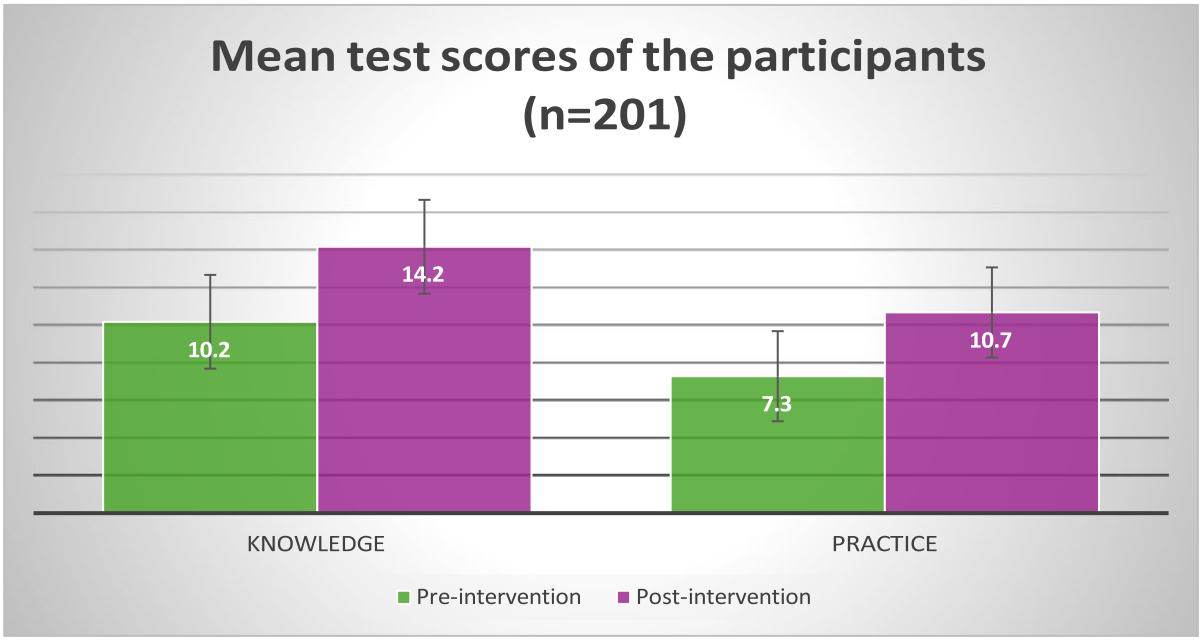

Figure 3.2: Pre- and post-intervention hygiene knowledge and practice mean scores of municipal waste and sanitation workers.

Across the pre-intervention phase, it was revealed that participants' hygiene knowledge and practice mean scores were fairly poor. Similar findings were reported in a study conducted in Sudan, which found that healthcare waste workers had fair knowledge and practices regarding hygiene pre-educational intervention (Elnour et al., 2015). However, contradictory findings during the pre-intervention phase were found in a study conducted in Palestine by Tabash et al. (2016) amongst healthcare waste workers, where a poor mean knowledge score of 41.4% (SD=21.4) regarding hygiene was recorded. However, in the post-intervention phase, the present study recorded a significant improvement in participants' comprehension of hygiene. This indicates that participants now have a much better grasp of good hygiene practices. Equally applicable to the mean score of participants' practices towards hygiene, an increasing trend in the score indicates a heightened degree of optimism towards hygiene. This improvement in both hygiene knowledge and practice scores of the participants indicates that the implemented intervention programme had a positive effect.

Furthermore, in the pre-intervention phase, a significant positive correlation between knowledge and practice ($r=0.54$, $p<0.001$) was observed in this study. Similar deductions can be observed across the post-intervention stage, with a significant positive correlation between knowledge and practice ($r=0.40$, $p<0.001$). This meant that participants with high levels of knowledge had a fair practice level. However, contradictory findings were reported in a study conducted in Egypt, which found no statistically significant correlation between waste workers' hygiene knowledge and practice ($r=0.078$, $p=0.738$) pre-educational programme (Awad et al., 2023).

3.6 DIFFERENCES IN HYGIENE KNOWLEDGE AND PRACTICE SCORES

The differences in mean values for the pre- and post-educational intervention knowledge and practice scores were assessed in the present study. The results showed statistically significant differences between the pre- and post-intervention hygiene knowledge and practices scores, with p-values at a 5% level of significance.

The study participants had fair knowledge and practices regarding hygiene pre-educational intervention, as discussed in the previous section. Also, the paired sample t-test shows that there is a difference (4.0 ± 4.8) in the scores for hygiene knowledge, and the increase in knowledge levels was statistically significant ($p<0.001$).

Additionally, findings from the paired sample t-test indicate a statistically significant difference (4.3 ± 3.4) in hygiene practice scores with $p<0.001$. In other words, the study findings indicated a good level of prevention practices amongst the studied population, compared to a lower level of knowledge regarding the aetiology, symptoms, and prevention strategies of hygiene-related diseases during the pre-intervention phase. This could be attributed to the fact that participants refrained from engaging in unsafe hygiene practices when handling waste post-educational intervention programme.

3.7 DIFFERENCES IN KNOWLEDGE AND PRACTICES AND DEMOGRAPHIC PROFILES

In terms of the scores for hygiene knowledge and practices across the participants' demographic characteristics, across the participants' work depot (p=0.040), age (p=0.006), gender (p=0.050), ethnic groups (p=0.049) and highest formal education obtained (p=0.050) there were significant differences in the practice scores. The knowledge difference was statistically significant only across the participants' work depots (p=0.020). The reported differences in hygiene knowledge (p=0.963) and practice (p=0.953) scores across the categories of waste and sanitation workers were not statistically significant **(Table 3.7)**.

Table 3.7: Comparison of demographic characteristics and knowledge and practices scores amongst study participants (n=201).

	n	**%**	**Knowledge**		**Practice**	
			Mean	Standard deviation	Mean	Standard deviation
Name of the depot						
Depot B	22	10.9	1.3	1.4	1.6	1.3
Depot A	48	23.9	2.8	1.8	3.4	2.0
WTP-A	6	3.0	0.4	0.8	0.4	0.6
Depot C	59	29.4	3.5	2.7	4.2	4.2
Depot D	48	23.9	2.8	2.9	3.4	3.8
Depot E	18	9.0	1.1	1.6	1.3	1.5
ANOVA						
***p*-value**			0.020*		0.040*	
Category of waste and sanitation worker						
Sanitation worker	6	3.0	0.4	0.8	0.4	0.6
Street sweeper	85	42.3	5.0	3.9	6.1	4.3
Waste transporter	110	54.7	6.5	5.1	7.9	6.6

ANOVA						
***p*-value**			0.963		0.953	
Age of the respondent						
18-30	32	15.9	1.9	1.6	2.3	2.5
31-40	54	26.9	3.2	3.1	3.9	3.3
41-50	71	35.3	4.2	3.9	5.1	5.1
51+	44	21.9	2.6	2.3	3.1	1.8
ANOVA						
***p*-value**			0.588		0.006*	
Gender of the respondent						
Male	148	73.6	8.7	6.4	10.6	7.4
Female	53	26.4	3.1	3.2	3.8	4.1
ANOVA						
p-value			0.339		0.050*	
Ethnic group						
African	163	81.1	9.6	7.3	11.6	8.5
Coloured	38	18.9	2.2	2.2	2.7	2.9
ANOVA						
***p*-value**			0.450		0.049*	
Highest formal education obtained						
Below grade 12	118	58.7	6.9	5.7	8.4	6.9
Grade 12	68	33.8	4.0	3.2	4.9	4.5
Tertiary level	15	7.5	0.9	1.2	1.1	1.2
ANOVA						
***p*-value**			0.196		0.050*	
Have you heard of hygiene related diseases?						
Yes	80	39.8	4.7	5.5	5.7	6.2

No	95	47.3	5.6	2.7	6.8	4.6
Not sure	26	12.9	1.5	1.9	1.9	1.8
ANOVA						
***p*-value**			0.124		0.378	

*Significant at 5% level of significance.

Similar findings were reported in a study conducted in Pakistan, which found a statistically significant difference between sanitation workers' gender ($p<0.05$) and their hygiene practice score (Kumar et al., 2015). These findings were further supported by a study conducted by Singh et al. (2020), which found no statistically significant difference in the knowledge scores across healthcare waste workers' gender ($p=0.057$), and age ($p=0.538$).

3.8 FACTORS RELATED TO KNOWLEDGE AND PRACTICES OF HYGIENE

From the multivariable linear regression analysis performed to identify factors related to the knowledge and practices of hygiene in the pre-intervention phase, it can be observed that for knowledge, participants working at Depot A (β=-2.82, $p=0.005$) were significantly less knowledgeable about hygiene compared to those in Depot B. Waste transporters (β=-1.78, $p=0.285$) were less knowledgeable compared to street sweepers (β=0.78, $p=0.208$), and post-intervention were significantly less knowledgeable (β=-2.19, $p=0.032$) compared to sanitation workers. Regarding age, participants older than 51 years of age had slightly poor knowledge (β =-0.09, $p=0.919$) regarding hygiene when compared to the participants who were 18-30 years old. Conversely, post-intervention, participants who were 18–30 years of age had better knowledge regarding hygiene compared to those who were 31 years and older. Participants who had not heard of hygiene-related diseases (β=-3.05, $p<0.001$) pre-intervention were significantly less knowledgeable about hygiene than their counterparts who had heard about hygiene-related diseases.

Furthermore, in the pre-intervention phase, it can be observed that for practice, participants from Depot A (β=-2.02, $p=0.030$) and those who were 51 years and older (β=-2.11, $p=0.011$) had a significant poor practice regarding hygiene. Only female participants (β=1.44, $p=0.022$) and the Coloured ethnic group (β=1.44, $p=0.050$) had good hygiene practices when handling waste, compared to male participants and those of Black African descent. It can be further observed that participants who have not heard of hygiene-related diseases (β=-1.20, $p=0.024$) had significant poor practices regarding hygiene. However, in the post-intervention phase, municipal waste and sanitation workers in WTP-A (β=1.95, $p=0.037$), those who were 31–40 years of age (β=1.08, $p=0.017$) had significant poor hygiene practices **(Table 3.8)**.

Table 3.8: Regression results of participants' hygiene knowledge and practices (n=201).

Pre-intervention	**Knowledge**			**Practice**		
	Estimate	Standard error	P-value	Estimate	Standard error	P-value
(Intercept)	12.12	1.10	<0.001	8.23	1.03	<0.001
Name of the depot						

Depot B (ref)						
Depot A	-2.82	0.99	0.005*	-2.02	0.92	0.030*
WTP-A	-0.01	1.70	0.995	0.36	1.59	0.819
Depot C	-0.96	0.98	0.325	-0.59	0.91	0.516
Depot D	-1.52	1.09	0.167	-1.17	1.02	0.253
Depot E	-0.88	1.18	0.455	0.40	1.10	0.718
Category of waste and sanitation worker						
Sanitation worker (ref)						
Street sweeper	0.78	0.62	0.208	0.23	0.58	0.689
Waste transporter	-1.78	1.66	0.285	-1.43	1.55	0.358
Age of the respondent						
18-30 (ref)						
31-40	0.84	0.82	0.307	0.16	0.77	0.834
41-50	0.48	0.80	0.548	-0.08	0.75	0.918
51+	-0.09	0.88	0.919	-2.11	0.82	0.011*
Gender of the respondent						
Male (ref)						
Female	0.26	0.67	0.695	1.44	0.63	0.022*
Ethnic group						
African (ref)						
Coloured	-0.10	0.80	0.904	1.44	0.75	0.050*
Highest formal education obtained						
Below grade 12 (ref)						
Grade 12	0.48	0.58	0.411	0.40	0.54	0.460
Tertiary level	0.77	1.05	0.461	1.26	0.98	0.200
Have you heard of hygiene related diseases?						
Yes (ref)						

No	-3.05	0.56	<0.001	-1.20	0.53	0.024*
Not sure	-0.82	0.85	0.336	0.07	0.79	0.930
Knowledge				0.46	0.07	<0.001
Post-intervention	**Knowledge**			**Practice**		
	Estimate	Standard error	P-value	Estimate	Standard error	P-value
(Intercept)	14.25	0.72	<0.001	9.82	0.60	<0.001
Name of the depot						
Depot B (ref)						
Depot A	0.92	0.65	0.156	0.83	0.54	0.125
WTP-A	2.00	1.11	0.050	1.95	0.93	0.037*
Depot C	0.30	0.64	0.641	0.50	0.53	0.344
Depot D	-0.52	0.71	0.466	-0.45	0.60	0.446
Depot E	-1.17	0.77	0.132	0.12	0.64	0.852
Category of waste and sanitation worker						
Sanitation worker (ref)						
Street sweeper	0.16	0.41	0.692	0.19	0.34	0.576
Waste transporter	-2.19	1.01	0.032	-1.76	0.88	0.048*
Age of the respondent						
18-30 (ref)						
31-40	-0.35	0.54	0.511	1.08	0.45	0.017*
41-50	-0.41	0.52	0.436	0.40	0.44	0.356
51+	-0.40	0.57	0.486	0.42	0.48	0.377
Gender of the respondent						
Male (ref)						
Female	-0.19	0.44	0.662	-0.22	0.36	0.546
Ethnic group						

African (ref)						
Coloured	-0.33	0.52	0.533	-0.86	0.44	0.050*
Highest formal education obtained						
Below grade 12 (ref)						
Grade 12	0.03	0.38	0.946	0.18	0.32	0.566
Tertiary level	0.59	0.69	0.390	0.69	0.57	0.229
Have you heard of hygiene related diseases?						
Yes (ref)						
No	0.15	0.37	0.677	0.30	0.31	0.331
Not sure	0.38	0.55	0.488	-0.54	0.46	0.243
Knowledge				0.58	0.06	<0.001

*Significant at a 5% level of significance (ref)=reference category

The current study's findings indicate that pre-intervention work depots significantly influence the hygiene knowledge and practices of MWSW. The study revealed that participants working at Depot A were significantly less knowledgeable about hygiene compared to those at Depot B. This could be due to the variety of waste depots to which the participants were assigned. For instance, during the site visit, resource availability and services varied across the waste depots. Therefore, compared to less-resourced waste depots, well-resourced waste depots would give waste and sanitation workers the chance to participate in hygiene-related training and receive close, supportive supervision. The findings of the study are in line with those of Millanzi et al. (2023) in Tanzania, which reported that healthcare sanitary workers employed by regional and district hospitals (well-resourced healthcare facilities) were significantly more knowledgeable regarding hygiene compared to their counterparts working in health centres and dispensaries (less-resourced healthcare facilities).

Regarding the category of waste and sanitation workers, the present study reported that waste transporters were significantly less knowledgeable compared to sanitation workers' post-educational intervention programme. This could be due to the nature of their work; waste transporters spend a significant amount of time away from their depots and receive less supervision than sanitation workers, as observed by the researcher during the site visit. This lack of supervision may have resulted in their disregard for the educational intervention being provided. Hence, they were less knowledgeable regarding hygiene compared to their counterparts in the post-intervention programme. Similar findings were reported in a study conducted by AbouZeid et al. (2022) in Egypt, which found that waste transporters were less knowledgeable regarding the importance of PPE use. This was due to a lack of consistent managerial supervision, which would serve as a constant reminder of the significance of PPE use when handling waste.

Furthermore, the findings of this study indicated that post-intervention phase, participants who were 18–30 years old had better knowledge regarding hygiene compared to those who were 31 years and older, although it was not statistically significant. This may be attributed to the fact that participants who were 18–30 years old had a better degree of cognitive ability regarding hygiene. Furthermore, Ben Jmaa et al. (2023) indicated that older workers are less likely to retain and implement the information conveyed during intervention programmes. Consistent with this, a study in North India found that workers aged 20–30 demonstrated significantly higher knowledge following educational programmes compared to middle-aged workers (41–59) (Singh et al., 2020).

The findings of the study further revealed that participants who had acquired Grade 12 and the tertiary level of education had a slight positive knowledge regarding hygiene compared to those who had not completed grade 12 in both the pre- and post-educational intervention phases.

Moreover, the study findings revealed that participants who had not heard of hygiene-related diseases were significantly less knowledgeable about hygiene than their counterparts who had heard about hygiene-related diseases before. Similar findings were discovered in Bangalore amongst healthcare workers (doctors, nurses, and sanitary workers) that sanitary workers had poor knowledge regarding waste management compared to other healthcare workers who had received hygiene-related training before (Basavaraj et al., 2021).

Thus, significant factors in the participants' knowledge regarding hygiene in this study were the working environment (depot) and hygiene-related training background. However, it was their race, age, and educational training obtained, for their hygiene practices. In contrast, a study conducted in Pakistan by Kumar et al. (2015) found that there is no statistically significant association between hygiene practices and the age of sanitation workers, respectively.

Moreover, regarding the association between knowledge and practice scores of the participants, it can be observed that every 1% increase in knowledge score was significantly associated with an increase in practice score of 0.46 at the pre-intervention phase. However, at the post-intervention phase, a 1% increase in knowledge score was associated with a 0.58 practice score, which can be seen as a good indication of the effect of the educational intervention.

CHAPTER 4: CONCLUSIONS & RECOMMENDATIONS

4.1 CONCLUSIONS

Based on the present study findings, MWSW had better knowledge and practices regarding hygiene in the post-intervention phase. This was evident because the post intervention test score on hygiene knowledge amongst the studied population was greater than the pre-intervention test score. The post-intervention test score on hygiene practice also exceeded the pre-intervention test score. Therefore, from these findings, one can conclude that the implemented educational intervention programme had a positive impact on participants' hygiene knowledge and practices. Similar observations were reported in previous studies: sanitation workers' hygiene knowledge and practices significantly improved post-intervention programme (Sapkota et al., 2014; Elnour et al., 2015; Kumar et al., 2015). However, contradictory findings were reported in a study conducted in Pakistan, which found that post educational intervention, sanitation workers' hygiene knowledge and practices declined (Ben Jmaa et al., 2023). The argued cause of this finding is a lack in the provision of regular reinforcing information on hygiene during the intervention phase.

Further research revealed that in the post-educational intervention phase, individuals in the category of waste transporters were significantly less informed regarding hygiene compared to those in the category of sanitation workers. This suggests that sanitation workers during the intervention phase attentively listened to the PowerPoint presentation, possibly motivated by their apprehension of facing fines from waste managers. The close monitoring of sanitation workers, in contrast to waste transporters, may account for this heightened attention. Similarly, with the study findings by AbouZeid et al. (2022) in Egypt, the presence of supervision amongst waste workers significantly influenced the hygiene knowledge of the participants post intervention. Moreover, the results obtained during the post-intervention phase indicated that participants who were aged 31–40 and those in WTP-A had significantly poor hygiene practices.

Overall, the work environment, age, race, gender, workers' category, and awareness of hygiene-related diseases significantly influenced the participants' hygiene knowledge and practices both pre- and post-intervention.

4.2 RECOMMENDATIONS

Considering the study findings, the following recommendations are for the Department of Education, policymakers, Environmental Health Practitioners (EHPs), and further research studies:

Department of Education

- The introduction of a curriculum that sufficiently covers hygiene-related diseases in pre-matric education is highly recommended, as the findings of the study revealed that participants who had acquired Grade 12 as well as tertiary level of education had slight positive knowledge scores regarding hygiene compared to those who had not completed Grade 12.

Policymakers

- To develop guidelines for hygiene knowledge and practices for waste and sanitation workers.

Environmental Health Practitioners

- Environmental Health Practitioners can use the findings of the present study to develop similar initiatives that involve and empower MWSW with good hygiene knowledge and practices.

- It is recommended that hygiene-related training programmes be implemented actively and intensively, presented in a manner that is clear, precise, and tailored to the educational level of sanitation workers.

Further research studies

- Additional research is needed to provide definitive insights into how demographic factors influence the effectiveness of educational programmes in enhancing the hygiene knowledge and practices of waste and sanitation workers.

- To validate the current findings, it is proposed to implement a comparable educational intervention programme on hygiene amongst a substantial number of waste and sanitation workers in different settings

REFERENCES

Adashi, E.Y., Walters, L.R.B. and Menikoff, J.A. (2018). The Belmont Report at 40: Reckoning with time. *American Journal of Public Health, 108*(10): 1345–1348. doi:10.2105/AJPH.2018.304580.

Akoglu, H. (2018). User's guide to correlation coefficients. *Turkish Journal of Emergency Medicine*, 18(3): 91–93. doi:10.1016/j.tjem.2018.08.001.

Alam, M., Sharior, F., Shoaib, D.M., et al. (2022). Hygiene knowledge and practices and determinants of occupational safety among waste and sanitation workers in Bangladesh during the COVID-19 pandemic. *Hygiene and Environmental Health Advances, 4:* 100022. doi: 10.1016/j.heha.2022.100022.

Amato, H. K., Martin, D., Hoover, C. M., et al. (2022). Somewhere to go: assessing the impact of public restroom interventions on reports of open defecation in San Francisco, California from 2014 to 2020. *BMC Public Health*, *22*(1): 1673. doi:10.1186/s12889-022-13904-4.

Awad, H. E., Farahat, N. H., and Mohamed, H. M. (2023). An Occupational Health Program for Waste Collection Workers. *Evidence-Based Nursing Research*, *5*(1): 32–43. doi: 10.47104/ebnrojs3.v5i1.275.

Azfar, Z.M., Nazri, S.M., Rusli, A.M., et al. (2018). Knowledge, attitude and practice about leptospirosis prevention among town service workers in northeastern Malaysia: A cross sectional study. *Journal of Preventive Medicine and Hygiene,* 59(1): E92–E98. doi: 10.15167/2421-4248/jpmh2018.59.1.776.

Basavaraj, T. J., Shashibhushan, B. L., and Sreedevi, A. (2021). To assess the knowledge, attitude and practices in biomedical waste management among health care workers in dedicated COVID hospital in Bangalore. *The Egyptian Journal of Internal Medicine*, *33*(1): 37. doi: 10.1186/s43162-021-00066-9.

Ben Jmaa, M., Ben Ayed, H., Ben Hmida, M., et al. (2023). Effectiveness of a Training Intervention about Healthcare Waste Management on the Knowledge and Practical Skills of Healthcare Professionals in a Teaching Hospital of Southern Tunisia. *Hospital Topics*, *101*(2): 55–64. doi: 10.1080/00185868.2021.1969307.

Degavi, G., Debbarma, S., Adola, S.G., et al. (2021). Occupational hazards and its relation with health-seeking and practicing behaviors among sanitary workers in Southern, Ethiopia. *International Journal of Africa Nursing Sciences, 15*: 100339. doi:10.1016/j.ijans.2021.100339.

Elnour, A.M., Moussa, M.M., El-Borgy, M.D., et al. (2015). Impacts of health education on knowledge and practice of hospital staff with regard to Healthcare waste management at White Nile State main hospitals, Sudan. In *International Journal of Health Sciences,* 9(3): 315-331.

Gebremedhin, F., Debere, M.K., Kumie, A., et al. (2016). Assessment of knowledge, attitude and practices among solid waste collectors in Lideta Sub-city on prevention of occupational health hazards, Addis Ababa, Ethiopia. *Science Journal of Public Health*, *4*(1): 49–56. Doi: 10.11648/j.sjph.20160401.17.

Golandaj, J. A., & Kallihal, K. G. (2021). Awareness, attitude and practises of biomedical waste management amongst public health-care staff in Karnataka, India. *Journal of Humanities and Applied Social Sciences*, *3*(1): 49–63. doi: 10.1108/jhass-08-2019-0041.

Gomathi, P. and Kamala, K. (2020). Threatening Health Impacts and Challenging Life of Sanitary Workers. *Journal of Evolution of Medical and Dental Sciences, 9*(41): 3055–3062. doi:10.14260/jemds/2020/669.

He, Z., Bishwajit, G., Zou, D., et al. (2018). Burden of common childhood diseases in relation to improved water, sanitation, and hygiene (WASH) among Nigerian children. *International Journal of Environmental Research and Public Health*, *15*(6): 1241. doi: 10.3390/ijerph15061241.

Hillier, M.D. (2020). Using effective hand hygiene practice to prevent and control infection. *Nursing standard (Royal College of Nursing (Great Britain): 1987), 35*(5): 45–50. doi: 10.7748/ns.2020.e11552.

Humphrey, J.H., Mbuya, M.N.N., Ntozini, R., et al. (2019). Independent and combined effects of improved water, sanitation, and hygiene, and improved complementary feeding, on child stunting and anaemia in rural Zimbabwe: a cluster-randomised trial. *The Lancet Global Health, 7*(1): e132–e147. doi: 10.1016/S2214-109X(18)30374-7.

Jayakrishnan, T., Jeeja, M. C., and Bhaskar, R. (2013). Occupational health problems of municipal solid waste management workers in India. *International Journal of Environmental Health Engineering*, *2*(1): 42. Doi: 10.4103/2277-9183.122430.

Kalumbi, L.R., Chisomo, T., Eleanor E. Macpherson., et al. (2020). Perspectives and Practices on Water, Sanitation, and Hygiene from a Fishing Community along Lake Malombe, Southern Malawi. *International Journal of Environmental Research and Public Health, 17* (18): 1–17. doi: 10.3390/ijerph17186703.

Kumar, R., Somrongthong, R., and Shaikh, B. T. (2015). Effectiveness of intensive healthcare waste management training model among health professionals at teaching hospitals of Pakistan: A quasi-experimental study. *BMC Health Services Research*, *15*(1): 15-81. doi:10.1186/s12913-015-0758-7.

Maciejewski, M.L. (2020). Quasi-experimental design. *Biostatistics and Epidemiology, 4*(1): 38–47. doi:10.1080/24709360.2018.1477468.

Mamuya, S., & Badi, S. (2019). Factors contributing to occupational injuries among solid waste collectors: across sectional study in a municipal in Tanzania. *MOJ Public Health*, *8*(6): 237-241. doi: 10.15406/mojph.2019.08.00313.

Mara, D.D. (2003). Water, sanitation, and hygiene for the health of developing nations. *Public Health, 117*(6): 452–456. doi:10.1016/S0033-3506(03)00143-4.

Melaku, H.S. and Tiruneh, M.A. (2020). Occupational health conditions and associated factors among municipal solid waste collectors in Addis Ababa, Ethiopia. *Risk Management and Healthcare Policy, 13*: 2415–2423. doi: 10.2147/RMHP.S276790.

Melariri, P., Steenkamp, L., William, M. et al. (2019). Water, sanitation and hygiene practices in early childhood development (ECD) centres in low socio-economic areas in Nelson Mandela Bay, South Africa. *Journal of Water Sanitation and Hygiene for Development, 9*(1): 164–171. doi:10.2166/washdev.2019.130.

Millanzi, W. C., Herman, P. Z., and Mtangi, S. A. (2023). Knowledge, attitude, and perceived practice of sanitary workers on healthcare waste management: A descriptive cross-sectional study in Dodoma region,Tanzania. *SAGE Open Medicine*, *11*: 1-16. doi:10.1177/20503121231174735.

Nelson Mandela Bay Metropolitan Municipality (2015). Nelson Mandela Bay Metropolitan Municipality, Online, p. 1. Available at: https://municipalities.co.za/demographic/1/nelson-mandela-bay-metropolitan-municipality (Accessed: 15 August 2023).

Nelson Mandela Bay Municipality-Integrated Waste Management Plan (2016). Available at: https://www.nelsonmandelabay.gov.za/datarepository/documents/iwmp-executive-summary.pdf (Accessed: 25 May 2023).

Ohajinwa, C. M., Van Bodegom, P. M., Vijver, M. G., et al. (2017). Health risks awareness of electronic waste workers in the informal sector in Nigeria. *International Journal of Environmental Research and Public Health*, *14*(8): 9. doi:10.3390/ijerph14080911.

Olaifa, A., Govender, R. D., & Ross, A. J. (2018). Knowledge, attitudes and practices of healthcare workers about healthcare waste management at a district hospital in KwaZulu-Natal. *South African Family Practice*, 60(5): 137–145. doi: 10.1080/20786190.2018.1432137.

Philippe, S., Hueso, A., Kafuria, G., et al. (2022). Challenges Facing Sanitation Workers in Africa: A Four-Country Study. *Water (Switzerland), 14*(22): 1–19. doi: 10.3390/w14223733.

Pruss-Ustun, A., Wolf, J., Bartram, J., et al. (2019). Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low- and middle-income countries. *International Journal of Hygiene and Environmental Health, 222*(5): 765–777. doi: 10.1016/j.ijheh.2019.05.004.

Rasyid, S., Saafi, L.O. and Jayadipraja, E.A. (2021). Relationship of Knowledge and Support of Health Workers with the Achievement of Latrine Using in Tirawuta Sub-District, East Kolaka District, *Indonesian Journal of Health Sciences Research and Development, 3*(2): 8–13. doi: 10.36566/ijhsrd/vol3.iss2/82.

Shoaib, D.M., Ahmed, t., Tabassum, K.F., et al. (2024). Evaluation of occupational health and safety intervention for the waste and sanitation workers in Bangladesh during COVID-19. International Journal of Hygiene and Environmental Health, 255: 1438-4639. doi: 10.1016/j.ijheh.2023.114288.

Shrestha, M.V., Manandhar, N. and Joshi, S.K. (2018). Study on Knowledge and Practices of Water, Sanitation and Hygiene among Secondary School Students. *Journal of College of Medical Sciences-Nepal, 14*(3): 160–165. doi:10.3126/jcmsn.v14i3.21158.

Sobo, B., and Ganyo, P. (2019). Presbyterian university college, ghana faculty of development studies department of environmental natural resources and management safety practices of informal waste collectors in the Ga-East Municipality. Available at: https://ir.ucc.edu.gh/xmlui (Assessed: 25 July 2024).

South African Government (2023). Health update on response to Cholera outbreak in South Africa. Available at: https://www.gov.za/speeches/health-update-response-cholera-outbreak-south-africa-8-jun-2023-0000 (Accessed: 8 July 2023).

Tabash, M. I., Hussein, R. A., Mahmoud, A. H., et al. (2016). Impact of an intervention programme on knowledge, attitude and practice of healthcare staff regarding pharmaceutical waste management, Gaza, Palestine. *Public Health*, *138*: 127–137. doi: 10.1016/j.puhe.2016.04.001.

Temesgen, L. M., Mengistu, D. A., Mulat, S., et al. (2022). Occupational Injuries and Associated Factors Among Municipal Solid Waste Collectors in Harar Town, Eastern Ethiopia: A Cross-Sectional Study. *Environmental Health Insights*, *16*: 1-8. doi: 10.1177/11786302221104025.

Wulandari, C. and Kurniasih, H. (2019). Community preferences for social forestry facilitation programing in Lampung, Indonesia. *Forest and Society, 3*(1): 114–132. doi:10.24259/fs.v3i1.6026.

Yaya, S., Hundani, A., Udenigwe, O., et al. (2018). Improving water, sanitation and hygiene practices, and housing quality to prevent diarrhea among under-five children in Nigeria. *Tropical Medicine and Infectious Disease, 3*(2): 1–11. doi:10.3390/tropicalmed3020041.

APPENDIX A: QUESTIONNAIRE ON HYGIENE KNOWLEDGE AND PRACTICES IN ENGLISH

NELSON MANDELA UNIVERSITY

Impact of an educational intervention on hygiene knowledge and practices among municipal waste and sanitation workers in Nelson Mandela Bay, South Africa.

Please mark with an (**X**) on the box to choose your answer.

Information about the respondent

1. Name of the working area/region:
2. Name of the depot:
3. Identity code:
4. Contact details:

5. **Age of the respondent**

18-30 years	
31-40 years	
41-50 years	
51 and above	

6. **Gender of the respondent**

Male	
Female	
Self-describe	

7. **Ethnic group.**

African	
Coloured	
White	
Self-describe	

8. **Highest formal education obtained.**

Below grade 12	
Grade 12	
Tertiary level	

Knowledge

Please mark with an **(x)** in the box to choose your answer. **NB! If you are unsure, select "Unsure" rather than guessing.**

1. **Have you heard of Hygiene-related diseases?**

   a) Yes ☐
   b) No ☐
   c) Not sure ☐

If yes, from where did you hear about WASH-related diseases?

1.1 Educational programmes ☐
1.2 TV ☐
1.3 Radio ☐
1.4 Newspaper ☐
1.5 Word of mouth (colleagues, friends, or family member) ☐
1.6 Hospital/Healthcare ☐
1.7 Other (specify) _____

Statement	True	False	Unsure
2. Diarrhoea and cholera are hygiene-related diseases.			
3. Poor hygiene practices cause diarrhoeal diseases			
4. Blindness is the most common sign of diarrhoea.			
5. Hygiene-related diseases are not preventable.			
6. Hand washing after work can prevent diarrhoeal diseases.			
7. Rubbing your hands together is more effective against microorganisms than hand washing.			
8. Hand hygiene and hygiene-related diseases they do not relate.			
9. Touching face and sneezing while handling waste can increase the risk of hygiene-related disease transmission.			
10. It is not important to properly dispose municipal waste.			
11. Improper waste disposal is a threat to environmental hygiene.			
12. Waste disposal in open places can have harmful effect on human health.			
13. I am aware of safe basic environmental cleaning procedures.			
14. Safe drinking water should be colourless, with no smell and should not contain fine particles or infectious organisms.			
15. A clean water source must be used for hand washing.			

16. Waste can be a breeding site for flies and rodents.			
17. It is important to use protective clothing when performing my duties.			
18. The importance of latrine use is privacy only.			

Practice

Please mark with an (X) in the box to choose your answer.

Statement	Yes	No	Maybe
19. I wear gloves when handling waste.			
20. I dispose Personal Protective Equipment (PPE) such as, gloves and masks in the river after used.			
21. I dispose my facemask, gloves, and tissue in a tightly closed bag, separate from regular trashes.			
22. I am toileting in an open space sometimes.			
23. I encourage other workers to practice proper waste disposal.			
24. I have taken actions to prevent my fellow colleagues and family from getting hygiene-related disease.			
25. I remove cloths worn when sweeping streets or collecting waste or latrine cleaning immediately when I am done.			
26. I don't eat or smoke when I am working			
27. I wash hands using water only.			
28. I wash hands with water and soap before having meal.			
29. I dry wet hands on my work outfit.			
30. I keep my water or lunch box far from waste site and dirty place when I am working, so that no possible contamination from germs, animals, or vectors.			
31. I bath after coming back from work.			

APPENDIX B: DATA COLLECTION & INTERVENTION