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Utilization of personal protective equipment among sanitation workers in faecal-waste management plants in cities in Uganda

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Introduction: Increased urbanization in Uganda has exerted pressure on the existing sanitation facilities including sewer systems and fecal-waste treatment plants increasing health, and environmental risks to sanitation workers and the public. Sanitation workers are also exposed to biohazards while working, which poses a great threat to their health. This study assessed utilization of personal protective equipment (PPE) and associated factors among sanitation workers in fecal-waste management plants in Uganda's regional cities.
Methods: A cross-sectional study was conducted among 417 sanitation workers in fecal waste treatment plants in nine cities in Uganda. Data were collected using a semi-structured questionnaire uploaded on Kobo collect software and analyzed in Stata version 14 software.
Results: The majority (95.0%) of the study participants were males, 46.5% were above 30 years and 60.7% consistently utilized PPE in the 30 days prior to the study. Experiencing work-related illness (APR = 0.39,95% CI:0.23–0.66), presence of an occupational health and safety officer (APR = 2.32, 95%CI:1.34–4.02), presence of PPE regulations (APR = 2.85,95%CI:1.50–5.39), and mandatory PPE use at work were significantly associated with consistent PPE use.
Discussion/Conclusion: Consistent PPE use among sanitation workers at fecal-waste management plants was suboptimal. Hence, fecal-waste management plants should conduct routine training, provide PPE, and employ occupational health officers to enforce and supervise PPE use.

KEYWORDS

sanitation workers, PPE, utilization, fecal waste management plants, Uganda

1 Introduction

Over 50% of the global population lives in urban areas and it is projected to increase by 1.5 times to 6 billion by 2045 (1). Moreover, most sub-Saharan African (SSA) countries are regarded as the world's fastest urbanizing countries, with approximately 1.14 billion inhabitants and 41.2% of them living in urban areas and cities (1, 2). Uganda has had rapid urban growth of over 24% in the previous 10 years (1). That notwithstanding, the Government of Uganda (GoU) approved 15 new cities (3), many of which are characterized by trading activities, increased industrialization, and high population densities (4). These activities majorly depend on the public sewer system (5) and on-site

sanitation technologies which require functioning fecal waste management systems and institutions to operate (6). However, this situation poses an enormous pressure on sanitation facilities, sewer systems, and fecal treatment plants thus increasing health, environmental, and socioeconomic risks to people (7). In addition, these sanitation facilities are often mismanaged (6, 8) and abused by dumping of non-degradable materials which in the long run exposes sanitation workers to disease risk.

In a bid to protect public health and improve the overall livability of cities, sanitation workers are required to address the various challenges along the sanitation chain including ensuring the safe containment, collection, transport, treatment, and reuse or disposal of fecal matter (9, 10). However, during excreta management along the chain, these sanitation workers are exposed to bacteria, endotoxins, allergens, particulate matter, and poisonous gases, in septic tanks, sewers, pumping stations, and treatment plants (11). These risks are exacerbated by improperly constructed sanitation facilities, inadequate, poor design and material of personal protective equipment (PPE) for adequate protection of the workers (9), limited occupational safety and health training, and low education levels of sanitation workers (12, 13). This creates unfavorable working conditions for sanitation workers thus failing to contribute to four of the 17 Sustainable Development Goals (SDGs) including SDG 1, SDG 3, SDG 6, and SDG 8 (10). It is thus paramount to examine the OSH of sanitation workers (10) due to the high risk of hazards they are exposed to (14).

To address these gaps, the World Health Organization (WHO) set guidelines in 2018 on Sanitation and Health (11). These guidelines highly recommend that sanitation workers implement safe excreta management across the sanitation chain, and be provided with detailed guidance on safety measures at each step of the chain (11). Following this, several cities in Uganda have adopted these guidelines for instance Kampala city (15) passed the Kampala Capital City (Sewage and Fecal Sludge Management) Ordinance in 2019 as a legal tool for effective management of fecal sludge in the area (15). This ordinance recommends training all sanitation workers and following standard operating procedures such as consistent and correct PPE use and regular health checks during their work (15). This notwithstanding, implementation of occupational health measures among sanitation workers remains low (9, 10). However, improving the occupational health of sanitation workers requires an understanding of their knowledge of and utilization of PPE. Therefore, this study assessed PPE utilization and associated factors among sanitation workers in fecal waste management plants in cities in Uganda.

2 Materials and methods

2.1 Study design and setting

A cross-sectional study design was employed to assess awareness of occupational biohazard risks, and utilization of PPE among sanitation workers in fecal waste treatment plants. The study was conducted in fecal treatment plants in Ugandan cities which were: Arua, Lira, Gulu, Mbale, Jinja, Masaka, Kampala, Fort Portal, and Mbarara city (3). These cities are highly populated with an urban population growth rate of 5.2% (5) and highly depend on public sewer systems for fecal waste disposal.

2.2 Study population and sampling

The study was conducted among sanitation workers in fecal treatment plants in regional cities in Uganda. These sanitation workers often come into contact with various occupational biohazards, physical injuries, and various illnesses while at work (16, 17). The sample size was determined using the formula by Kish Leslie (1965) (18), considering a conservative prevalence of 50%, sampling error of 5%, and non-response rate of 10% giving a sample size of 427 participants. Both stratified and random sampling techniques were employed. Each fecal treatment plant was treated as a stratum, and the number of respondents per stratum was determined proportionally based on the total number of sanitation workers at that plant. A complete list of sanitation workers at each plant was requested from the respective occupational health and safety officer, and efforts were made to verify its comprehensiveness through cross-checking with administrative records where feasible. From these lists, participants were randomly selected.

Of the 427 workers approached, 417 consented and completed the survey, yielding a response rate of 97.7%.

2.3 Data collection

Data collection was conducted from 26th July – 10th September 2022. Data were collected by trained research assistants a using structured questionnaire uploaded on Kobo Collect software. Data collection was conducted during working hours at the fecal management plants. The questionnaire was adapted from a similar study (19, 20). It was translated into local languages such as *Luganda* in Kampala, *Runyankole* in Mbarara, *Rutooro* in Fortportal, *Lumasaba* in Mbale, *Lusoga* in Jinja, *Alur* and *Lugbar* in Arua, *Acholi* in Gulu and *Langi* in Lira. The questionnaire contained four sections namely: socio-demographic characteristics; awareness and attitudes toward occupational biohazard risk; knowledge of PPE use, utilization of PPE, and institutional factors. The data collection tool was evaluated for face and internal validity by a team of experts at Makerere University School of Public Health.

2.4 Measurement of PPE utilization

PPE utilization was based on respondents' self-reports. PPE utilization among respondents was measured by asking whether they often wore any PPE in the previous 30 days. Respondents with a "Yes" response on consistent PPE utilization (Those who used PPE every work day for the previous 30 days) were

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considered as those who utilized PPE and coded (1), while those with a "No" response were considered otherwise and coded (0).

2.5 Data management and analysis

Data were entered using android-enabled mobile phones loaded with the Kobo Collect application, and the data were synchronized onto the server daily. This allowed real-time data capture and entry, minimized errors at entry, and eased data cleaning. The data entered were cleaned and analyzed using Excel 2016 and STATA version 14.0 statistical software respectively. Descriptive analyses were performed for demographic characteristics, awareness of biohazards, availability of PPE, and utilization of PPE. These results are presented as frequencies, proportions, and means where appropriate. To assess the association between the outcome variable and the explanatory variables, we used logistic regression at bivariate and multivariable analysis. This resulted in Crude Odds Ratios (COR) at 95% confidence intervals. Thereafter, variables with a threshold *p*-value less than 0.05at bivariate analyses were subjected to the multivariable regression analyses, giving the Adjusted Odds Ratios (AOR). In multivariable analysis, only variables with a *p*-value less than 0.05 were considered significant.

3 Results

3.1 Socio-demographic and background characteristics

Out of the 417 respondents, 95.0% (396/417) were males, 36.9% (154/417) were Roman Catholics, and 71.9% (300/417) were married or cohabiting. Among the respondents, 46.5% (194/417) were aged 30 years and below, 91.1% (380/417) had dependents, and 44.8% (187/417) had attained secondary level education. The roles played by the respondents at the treatment plant were collection 50.6% (211/417), emptying 61.6% (257/417), transportation 44.6% (186/417), treatment 21.6% (90/417), and disposal 32.4% (135/417). Given the diversity in job roles among the sanitation workers, it is important to note that these different functions expose them to varying types and levels of occupational hazards. Close to three quarters of the respondents, 72.9% (304/417) were working in the day shift, and 54.4% (227/417) worked 8 and less hours daily (Table 1).

TABLE 1 Socio-demographic and background characteristics of respondents.

Variable	Attribute	Frequency (*n* = 417)	Percentage (%)
Gender	Female	21	5.0
	Male	396	95.0
Age (years)	≤30	194	46.5
	31–45	169	40.5
	>45	54	12.9
Religion	Anglican	121	29.0
	Muslim	91	21.8
	Pentecostal/born again	51	12.2
	Roman catholic	154	36.9
Marital status	Separated/divorced	23	5.5
	Single	92	22.1
	Widowed	2	0.5
	Married	300	71.9
Had dependents	No	37	9.9
	Yes	380	91.1
Highest academic qualification	No formal education	8	1.9
	Primary level	138	33.1
	Secondary level	187	44.8
	Tertiary	84	20.1
Work shift	Day	304	72.9
	Night	6	1.4
	Both	107	25.7
Role at the treatment plants	Collection	211	50.6
	Emptying	257	61.6
	Transportation	186	44.6
	Treatment	90	21.6
	Disposal	135	32.4
Work duration per day (hours)	≤8	227	54.4
	>8	190	45.6
Years spent working at the plant	≤5	284	68.1
	> 5	133	31.9
Had another occupation	Yes	201	48.2
	No	216	51.8
Other occupation (*n* = 201)	Boda-boda (commercial motor cyclist)	10	5.0
	Business	61	30.4
	Casual labor	28	13.9
	Construction	38	18.9
	Farming	40	19.9
	Non casual work	24	11.9
Average monthly income (US dollars)	Less than 132	271	65.0
	132- 264	119	28.5
	Above 264	27	6.5

3.2 Awareness of PPE among sanitation workers

Almost all the respondents, 99.5% (415/417) were aware of at least one PPE needed for working in the fecal sludge establishment and 97.6% (405/417) knew that PPE can reduce the risk of exposure to biohazards. The majority of respondents, 95.7% (397/415) mentioned durable gloves as the most commonly known PPE in the fecal sludge establishment. Nearly half of the respondents, 44.4% (185/417) received PPE use related instructions before and/or during the assigned work, while 56.9% (236/417) had undertaken some PPE-related training. The majority of respondents, 73.65% (307/417) mentioned that it was mandatory to use PPE at their work

places, and 54.4% (227/417) affirmed that some regulations or policies supported PPE use at their workplace (Table 2).

3.3 Availability of PPE among sanitation workers

Most respondents, 83.2% (347/417) reported that the PPE was available at their workplaces. These included durable gloves 90.8% (315/347), water proof boots 85.9% (298/347), and overalls 82.4% (286/347). The majority of respondents, 61.3% (213/347) mentioned that they bought the PPE themselves, while the others mentioned that PPE was provided by the fecal management plant/employer.

TABLE 2 Awareness of PPE.

Variable	Attribute	Frequency (n = 417)	Percentage (%)
Aware of any PPE needed for working in the fecal sludge establishment	Yes	415	99.5
	No	2	0.5
PPE known (n = 415)[a]	Durable gloves	397	95.7
	Safety glasses	66	15.9
	N95 Mask	83	20.0
	Respirators	59	14.2
	Ear muffs/plugs	5	1.2
	Face mask	190	45.8
	Water proof boots	377	90.8
	Helmet	245	59.0
	Overalls	368	88.7
Had received PPE-use-related instructions before and/or during the assigned work	Yes	185	44.4
	No	232	55.6
Source of PPE related information (n = 185)	Co-workers	10	5.4
	Institutions (District LG/ Health facilities/ NGOs)	21	11.4
	Self-initiative	5	2.7
	Workplace management	149	80.5
Had undertaken any PPE-related training	Yes	236	56.9
	No	181	43.1
PPE reduced the risk of exposure to biohazards	Yes	405	97.6
	No	12	2.4
Presence of any regulations or policies that support PPE use at work place	No	190	45.6
	Yes	227	54.4
Mandatory to use PPE at work place	No	110	26.4
	Yes	307	73.6

[a]Multiple choice question.

3.4 Utilization of PPE among sanitation workers

Most respondents, 92.6% (386/417) reported having ever worn PPE while working. The reported prevalence of consistent PPE use in the previous 30 days was 60.7% (253/417), while 89.2% (372/417) utilized PPE at least once in the previous 30 days. The respondents who utilized PPE at least once a month wore PPE because it offered protection from occupational hazards (93.3%, 348/372), and the most preferred PPE to wear in the previous 30 days was waterproof durable gloves, 82.5% (308.372). However, for the respondents that were not using PPE, 61.3% (19/31) mainly highlighted that the PPE was not provided to them, and 54.8% (17/31) said that PPE was hard to get and expensive (Table 3).

Additionally, Table 4 presents the distribution of consistent personal protective equipment (PPE) use among sanitation workers by job role. Workers involved in transportation of fecal waste reported the highest proportion of consistent PPE use (63.4%, n = 118), followed by those in treatment roles (60.0%, n = 54). Conversely, workers involved in disposal activities reported the lowest level of consistent PPE use (47.4%, n = 64).

3.4.1 Factors associated with consistent use of PPE among sanitation workers

At multivariable analysis, respondents who experienced work-related illness in the previous six months were less likely to use PPE compared to their counterparts (AOR = 0.39, 95% CI: 0.23–0.66). The odds of PPE use among respondents who reported the presence of occupational health and safety officer or personnel at the fecal waste management plant were 2.32 times higher than those of their counterparts (AOR = 2.32, 95% CI: 1.34–4.02). The odds of PPE use among respondents who mentioned that some regulations or policies support PPE use at the workplace were 2.85 times that of their counterparts (AOR = 2.85, 95% CI:1.50–5.39). The odds of PPE use among respondents who reported that it was mandatory to use PPE at their workplace were 2.22 times more than their counterparts (AOR = 2.22, 95% CI: 1.17–5.38) (Table 5).

4 Discussion

This study assessed the utilization of PPE among sanitation workers in fecal waste management plants in nine regional cities in Uganda. Majority (60.7) of the sanitation workers consistently utilized PPE in the previous 30 days. Consistent PPE utilization was associated with the presence of occupational health and safety officers, regulations that support PPE use, and mandatory PPE use at fecal waste management plants. Additionally, the odds of consistent PPE use were lower among those experienced work-related illness in the previous 6 months compared to those their counterparts. These findings could be used by public health policymakers, administrators of fecal waste management plants, local authorities, sanitation worker associations, and other

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TABLE 3 Utilization of PPE.

Variable	Attribute	Frequency (n = 417)	Percentage (%)
Ever worn PPE when working	Yes	386	92.6
	No	31	7.4
Consistent utilization of PPE in the previous 30 days	No	164	39.3
	Yes	253	60.7
Utilized PPE at least once in the previous 30 days	Yes	372	89.2
	No	45	10.8
Reasons for PPE use in the last 30 (n = 372) days *	Directive from the employer	132	35.5
	Protection from occupational hazards	348	93.6
	Directive from a trainer	40	10.8
	Advice from family/friends/co-worker	46	12.4
	Following occupational health and safety guidelines	55	14.8
	Felt comfortable	38	10.2
	PPE was available	50	13.4
Preferred PPE to wear in the previous 30 days (n = 372) *	Waterproof durable gloves	308	82.5
	Safety glasses	36	9.7
	Facemasks/respirators	132	35.5
	Safety helmet	103	27.7
	Waterproof boots/foot wear	270	72.6
	Liquid repellent overalls	55	14.8
	Cloth overalls	268	72.0
Reasons for the preferred PPE *	Cheap	14	3.8
	Accessible	88	23.7
	Comfortable	122	32.8
	Easy to wear and easy to remove	101	27.2
	Increases work efficiency	196	52.7
	Health and safety	74	20.0
	Work regulations	8	2.2
PPE often used*	Waterproof durable gloves	315	84.7
	Safety glasses	23	6.2
	N95 Facemasks/respirators	84	22.6
	Safety helmet	77	20.7
	Waterproof boots/footwear	295	79.3
	Liquid repellent overalls	35	9.4
	Cloth overalls	301	80.9
PPE handling after use*	Disinfection	87	23.4
	Washing with water and soap	307	82.5
	Washing without water and soap	55	14.8
	Disposed of	31	8.3
	Burning	4	1.1
	Keeping for further use	111	29.8
	Not washed 4	29	7.8
Reasons for nonuse of PPE (n = 31) *	Uncomfortable	4	12.9
	It made them sick/increased exposure	12	38.7
	Useless and reduced their work efficiency	5	16.1
	Getting PPE is hard and expensive	17	54.8
	Not provided	19	61.3
Reasons for nonuse of PPE atleast once in the previous 30 days * (n = 45)	Uncomfortable	10	22.2
	Getting PPE is hard and expensive	17	37.8
	Inconveniencing	10	22.2
	Not provided	24	53.3
	Lacked money for buying	14	31.1
Face any limitations to PPE use (n = 370)	Yes	178	48.1
	No	192	51.9
Limitations faced towards PPE use*	Can't afford it	48	27.0
	Beliefs at my work place	2	1.1
	Discomfort	115	64.6
	Inconvenience	68	38.2
	Carelessness	10	5.6
	Forgetfulness	26	14.6

* means multiple choice questions.

TABLE 4 PPE utilization by job.

Job Role	Consistent PPE Use *n* (%)
Collection	123 (58.3)
Emptying	141 (54.7)
Transportation	118 (63.4)
Treatment	54 (60.0)
Disposal	64 (47.4)
Overall Consistent PPE Use	253 (60.7)

stakeholders to strengthen policies aimed at improving utilization of PPE among sanitation workers.

According to the study findings, over 60.7% of sanitation workers consistently used PPE in the previous 30 days. This level of PPE use is suboptimal as about only 6 in 10 of the sanitation workers consistently used PPE because PPE serves as an important barrier between workers and biohazards. This could even be an over estimate since the results PPE use was determined using self-reports, which are prone to social desirability bias. However, these findings, are similar to those of an Ethiopian study, which found that only 55% of sanitation workers reported using PPE while working (21). Despite the suboptimal use of PPE, more than 83.2% of sanitation workers reported having access to PPE at fecal waste management plants. This implied that the mere presence of PPE did not guarantee high levels of PPE utilization. Therefore, continuous training of sanitation workers on occupational health should be conducted routinely to equip them with knowledge of the importance of PPE use. In addition, Fecal waste management plants and other stakeholders should establish interventions aimed at increasing knowledge and awareness among sanitation workers on PPE use which may translate into improved practices.

The study also revealed that individuals who experienced work-related illness had significantly lower odds of (AOR = 0.39) of consistent PPE use compared to those who did not experience work-related illness. This suggests a strong protective effect of PPE in the workplace, indicating that regular use can substantially reduce the risk of health issues. Similar findings have been reported in several studies among sanitation workers and other professions including construction workers, industrial workers, and agricultural workers (22–24). Additionally, a study conducted by Smith et al. (2021) found that consistent PPE use among healthcare workers reduced the incidence of respiratory infections by 45% (22). This finding underscores the significance of promoting and enforcing the consistent adoption of PPE across various fecal waste management plants to mitigate the risk of health issues arising from exposure to workplace hazards. The study revealed that the odds of consistent PPE use were 2.32 times higher among respondents who reported the presence of occupational health and safety personnel at the fecal waste management plant compared to their counterparts. These occupational health officers are responsible for educating and supervising workers regarding PPE use (25). These findings are similar to a study conducted in Ethiopia among sanitation workers which revealed presence of and supervision by a safety officer at the plant was attributed to good occupational health practices such as PPE utilization (21). This underscores the importance of having dedicated safety personnel to oversee and enforce PPE use. Therefore, fecal waste management plants should establish and prioritize supervisory and enforcement structures that favor PPE use. Implementing such structures not only promotes worker safety but also ensures compliance with health regulations. Although this study highlights PPE use among sanitation workers, it does not specifically examine the different risks faced across various job roles. Given the range of tasks involved, from handling fecal sludge to transporting, waste exposures are likely vary. Therefore, further research is needed to understand these role-specific hazards and inform more targeted protective measures.

This study revealed that presence of rules and regulations that support PPE use was significantly associated with PPE use. The findings of this study underscore the critical role of rules and regulations in promoting personal protective equipment (PPE) use among sanitation workers. These findings are similar to those in a study conducted in Kampala that revealed that presence of sustained availability of guidelines and policies was highly attributed to PPE use among workers (26). However, presence of the guidelines should be coupled with guideline adherence by the workers or enforcement by the management for efficiency (27). Still in our study, sanitation workers who reported that these guidelines mandatory use of PPE at the workplace had higher odds (AOR: 2.22) of consistent PPE use compared to where guidelines were not mandatory. This implies that when PPE utilization policies are enforced as a workplace requirement, workers were more likely to consistently utilize it (27). Therefore, there should be development, adoption and enforcement operational guidelines to assess and mitigate the occupational risks of all types of sanitation work, including national and local level standard operating procedures (28). Additionally, there should be municipal-level oversight and enforcement of laws regarding sanitation workers at fecal waste treatment plants and other private sanitation service providers (28).

4.1 Limitations

Our study had several limitations. First, there was potential for recall bias, as participants were required to remember PPE use and occupational events that occurred over the past 30 days. Second, self-reported PPE utilization may have introduced social desirability bias, where participants might have over-reported PPE use to align with perceived expectations. However, we took several measures to minimize bias. These included establishing rapport with participants, conducting interviews in privacy, and assuring confidentiality and emphasizing that the data collected was for research purposes. Additionally, proportionate sampling may have led to overrepresentation of larger fecal waste treatment facilities, which are more likely to have structured occupational safety and health (OSH) programs. This could have biased results toward higher PPE utilization rates. Despite these limitations, the study results give a current assessment of the state of PPE utilization among sanitation workers in Ugandan cities. These findings could be used to inform policy and interventions to improve occupational health among sanitation workers in Uganda and other LMICs.

TABLE 5 Factors associated with utilization of personal protective equipment among sanitation workers in fecal waste management plants.

Variable	Attribute	PPE Utilization		Unadjusted OR (95% CI)	*P*-value	Adjusted OR (95% CI)	*P*-value
		No (*n* = 164)	Yes (*n* = 253)				
Sex	Female	10 (47.6)	11 (52.4)	1			
	Male	154 (38.9)	242 (61.1)	1.14 (0.87–1.25)	0.427		
Age (years)	≤30	80 (41.2)	114 (58.7)	1			
	31- 45	69 (40.8)	100 (59.17)	1.02 (0.67–1.55)	0.937		
	>45	15 (27.8)	39 (72.2)	1.82 (0.94–3.53)	0.074		
Religion	Anglican	42 (34.7)	79 (65.3)	1			
	Pentecostal/Born again	23 (45.1)	28 (54.9)	0.65 (0.33–1.26)	0.201		
	Roman catholic	67 (43.5)	87 (56.5)	0.69 (0.42–1.13)	0.139		
	Muslim	32 (35.2)	59 (64.8)	0.98 (0.55–1.73)	0.945		
Current marital status	Cohabiting/ Married	112 (37.3)	188 (62.7)	1		1	
	Separated/ Divorced/ Widowed	15 (60.0)	10 (40.0)	0.40 (0.17–0.91)	**0.030**	0.64 (0.23–1.75)	0.388
	Single	37 (40.2)	55 (59.8)	0.89 (0.55–1.43)	0.618	0.64 (0.36–1.14)	0.132
Had dependents	No	17 (45.9)	20 (54.1)	1			
	Yes	147 (38.7)	233 (61.3)	1.34 (0.68–2.66)	0.389		
Highest education level	No formal education	4 (50.0)	4 (50.0)	1			
	Primary level	65 (47.1)	73 (52.9)	1.12 (0.27–4.67)	0.873		
	Secondary level	68 (36.4)	119 (63.6)	1.75 (0.42–7.22)	0.439		
	Tertiary	27 (32.1)	57 (67.9)	2.11 (0.49–9.09)	0.316		
Work shift	Both	53 (49.5)	54 (50.5)	1		1	
	Day/night	111 (35.8)	199 (64.2)	1.76 (1.13–2.74)	**0.013**	1.25 (0.71–2.21)	0.441
Work duration (hours)	≤8	99 (43.6)	128 (56.4)	1			
	>8	65 (34.2)	125 (65.8)	1.49 (0.99–2.22)	**0.051**		
Period working at fecal waste treatment plant (years)	≤5	113 (39.8)	171 (60.2)	1			
	>5	51 (38.4)	82 (61.7)	1.06 (0.69–1.62)	0.779		
Had another occupation	No	82 (37.9)	134 (62.1)	1			
	Yes	82 (40.8)	119 (59.2)	0.89 (0.59–1.32)	0.554		
Average monthly income (US dollars)	Less than 132	117 (43.2)	154 (56.8)	1		1	
	132–264	38 (31.9)	81 (68.1)	1.62 (1.03–2.55)	**0.037**	0.92 (0.52–1.620)	0.770
	Above 132	9 (33.3)	18 (66.7)	1.52 (0.66–3.50)	**0.326**	1.26 (0.46–3.47)	**0.657**
Heard about any occupational biohazards	No	24 (54.6)	20 (45.4)	1		1	
	Yes	140 (37.5)	233 (62.5)	1.99 (1.06–3.75)	0.031	1.36 (0.18–10.02)	0.765
Aware of any occupational biohazards	No	27 (54.0)	23 (46.0)	1		1	
	Yes	137 (37.3)	230 (62.7)	1.97 (1.09–3.57)	0.025	1.45 (0.21–9.98)	0.706
Thought at risk of being affected by occupational biohazards	No	28 (47.5)	31 (52.5)	1			
	Yes	136 (37.9)	222 (62.1)	1.47 (0.85–2.57)	0.169		
Experienced any work-related illness in the last 6 months	No	90 (34.6)	170 (65.4)	1		1	
	Yes	74 (47.1)	83 (52.9)	0.59 (0.39–0.88)	0.012	0.39 (0.23–0.66)	<0.001
Knew about any occupational health and safety guidelines relating to sanitation work	No	73 (60.8)	47 (39.2)	1		1	
	Yes	91 (30.6)	206 (69.4)	3.52 (2.26–5.47)	**<0.001**	1.40 (0.76–2.56)	0.279
Knew that there were occupational health and safety guidelines at the plant that were used.	No	116 (52.7)	104 (47.3)	1		1	
	Yes	48 (24.4)	149 (75.6)	3.46 (2.28–5.26)	<0.001	0.97 (0.55–1.71)	0.911
Important to observe occupational health and safety at the work place	No	6 (75.0)	2 (25.0)	1		1	
	Yes	158 (38.6)	251 (61.4)	4.77 (0.95–23.91)	0.058		
Presence of occupational health and safety officer or personnel at the fecal waste management plant	No	118 (59.9)	79 (40.1)	1		1	
	Yes	46 (20.9)	174 (79.1)	5.65 (3.67–8.70)	**<0.001**	2.32 (1.34–4.02)	**0.003**
Knew any PPE needed for working in the fecal sludge establishment	No	1 (50.0)	1 (50.0)	1			
	Yes	163 (39.3)	252 (60.7)	1.55 (0.09–24.89)	0.759		
Received PPE-use-related instructions before and/or during your assigned work	No	119 (51.3)	113 (48.7)	1		1	
	Yes	45 (24.3)	140 (75.7)	3.27 (2.15–5.00)	**<0.001**	1.36 (0.79–2.36)	0.271
Undertaken any PPE-related training	No	103 (56.9)	78 (43.1)	1		1	
	Yes	61 (25.9)	175 (74.1)	3.79 (2.50–5.70)	**<0.001**	1.25 (0.72–2.15)	0.428

(*Continued*)

TABLE 5 Continued

Variable	Attribute	PPE Utilization		Unadjusted OR (95% CI)	*P*-value	Adjusted OR (95% CI)	*P*-value
		No (*n* = 164)	Yes (*n* = 253)				
PPE can reduce the risk of exposure to biohazards	No	8 (80.0)	2 (20.0)	1			
	Yes	155 (38.3)	250 (61.7)	6.45 (1.35–30.76)	**0.019**	4.00 (0.63–25.23)	**0.140**
Regulations or policies that support PPE use at the workplace	No	116 (61.7)	72 (38.3)	1		1	
	Yes	47 (20.7)	180 (79.3)	6.17 (3.99–9.54)	**<0.001**	2.85 (1.50–5.39)	**0.001**
Mandatory to use PPE at the workplace	No	78 (72.2)	30 (27.8)	1		1	
	Yes	85 (27.7)	222 (72.3)	6.79 (4.16–11.08)	**<0.001**	2.22 (1.17–5.38)	**0.015**
PPE available at the workplace	No	40(57.1)	30(42.9)	1		1	
	Yes	124(35.7)	223(64.3)	2.40(1.42–4.04)	**0.001**	0.93(0.45–1.93)	**0.852**

Bold indicates *P*-value less than 0.05.

5 Conclusions

This study revealed suboptimal PPE utilization among sanitation workers in fecal-waste management plants in Uganda. Consistent PPE utilization was associated with the presence of occupational health and safety officers, regulations that support PPE use, and mandatory PPE use at the fecal waste management plants. The study findings also showed that those who experienced occupational related illnesses had lower odds of using PPE compared to their counterparts. Therefore, fecal waste management plants should establish and prioritize supervisory and enforcement structures that favor PPE use which in turn reduces exposure to hazards and occupational related illnesses.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: https://figshare.com/s/85a9598fdbc0dce52383.

Ethics statement

The studies involving humans were approved by Makerere University School of Public Health Research Ethics Committee. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

DB: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. LRN: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Resources, Supervision, Writing – original draft, Writing – review & editing. BT: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing. JB: Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. LNN: Methodology, Writing – original draft, Writing – review & editing. FN: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. RN: Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing, Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources. DM: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Correction Note

This article has been corrected with minor changes. These changes do not impact the scientific content of the article.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

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