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Occupational hazards and community-based safety practices among sanitation workers Implications for social and environmental sustainability

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ABSTRACT

Background: This study investigated occupational exposures experienced among sanitation workers in the Accra Metropolitan Area (AMA), Ghana. Despite performing essential functions that sustain urban hygiene and public health, sanitation workers often neglect their occupational health risks. This study explored the types and frequency of hazards faced by sanitation workers at AMA. **Methods:** Using a descriptive cross-sectional design, data were collected from 277 sanitation workers through a structured questionnaire. The analysis of the data involved both descriptive and inferential statistics. **Findings:** The study revealed that a majority of the sanitation workers were routinely exposed to hazards, including cuts, heat stress, dust inhalation, and contact with human waste. The study revealed that over 70% of the respondents had experienced work-related illnesses or injuries. Inferential analysis showed statistically significant relationships between consistent PPE usage and lower injury rates ($p < 0.001$), frequency of exposure and illness ($p = 0.027$), and experience level and health outcomes ($p = 0.048$). The study also exposed inequities in PPE access, especially among contract and casual workers. **Conclusion:** The study, therefore, recommends the establishment of inclusive safety policies aligned with national occupational health frameworks and the Sustainable Development Goals for sanitation workers in Ghana. **Novelty/Originality of this article:** The findings underscore the urgent need for systemic reforms in sanitation work policy in Ghana and other developing countries.

KEYWORDS: heat stress, informal employment, occupational health, PPE, urban sanitation.

1. Introduction

Sanitation work is indispensable to public health, particularly in rapidly urbanizing cities of low- and middle-income countries. These workers provide essential services that support urban living by removing waste, maintaining drainage systems, cleaning streets, and managing human waste. Nevertheless, they often do so under conditions that pose serious occupational health risks. In many African countries, including Ghana, sanitation work is usually informal and under-regulated, leading to routine exposure to hazardous substances and disease-causing agents without adequate protection or recognition (Satterthwaite, 2021).

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Occupational exposure among sanitation workers can be classified into physical, chemical, biological, and psychosocial hazards (Rai et al., 2021; Oza et al., 2022). Physically, workers are at risk of injuries from lifting heavy loads, sharp objects, and slips or falls in wet or poorly lit environments. Chemically, they may come into contact with cleaning agents, pesticides, and other toxic substances that can cause skin irritation, respiratory distress, or chronic illnesses. Biologically, the handling of human waste, decomposing materials, and used medical products exposes them to pathogens that cause diseases such as hepatitis A and B, leptospirosis, cholera, and helminth infections (Bagade & Doke, 2024). In some documented cases, sanitation workers have tested positive for pathogens such as E. coli, Salmonella, and Mycobacterium tuberculosis (Oza et al., 2022).

Consequently, a study conducted in India found that nearly 90% of sanitation workers had experienced at least one health problem linked to their occupation, including respiratory issues, dermatitis, and musculoskeletal pain (Tolera et al., 2023b). Similar patterns have been observed in Kenya and Nigeria, where high levels of exposure have been attributed to a lack of training, poor enforcement of safety regulations, and minimal use of personal protective equipment (PPE) (Ebekozien, 2022; Venkataraman et al., 2023). In the context of Ghana, particularly in the Accra Metropolitan Area, sanitation services are a combination of formal and informal operations, often outsourced to private waste management companies or local contractors. Workers frequently earn low wages, have irregular working hours, and receive limited benefits. The lack of institutional oversight means that health and safety protocols are inconsistently applied. Accordingly, a significant proportion of sanitation workers in Accra have no access to healthcare benefits or sick leave (Lissah et al., 2022; Dery et al., 2023). This socio-economic vulnerability further compounds their health risks, as they are less likely to seek medical help when symptoms emerge.

Preventive practices such as the use of gloves, boots, face masks, and protective clothing are often cited as necessary for reducing exposure. However, the actual situation presents a different picture. A study by Lissah et al. (2022) observed that only 35% of sanitation workers in the Greater Accra Region consistently used PPE. Factors such as discomfort, heat stress, unavailability, and lack of awareness contributed to low compliance. Even when provided, PPE is often substandard or poorly maintained, making it ineffective (Dallas et al., 2021). Moreover, most workers receive little to no training on occupational safety, instead relying on experience or informal advice from peers. Beyond physical and biological hazards, sanitation workers also face psychosocial risks. These include social stigma, discrimination, and psychological stress. In Ghana and in many African contexts, sanitation work is often associated with low status. Workers may be publicly ridiculed, socially isolated, or even physically assaulted while on the job. This stigmatization has mental health implications, contributing to anxiety, depression, and low self-esteem (Koschorke et al., 2022). Therefore, addressing occupational health risks necessitates not only technical interventions but also social and cultural shifts in the perception of these essential workers.

Globally, there has been growing attention to the plight of sanitation workers. The World Health Organisation (WHO) and the International Labour Organisation (ILO) have jointly advocated for the formalisation of sanitation work, improved safety regulations, and integration of occupational health into municipal services. Subsequently, in its guidelines for the health and safety of sanitation workers, the World Health Organization (2021) calls for regular health screenings, the provision of appropriate PPE, training on safe practices, and institutional mechanisms to report and redress workplace hazards. Despite these international calls to action, local implementation remains a challenge. In Accra, policies exist on occupational health and waste management, but gaps in enforcement, budgeting, and monitoring continue to expose workers to undue harm. The lack of research and surveillance systems means that authorities often lack the data necessary to drive improvements. It is within this context that this study becomes essential. By identifying the most prevalent occupational exposures, this study provides empirical evidence that can inform policy reforms and targeted interventions. Additionally, it serves to amplify the voices of sanitation workers whose health, dignity, and safety are fundamental to urban

sustainability.

Sanitation workers form the backbone of urban hygiene and public health infrastructure. Their work, ranging from waste collection and street sweeping to drain cleaning and latrine management, is essential for maintaining a clean and liveable urban environment. However, these workers often perform their duties under conditions that are dangerous, degrading, and largely overlooked by public policy and academic research. Sanitation workers in Ghana, especially in AMA, often encounter a range of preventable occupational hazards. These workers face a disproportionate risk of injury, infection, and long-term health complications due to the absence of adequate protection, training, and institutional support. Despite the critical nature of their work, sanitation workers in Accra operate in environments marked by poor waste segregation, open drains, inadequate waste disposal infrastructure, and high population density. These conditions increase their exposure to a range of health hazards, including sharp objects, chemical residues, human waste, and disease vectors such as flies and rodents.

2. Methods

2.1 The study setting and research design

This study was carried out in the Accra Metropolitan Area (AMA), one of Ghana's most densely populated and urbanized municipalities. As the political and economic capital of Ghana, Accra generates significant quantities of solid and liquid waste, necessitating a large and diverse sanitation workforce. Both public and private sectors employ sanitation workers in the AMA under a variety of arrangements, such as full-time, casual, and contract-based roles. These workers operate in different environments such as streets, markets, drains, and public toilet facilities, providing a wide spectrum of occupational exposure scenarios. In addition, the study employed a quantitative cross-sectional design. This approach was appropriate for capturing data at a single point in time regarding the prevalence and patterns of occupational exposures, awareness of health risks, use of preventive practices, and the availability and use of PPE among the sanitation workers (Young et al., 2022; Masirika et al., 2024). Additionally, the study utilized a structured, closed-ended questionnaire to gather numerical data, which was subsequently subjected to statistical analysis to identify trends, frequencies, and relationships among key variables.

2.2 Data collection and processing

The study's target population comprised sanitation workers actively engaged in sanitation-related duties within AMA during the research period. These included individuals involved in street sweeping, drain cleaning, public toilet management, landfill work, and waste collection. Workers were drawn from public institutions such as the AMA, private sanitation contractors, and informal sector operatives. A simple random sampling technique was employed to ensure that each sanitation worker within the selected clusters had an equal and independent chance of being included in the study. A sampling frame was first developed in collaboration with sanitation supervisors and company rosters across sub-metropolitan zones of the AMA. Each eligible worker was assigned a number, and random numbers were generated using a random number table to select participants. This method minimised selection bias and enhanced the representativeness of the sample.

Recruitment was conducted through field visits, with support from team leaders and sanitation coordinators. Workers were approached at designated points such as waste collection centres, meeting points, and work zones. The study's purpose was explained, and those who gave informed consent were enrolled and guided through the questionnaire process. The study involved only sanitation workers who were at least 18 years of age and had a minimum of six months of continuous work experience in the sanitation sector within AMA. These criteria were set to ensure that participants had sufficient exposure to the occupational environment and could provide meaningful responses based on their

experiences. A total of 277 sanitation workers who met the eligibility requirements participated in the study. To determine the appropriate sample size for the study, Yamane's (1967) formula was used. This formula is widely adopted in public health studies where the population is known, and a simple random sampling approach is employed. The formula expresses as:

$$n = \frac{N}{1+N(e)^2} \quad \text{(Eq.1)}$$

Where n represents the sample size, N represents the population size, and e represents the margin of error (typically 0.05 for a 95% confidence level). According to estimates provided by AMA and waste management firms, the total population of active sanitation workers in the metropolis was 950. Therefore, applying Yamane's formula for sample size.

$$n = \frac{950}{1+950(0.05)^2} = 281 \quad \text{(Eq.2)}$$

The calculated minimum sample size was 281. However, due to field constraints such as absenteeism, refusals, and scheduling conflicts, the final number of completed and valid questionnaires was 277, which still falls within the acceptable range and provides sufficient power for the planned analyses. Several measures were implemented to ensure data quality and consistency. The questionnaire was pretested with a small group of sanitation workers outside the sample population to refine language and ensure clarity. Research assistants underwent training on ethical conduct, data collection techniques, and standard operating procedures. Data was reviewed at the end of each day to ensure completeness and accuracy. Inconsistencies and missing responses were addressed promptly through clarification with respondents. All data was double entered into a secure electronic database to reduce the risk of transcription errors.

Although the study used a structured questionnaire with predefined options, steps were taken to ensure both reliability and validity. Reliability was supported by consistent use of the same instrument across all respondents, administered by trained personnel under similar conditions. Content validity was ensured by aligning the questionnaire with the study objectives and by consulting experts in occupational health and waste management. The face validity of the instrument was also enhanced through pilot testing and feedback from the target population. Where possible, responses were cross-checked with observational data and supervisor inputs for further accuracy. Subsequently, the data were analzsed using Statistical Package for the Social Sciences (SPSS) version 26, and to validate the research instrument, all questions with a scale were subjected to reliability tests using Cronbach's Alpha. A Cronbach's Alpha of at least 0.700 is acceptable, as it reflects the internal consistency of the research instrument in measuring the same constructs. Descriptive statistics such as means, frequencies, and percentages were used to summarize the data. Inferential analysis, using chi-square tests, was employed to examine relationships between categorical variables such as experience and reported illness, gender and injury occurrence, and employment category and PPE provision. The results were presented in tables and graphs to illustrate patterns and highlight the key findings.

3. Results and Discussion

This section presents the results of data collected from 277 sanitation workers within AMA. The data were analyzed based on the themes structured in the questionnaire: demographic characteristics and exposures experienced by sanitation workers with AMA.

3.1 Preliminary analysis

Cronbach's Alpha is a measure of internal consistency, indicating how closely related a set of items is as a group, with values ranging from 0 to 1. Higher values suggest greater reliability, with a commonly accepted threshold of 0.70 or above indicating acceptable reliability. The construct "occupational exposures experienced by sanitation workers in Accra Metropolitan Area" has a Cronbach's Alpha of 0.714. This value was above the 0.70 threshold indicating acceptable reliability. This indicates that the variables used to assess the occupational exposures experienced by sanitation workers in AMA were reasonably consistent, though there could be some room for improvement in the scale's design or item selection.

3.2 Demographic information of respondents

The age distribution indicated that most respondents were within the 36–45 age group, accounting for 29.2% of the sample, as shown in Figure 1. This indicates that the sanitation workforce in AMA was predominantly composed of individuals in their prime working years, which can be advantageous in handling physically demanding tasks. However, a notable 10.1% of the workforce was over 55, indicating a need for workplace accommodation for older workers. The relationship between the age of sanitation workers and their work is complex. Research indicates that older sanitation workers may face increased health risks or discrimination, impacting quality of life and work practices, with age often intersecting with other factors like gender, poverty, and access to protective equipment to create inequities in the informal sanitation sector (Oza et al., 2022; Tolera et al., 2023a). Older workers face increased risks of Musculoskeletal Disorders (MSDs) due to the physical demands of the job and potentially less effective PPE use over time. Overall, the age-related health impacts on sanitation workers are significant, with older age being a strong predictor of occupational injuries and MSDs (Das & Singh, 2025).

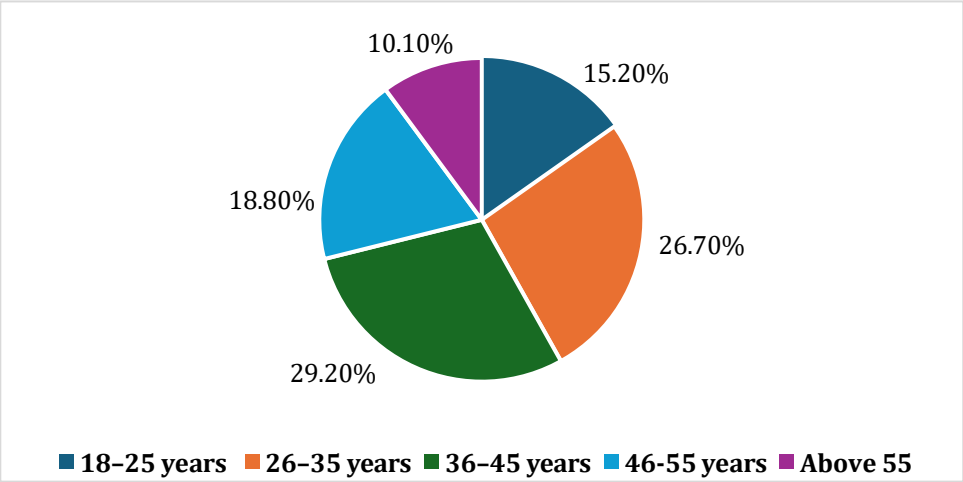

Fig. 1. The age distribution of the respondents

Furthermore, the study results revealed that 56.7% of the workforce at AMA was male, and the remaining 43.3% was female. This indicates a fairly balanced gender distribution of the workforce. However, in terms of exposures, female sanitation workers, especially in informal sectors, face unique exposures beyond typical physical hazards, including increased risks of stigma, discrimination, emotional distress, and sexual harassment (Monteiro & Nalini, 2021; Dery et al., 2023). While both sexes experience injuries, infections, and musculoskeletal issues, women are disproportionately affected by gender-based violence and social factors that can lead to unsafe work practices and unhealthy coping mechanisms, such as refusing PPE or working at night (Leslie et al., 2025).

Regarding the education level of the respondents, the data revealed that a significant number had only a basic education, with 28.5% having completed Junior High School and 22.0% having primary education, as shown in Figure 2. Only 7.9% had a tertiary education, which could limit access to higher-paying or supervisory roles. The relatively low education levels suggest that many of the workers could have a limited understanding of safety signage or technical instructions unless training is adapted to their comprehension levels. Accordingly, a higher education level in sanitation workers is associated with increased awareness of health hazards, better use of PPEs, and more adherence to safety practices, which in turn can reduce their exposure to diseases and occupational risks (Degavi et al., 2021; Alam et al., 2022; Sharior et al., 2023). Conversely, Geleta et al. (2021) suggest that lower education levels correlate with less awareness of hazards and a greater likelihood of experiencing morbidities and health issues due to improper or insufficient safety practices. Therefore, safety training that uses simple language and visuals can be employed to train the majority of the workers at AMA who have a very low educational background. Additionally, empowering workers through adult literacy and development programs could enhance workplace communication and safety outcomes.

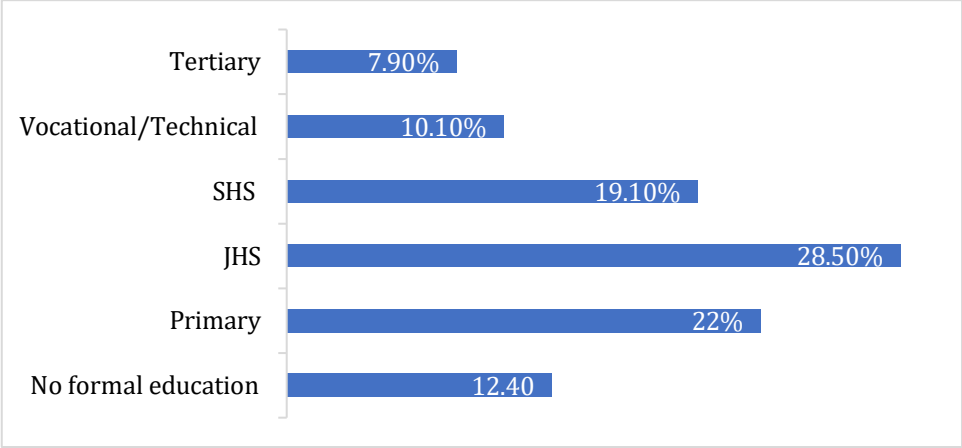

Fig. 2. Educational level of the respondents

Furthermore, the study revealed that 69.7% of the respondents (69.7%) held full-time employment, indicating a relatively stable workforce, as illustrated in Figure 3. However, the presence of part-time, casual, and contract-based workers, all making up 30.3%, points to employment vulnerability among a segment of the workforce. Casual and contract workers may lack benefits such as health insurance, paid leave, or consistent access to PPE. This employment diversity may result in varied levels of exposure and health risk. Occupational health policies must be inclusive of all employment types to ensure equity in protection and support.

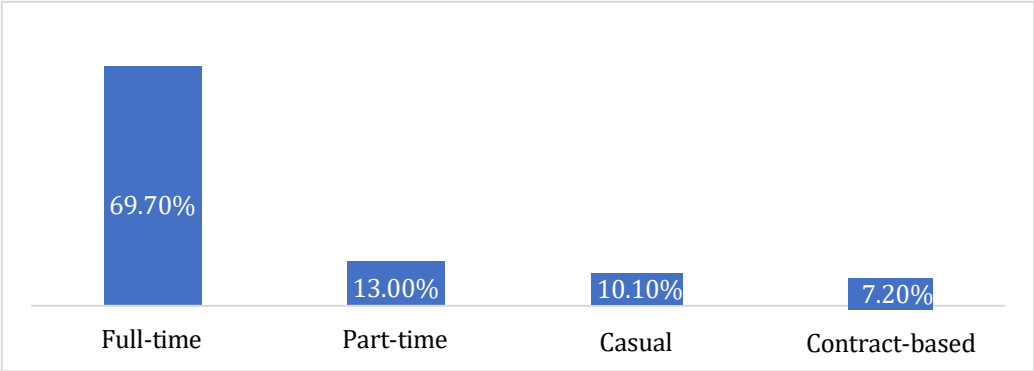

Fig. 3. Employment status of the sanitation workers at AMA

Also, nearly half of the respondents (29.3%) had more than 4-6 years of experience in

sanitation work, as shown in Figure 4. This suggests deep familiarity with job routines and hazards, which can be beneficial in hazard recognition. However, prolonged exposure to occupational hazards also increases cumulative health risks. Consequently, Oza et al. (2022), postulate that sanitation workers' experience shows a complex, sometimes direct correlation with increased exposure and health risks, but the relationship can be nuanced, with Bălă et al. (2021) indicating that while longer working experience is linked to higher rates of respiratory symptoms and potentially other health issues, other factors like inadequate PPE use (often due to stigma or lack of provision), exposure to confined spaces, and social factors (like gender discrimination or caste) also significantly influence the types and severity of exposures workers face. Thus, newer workers at AMA, workers who had been working for less than 1 year, representing 7.6%, may lack the experience to recognize and avoid certain hazards, making them more vulnerable. Tailored induction training for new workers and refresher courses for long-term staff can bridge this experience gap.

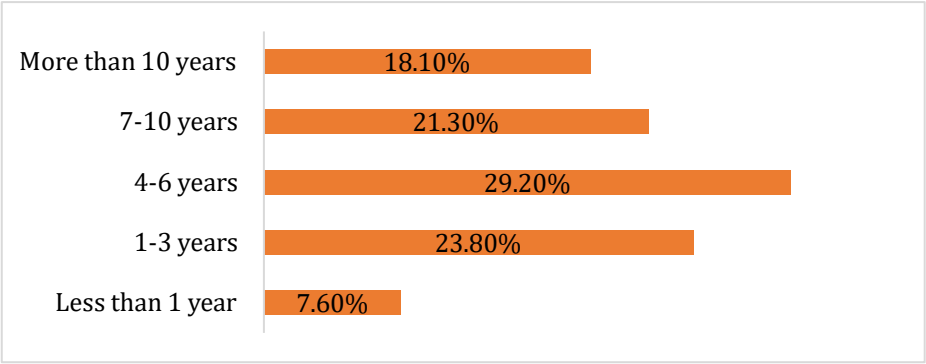

Fig. 4. Years of experience of the respondents

3.3 Areas of sanitation work at AMA

The major sanitation work area at the AMA was street sweeping, with 28.5% of the workers engaged in it, whereas the least work area was other work, with 9.0% of the workers involved in this area, as shown in Figure 5. The relationship between a sanitation worker's work area and the exposures they experience is direct and significant, with specific environments like sewage treatment plants, waste sorting facilities, and areas with informal sanitation presenting higher risks for exposure to biological pathogens, chemicals, gases (like hydrogen sulfide), and dust (Alam et al., 2022; Tolera et al., 2023a).

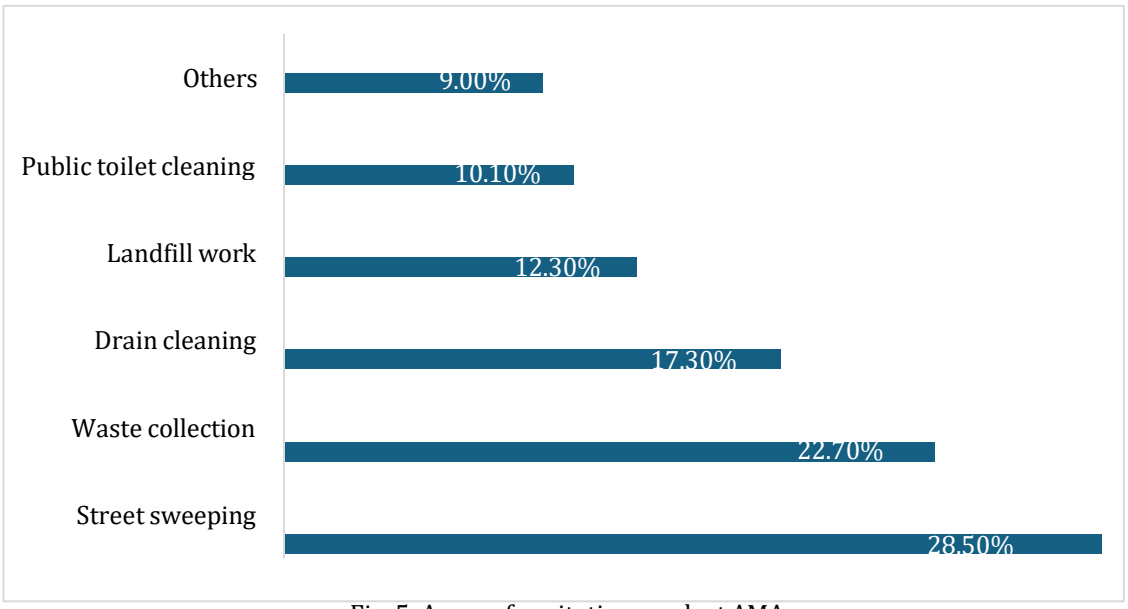

Fig. 5. Areas of sanitation work at AMA

These exposures lead to various health problems, including respiratory issues, infections, and allergies, and are further influenced by factors such as poor working conditions, inadequate PPE, and informal labor practices, which are more prevalent in certain areas, especially in low- income settings. Therefore, the diversity in job roles at AMA calls for role-specific safety protocols in each work area.

3.4 Relationship between some categorical variables

The researchers undertook a chi-square test to compare the statistical significance between categorical variables and a goodness-of-fit test, which checks if a single categorical variable's distribution matches a known or assumed theoretical distribution. The comparison for statistical significance was made between experience and reported illness, gender and injury occurrence, and employment category and PPE provision.

3.4.1 Experience and reported illness

The significance test results from the chi-square analysis between experience and reported illness indicated a significant association, as $\chi^2 = 6.03$, $p = 0.04882$ (see Table 1 below). Accordingly, studies indicate that occupational stress increases with the duration of service (Irawanto et al., 2021; Sandoval-Reyes et al., 2021; Babapour et al., 2022), with Krishnan et al. (2021) suggest that workers with longer work experience are more likely to develop MSDs due to the cumulative physical strain of the job.

Table 1. Chi-square test results for experience and reported illness

Years of experience	Ill	Not Ill	Chi-square	DF	P-value	Significance
<3 years	43	28				
4–6 years	76	56				
7+ years	45	29	6.03	2	0.04882	Significant

P = P-value and χ^2 = test statistic

3.4.2 Gender and injury occurrence

The significance test between gender and injury occurrence produced a chi-square value of 0.82 and a p-value of 0.36614, as indicated in Table 2, which means that there is no significant association between gender and injury occurrence. However, research suggests a complex relationship between gender and injury occurrence in sanitation work, with women sometimes facing higher risks of specific types of injuries and psychosocial hazards due to factors like stigma, unsafe work practices, and specific task demands (Alda-Vidal et al., 2023; Tolera et al., 2024b). Studies in different contexts show varying injury rates between genders, with some indicating higher overall risks for women (Zech et al., 2022). In contrast, others show different patterns of musculoskeletal or acute injuries depending on the specific tasks and work environment (Odebiyi & Udoka, 2023).

Table 2. Significance test results between gender and injury occurrence

Gender	Injured	Not injured	Chi-square	DF	P-value	Significance
Male	113	43				
Female	80	40	0.82	1	0.36614	Not significant

P = P-value and χ^2 = test statistic

3.4.3 Employment category and PPE provision

With a chi-squared value of 21.51 and a p-value of 0.00008, the significance test between the employment category and PPE provision revealed a significant relationship, as shown in Table 3. This supports other research, which indicates that employment type strongly correlates with PPE provision and access for sanitation workers, with formal (e.g.,

permanent) employment often linked to better provision of PPE and safer working conditions, while informal or temporary employment typically results in less, or no, PPE provision, increased job insecurity, and greater exposure to hazards (Alam et al., 2022; Tolera et al., 2023a). In addition, Al-Bayati et al. (2023) said that factors such as the size of the employing organization, enforcement of safety protocols, and economic conditions also significantly influence PPE availability and consistent use, regardless of employment status.

Table 3. Significant association between employment category and PPE provision

Employment type	PPE provided	Not provided	Chi-square	DF	P-value	Significance
Full-time	143	50				
Part-time	24	12				
Casual	12	10				
Contract	8	18	21.51	3	0.00008	Significant

P = P-value and χ^2 = test statistic

3.5 Occupational exposures among sanitation workers in AMA

The study revealed that sanitation workers in AMA were commonly exposed to multiple hazards, including cuts, human waste, and heat stress, as over 50% of the respondents experienced heat stress, sharp object injuries, or inhaled dust and smoke, as indicated in Figure 6. This supports other research that indicate that sanitation workers experience a wide range of occupational exposures, including exposure to biological hazards (like bacteria and viruses), chemical hazards (such as cleaning agents and harmful gases like methane), physical hazards (like excessive heat, loud noise, and physical exertion), ergonomic hazards (from repetitive motions and poor posture), and psychological hazards (stemming from job dissatisfaction, low pay, and social devaluation) (Rai et al., 2021; Oza et al., 2022). These exposures can lead to serious acute and chronic health issues. Multiple exposures per worker imply that sanitation work is not only labour-intensive but also high-risk. Targeted interventions such as shaded rest areas, better waste sorting, and hazard-specific PPE are essential to prevent such hazards.

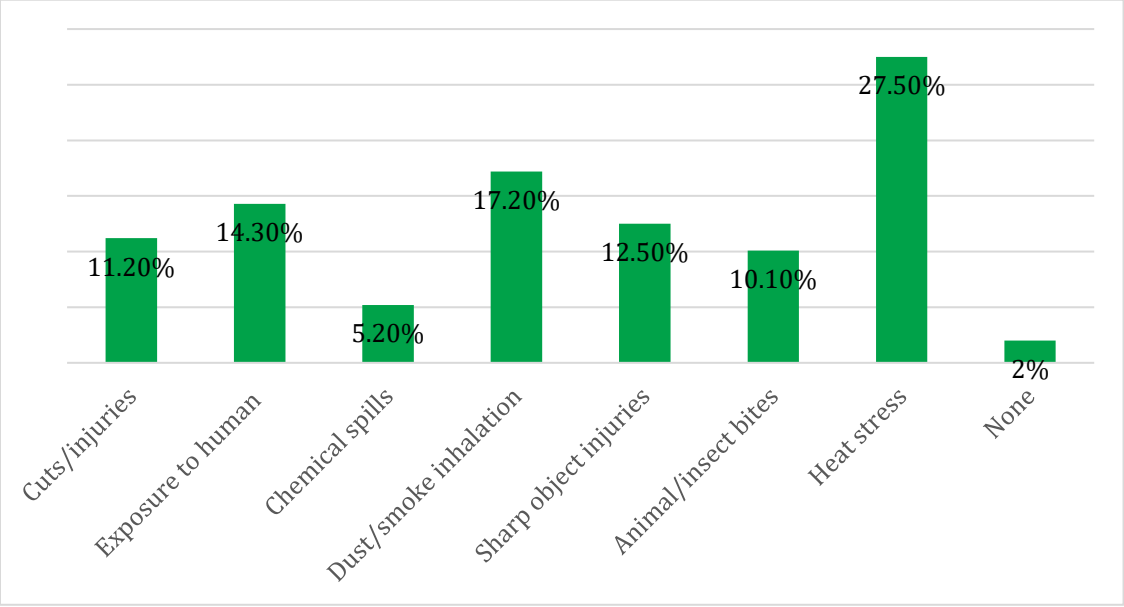

Fig. 6. Occupational exposure among sanitation workers in AMA

3.5.1 Frequency of exposure to hazards

Nearly half of the respondents (47.7%) reported daily exposure to hazards (as shown in Figure 7), highlighting the continuous nature of occupational risk among sanitation workers at AMA. Accordingly, exposure frequencies and the severity of associated health

impacts are often higher in low-income countries, linked to inadequate safety practices, limited access to PPE, and insufficient safety regulations (Rai et al., 2021). Thus, there is a need for authorities at AMA to adopt routine monitoring and risk assessments to minimize hazard frequency among the sanitation workers.

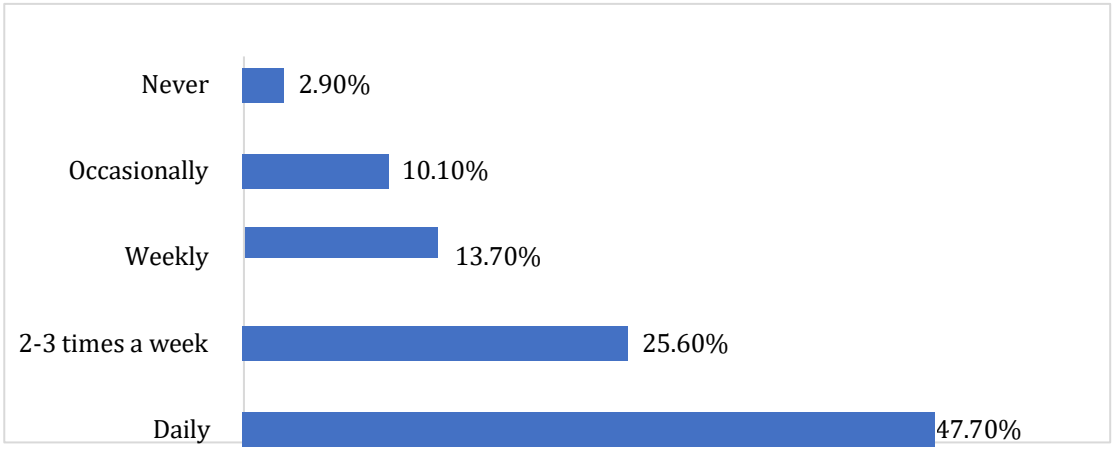

Fig. 7. Frequency of exposure to hazards among workers at AMA

3.5.2 Sanitation workers reporting ever fallen sick or injured due to work

A striking 70% of respondents admitted to being sick or injured due to their job. This underscores the real impact of workplace hazards on sanitation workers' health. Apparently, sanitation workers frequently report illnesses and injuries from their work, with common issues including MSDs from lifting and repetitive motions, injuries from hazardous materials, slips, trips, and falls, crush injuries, and motor vehicle accidents (Kyung et al., 2023). These incidents can be caused by various factors such as heavy objects, fatigue, stress, poor lighting, and the presence of dangerous substances, leading to physical limitations, reduced job satisfaction, and increased absenteeism for the affected workers. Therefore, the high reported rate of injury or illness by the workers at AMA calls for stronger preventive practices and emergency response mechanisms.

3.5.3 Work-related illnesses/injuries among sanitation workers at AMA

Muscle and back pain (25.9%) and cuts (26.3%) were the most commonly reported ailments among the sanitation workers at AMA, as shown in Figure 8. This is consistent with other research, which revealed that sanitation workers face high rates of physical injuries, like cuts and wounds, and MSDs such as back and body aches, often from poor posture and lack of protective equipment (Philippe et al., 2022; Tolera et al., 2024a).

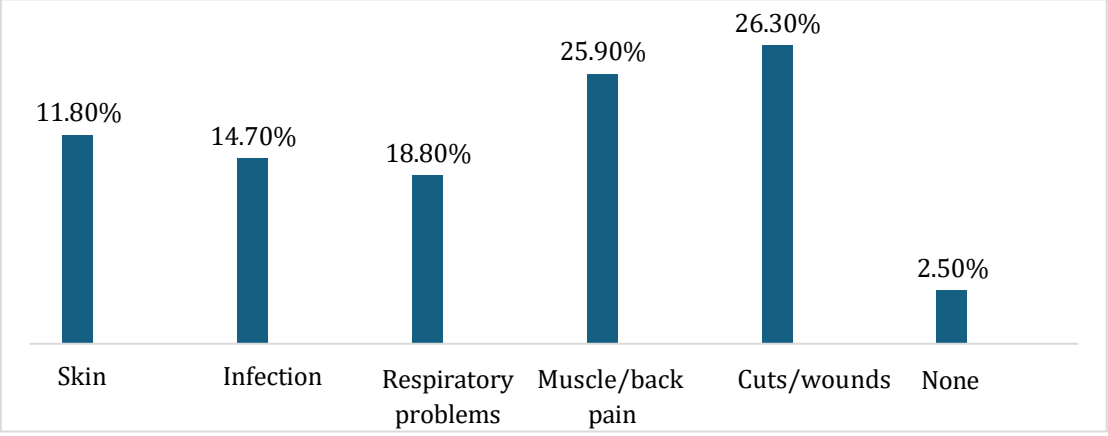

Fig. 8. Types of work-related illnesses/injuries among sanitation workers at AMA

Additionally, sanitation workers are also at significant risk for respiratory issues from inhaling dust and pathogens, gastrointestinal problems from exposure to contaminated waste, and infectious diseases like hepatitis, leptospirosis, and tuberculosis (Gowda et al., 2023). These risks are compounded by factors including long hours, failure to follow safety procedures, lack of training, unsafe work environments, and mental health challenges like stress. Therefore, the high rate of work-related illnesses among the sanitation workers at AMA necessitates comprehensive health surveillance and ergonomic improvements.

3.5.4 Sanitation workers who received medical care for work-related illnesses/injuries

The study revealed that 64.3% received medical care for job-related ailments, whereas a worrying 35.7% did not receive any medical care for their work-related illnesses. Medical support for sanitation workers, such as provision of PPEs, regular health check-ups, access to occupational health and safety training, and enabling workers to access insurance and healthcare services, as well as addressing issues like mental health due to work-related stress and social stigma, is essential for the welfare of sanitation workers (Philippe et al., 2022; Marambire et al., 2024). Therefore, efforts should be made to overcome the barriers that prevent some of the sanitation workers at AMA from receiving medical care.

3.5.5 Sanitation workers' reporting of work-related incidents

On reporting of work-related incidents, only 17.3% of respondents indicated that they consistently reported incidents, with 31.4% doing so only sometimes, as shown in Figure 9. Sanitation workers should report work-related incidents, including injuries, illnesses, and hazards, by first ensuring their safety and providing immediate assistance if anyone is injured (Sharior et al., 2023; Tolera et al., 2024b). Additionally, sanitation workers need to notify their supervisor or a designated safety representative, providing a clear, concise, and objective description of the event, including relevant details like date, time, location, and involved individuals. If applicable, photos or videos of the incident scene should be taken to preserve evidence. Following these steps ensures that the incident is properly documented, allowing for the implementation of corrective actions to prevent recurrence and ensure worker safety.

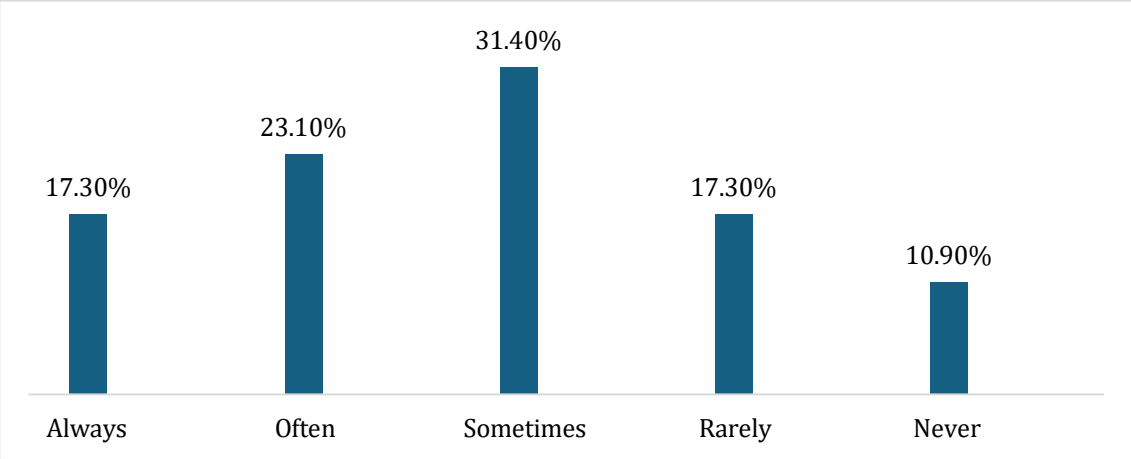

Fig. 9. Sanitation workers' reporting of work-related incidents

3.5.6 Significance of association between exposure frequency and reported illness

A test for the significance of the association between exposure frequency and reported illness among the respondents produced a chi-square statistic of 7.19 and a p-value of 0.02740, as shown in Table 4, which indicated a significant association between how often sanitation workers are exposed to hazards and the likelihood of becoming ill. Daily exposure correlates with higher illness rates, which is consistent with the expected health burden of

frequent contact with contaminants. These findings emphasise the need for improved job rotation, hazard reduction strategies, and routine health surveillance. Additionally, employers need to prioritize reducing daily exposure and offering appropriate medical support. This can contribute to minimizing long-term health complications.

Table 4. Significance of association between exposure frequency and reported illness

Frequency	Sick	Not sick	Chi-square	DF	P-value	Significance
Daily	98	28				
Weekly	65	34	7.19	2	0.02740	Significant
Occasional	31	21				

P = P-value and χ^2 = test statistic

3.5.7 Significance of association between PPE usage and injury occurrence

The significance of the association between PPE usage and injury occurrence test showed a strong association, as $\chi^2 = 23.30$ and $p = 0.00001$, as indicated in Table 5. Workers who reported always using PPE had a considerably lower injury rate than those who used it occasionally or rarely. Therefore, consistent and proper PPE use significantly reduces the frequency and severity of workplace injuries, supporting the hypothesis that PPE is an effective preventative measure against occupational hazards. Studies show a statistical link between non-compliance with PPE and higher injury rates, suggesting that employers should implement measures that highlight the need for worker education, proper equipment, and strict enforcement to create a safer work environment and prevent the economic costs associated with accidents (Al-Bayati et al., 2023; Jalil Al-Bayati, 2024). Thus, management at AMA needs to invest in regular provision, monitoring, and training related to PPE usage.

Table 5. Significance of association between PPE usage and injury occurrence

PPE usage	Injured	Not injured	Chi-square	DF	P-value	Significance
Always	45	73				
Often/sometimes	98	56	23.30	2	0.00001	Significant
Rarely/never	51	24				

P = P-value and χ^2 = test statistic

3.6 Logistic regression analysis on illness/injury occurrence among the sanitation workers

The study employed logistic regression analysis to investigate the relationship between some socio–demographic variables and occupational safety variables (covariates), and the likelihood of illness/injury occurrence among the sanitation workers. This analysis enabled the authors to determine odds ratios (ORs), which quantify the increased odds of injury associated with occupational exposures, as shown in Table 6. The absence of safety training, especially on job training, limited use of personal protective devices while on duty and prolonged duration of working hours were major factors that contributed to the occurrence of injury. Those who were not using PPE all the time while on duty had 2.52 times higher occupational injury than those who used PPE all the time while on duty. This is consistent with the findings from other researchers. The risk of occupational injury for sanitation workers who were less than 35 years old was reduced by 63% as compared with those who were over 35 years old (AOR = 0.21, 95% CI: 0.10-0.34). Accordingly, older sanitation workers face elevated risks of musculoskeletal disorders, including back and upper limb pain, with age being a significant predictor for these conditions, and are also vulnerable to needlestick injuries and other trauma from unsafe environments and a lack of consistent use of PPE (Alie et al., 2023; Khatri et al., 2025).

The key finding of this study is that sanitation workers in Accra face considerable health risks due to the nature of their work, as nearly 70% of respondents reported experiencing a job-related illness or injury, with muscle pain, cuts, skin infections, and respiratory conditions being the most common. These findings align with international studies such as

those by Lissah et al. (2022), who documented the health burdens among solid waste workers in Ghana, along with Gowda et al. (2023), who reported that exposure to pathogens, chemicals, and sharp objects poses a major occupational threat to waste workers globally.

Table 6. Logistic regression analysis result on occupational injuries among the sanitation workers

Characteristics	Crude OR (95% CI)	Adjusted OR (95% CI)		
		Model 1	Model 2	Final model
Sex (Male Vs Female[RG])	1.30 (1.03–1.77)*	2.25 (1.55–3.26)**	1.45 (0.70–3.03)	
Age (Less or 35 Vs ≥55[RG]	0.50 (0.25–0.63)**	0.57 (0.34–1.03)	0.14 (0.11–0.41)**	0.21 (0.10–0.34)**
Education status (Illiterate Vs ≥20 RG)	2.10 (1.12–3.82)*	2.25 (1.11–4.44)*		
Work experience (≤5 yrs[RG] Vs ≥10 yrs)	1.40 (1.14–1.85)*	1.10 (0.75–1.59)		
Daily work hours (≤ 8 hrs[RG] Vs > 8 hrs)	2.70 (1.25–5.72)*	2.57 (1.16–5.60)*	2.45 (0.58–9.46)	
PPE on duty (Yes[RG] Vs No)	4.03 (3.08–5.43)**			
PPE all the time (Yes[RG] Vs No)	2.31 (1.34–4.02)**		2.51 (1.38–4.49)*	2.52 (1.38–4.53)*
First training (Yes[RG] Vs No)	0.64 (0.43–1.02)		0.88 (0.46–1.62)	
On job training (Yes[RG] Vs No)	1.35 (1.10–1.91)**		1.06 (0.50–1.95)	

RG Reference Group. **Significant at p-value < 0.01, *Significant at p-value < 0.05

The significant association found between frequency of exposure and illness (p = 0.027) is supported by studies such as Khachadourian et al. (2023), which observed higher rates of illness among sanitation workers with prolonged and daily exposure. This pattern highlights the importance of regulating workload schedules and ensuring task rotation to minimize cumulative exposure. The current study adds to the body of evidence suggesting that sanitation work in urban areas, particularly in low-resource settings, remains under-regulated and under-protected. In addition, the study found that less experienced workers were more likely to report illness (p = 0.048), which reflects similar trends found in studies by Han et al. (2021) in China and Cunningham et al. (2022) in the US. These researchers found that newer workers, lacking adequate training or time to adapt to occupational risks, were more vulnerable to injuries and illnesses. This suggests that onboarding programs should be enhanced with a focus on occupational health, mentoring, and routine health check-ups for recruits.

4. Conclusions

This study examined occupational exposures among sanitation workers in AMA, a population that plays a critical yet often overlooked role in urban hygiene and public health. Using a quantitative descriptive cross-sectional design, data were gathered from 277 sanitation workers through a structured questionnaire. The research focused on demographic characteristics and occupational exposures. The statistical analysis employed both descriptive and inferential tools to identify patterns and relationships among variables such as employment category, gender, years of experience, and health outcomes. A wide range of occupational hazards expose sanitation workers at AMA. Cuts, contact with human waste, chemical spills, dust and smoke inhalation, and heat stress were the most frequently reported hazards. These exposures were not occasional; nearly half of the respondents indicated daily exposure to hazardous conditions. It was found that 70% of workers had previously fallen ill or sustained injuries as a direct consequence of their job. Illnesses such as muscle/back pain, skin infections, respiratory conditions, and diarrhea were common.

In addition, statistical tests confirmed important associations: consistent PPE usage

was significantly related to lower injury rates ($p < 0.001$), and workers who had undergone training were significantly more likely to adhere to PPE usage protocols ($p = 0.031$). Furthermore, workers exposed to hazards more frequently were more likely to report illnesses ($p = 0.027$), and less experienced workers were significantly more prone to illness ($p = 0.048$). These findings reveal the urgency of improving training, supervision, and provision of protective resources. The study also brought to light disparities based on employment status. Full-time workers were more likely to receive PPE compared to contract and casual workers, an inequity that points to systemic flaws in occupational health and safety policies. Interestingly, gender was not a significant predictor of injury occurrence, suggesting that male and female workers face similar risks and roles within the sanitation sector. The findings collectively emphasise the need for inclusive, well-funded, and systematically implemented occupational health policies in the sanitation sector.

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Author Contribution
Conceptualisation, P.A.B. and F.T.G.; Data curation, P.A.B.; Investigation, P.A.B. and F.T.G.; Software, F.T.G; Writing - original draft, P.A.B and F.T.G.; Writing—review and editing, F.T.G. and P.A.B. All authors have read and agreed to the published version of the manuscript.

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Ethical Review Board Statement
Ethical approval for the study was obtained from the Ghana Institute of Management and Public Administration (GIMPA) Institutional Review Board (IRB), where the second author was a graduate student at the time the study was conducted. All research activities were conducted in accordance with the ethical standards established by the IRB and in compliance with international guidelines for human subject research. Before participation, all respondents were provided with detailed information about the purpose and scope of the study, their rights as participants, and the voluntary nature of their involvement. Written or verbal informed consent was obtained from each participant. Participants were assured of the confidentiality of their responses and informed that they could withdraw from the study at any point without any consequences. No names or identifying information were recorded. Data was stored securely and used strictly for research purposes.

Informed Consent Statement
Informed consent was obtained from all subjects involved in the study. Participants were informed that all data were treated as confidential and would be used for academic purposes and recorded anonymously.

Data Availability Statement
The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding authors.

Conflicts of Interest
The authors declare no conflict of interest.

Declaration of Generative AI Use
The authors declare that no artificial intelligence tools were used.

References

Alam, M. U., Sharior, F., Shoaib, D. M., Hasan, M., Tabassum, K. F., Ferdous, S., Hasan, M., Rahman, M., Tidwell, J. B., Zaqout, M., & Farah, M. (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. https://doi.org/10.1016/j.heha.2022.100022

Alda-Vidal, C., Lawhon, M., Iossifova, D., & Browne, A. L. (2023). Living with fragile infrastructure: The gendered labour of preventing, responding to and being impacted by sanitation failures. *Geoforum, 141*, 103724. https://doi.org/10.1016/j.geoforum.2023.103724

Alie, M., Abich, Y., Demissie, S. F., Weldetsadik, F. K., Kassa, T., Shiferaw, K. B., & Assefa, Y. A. (2023). Magnitude and possible risk factors of musculoskeletal disorders among street cleaners and solid waste workers: a cross-sectional study. *BMC musculoskeletal disorders*, *24*(1), 493. https://doi.org/10.1186/s12891-023-06619-z

Al-Bayati, A. J., Rener, A. T., Listello, M. P., & Mohamed, M. (2023). PPE non-compliance among construction workers: An assessment of contributing factors utilizing fuzzy theory. *Journal of Safety Research, 85*, 242–253. https://doi.org/10.1016/j.jsr.2023.02.008

Babapour, A. R., Gahassab-Mozaffari, N., & Fathnezhad-Kazemi, A. (2022). Nurses' job stress and its impact on quality of life and caring behaviors: A cross-sectional study. *BMC Nursing, 21*(1), 1–10. https://doi.org/10.1186/s12912-022-00852-y

Bagade, O. M., & Doke, P. E. (2024). Advancements in combating pathogens in infectious biomedical waste. In *Hospital waste management and toxicity evaluation* (pp. 191–218). IGI Global Scientific Publishing. https://doi.org/10.4018/979-8-3693-5757-6.ch007

Bălă, G. P., Râjnoveanu, R. M., Tudorache, E., Motișan, R., & Oancea, C. (2021). Air pollution exposure—the (in)visible risk factor for respiratory diseases. *Environmental Science and Pollution Research, 28*(16), 19615–19628. https://doi.org/10.1007/s11356-021-13208-x

Cunningham, T. R., Guerin, R. J., Ferguson, J., & Cavallari, J. (2022). Work-related fatigue: A hazard for workers experiencing disproportionate occupational risks. *American Journal of Industrial Medicine, 65*(11), 913–925. https://doi.org/10.1002/ajim.23325

Dallas, M. P., Horner, R., & Li, L. (2021). The mutual constraints of states and global value chains during COVID-19: The case of personal protective equipment. *World Development, 139*, 105324. https://doi.org/10.1016/j.worlddev.2020.105324

Das, D., & Singh, A. K. (2025). Interactions between work-related factors, perceived fatigue and musculoskeletal disorders among handicraft artisans: Structural equation model analysis. *Ergonomics, 68*(1), 95–111. https://doi.org/10.1080/00140139.2023.2300952

Degavi, G., Dereso, C. W., Shinde, S., Adola, S. G., & Kasimayan, P. (2021). Prevention of occupational hazards among sanitary workers: Knowledge, attitude, and practice survey in Bulehora, West Guji zone, Oromia, Ethiopia. *Risk Management and Healthcare Policy, 14*, 2245–2252. https://doi.org/10.2147/rmhp.s308323

Dery, F., Bisung, E., Abudho, B., Soliku, O., & Dery, G. (2023). Examining the health and wellbeing of women sanitation workers in Ghana and Kenya. *Wellbeing, Space and Society, 5*, 100167. https://doi.org/10.1016/j.wss.2023.100167

Ebekozien, A. (2022). Construction companies' compliance to personal protective equipment on junior staff in Nigeria: Issues and solutions. *International Journal of Building Pathology and Adaptation, 40*(4), 481–498. https://doi.org/10.1108/ijbpa-08-2020-0067

Geleta, D. H., Alemayehu, M., Asrade, G., & Mekonnen, T. H. (2021). Low levels of knowledge and practice of occupational hazards among flower farm workers in southwest Shewa zone, Ethiopia: A cross-sectional analysis. *BMC Public Health, 21*(1), 1–12. https://doi.org/10.1186/s12889-021-10254-5

Gowda, B., Gurusiddappa, L. H., & Kalikeri, S. (2023). Study on occupational health hazards of municipal solid waste workers—A review. *World Journal of Environmental Biosciences, 12*(1), 24–31. https://doi.org/10.51847/dmEF1XWBtq

Han, S. R., Wei, M., Wu, Z., Duan, S., Chen, X., Yang, J., Borg, M. A., Lin, J., Wu, C., & Xiang, J. (2021). Perceptions of workplace heat exposure and adaptation behaviors among Chinese construction workers in the context of climate change. *BMC Public Health, 21*(1), 1–16. https://doi.org/10.1186/s12889-021-12231-4

Irawanto, D., Novianti, K., & Roz, K. (2021). Work from home: Measuring satisfaction between work–life balance and work stress during the COVID-19 pandemic in Indonesia. *Economies, 9*(3), 96. https://doi.org/10.3390/economies9030096

Jalil Al-Bayati, A. (2024). Human and workplace factors contributing to PPE non-compliance: A critical assessment. In *Construction Research Congress 2024* (pp. 388–395). American Society of Civil Engineers. https://doi.org/10.1061/9780784485293.039

Khachadourian, V., Mahjani, B., Sandin, S., Kolevzon, A., Buxbaum, J. D., Reichenberg, A., & Janecka, M. (2023). Comorbidities in autism spectrum disorder and their etiologies. *Translational Psychiatry, 13*(1), 1–7. https://doi.org/10.1038/s41398-023-02374-w

Khatri, S., Shah, G. K., Bhandari, P., Koirala, S., Neupane, K., Bhattarai, N., ... & Neupane, D. (2025). Musculoskeletal disorders and other occupational health outcomes among sanitation workers in Nepal: A community based cross-sectional survey exploring the risk factors, knowledge, and practices. *BMC public health*, *25*(1), 1273. https://doi.org/10.1186/s12889-025-22282-6

Koschorke, M., Al-Haboubi, Y. H., Tseng, P. C., Semrau, M., & Eaton, J. (2022). Mental health, stigma, and neglected tropical diseases: A review and systematic mapping of the evidence. *Frontiers in Tropical Diseases, 3*, 808955. https://doi.org/10.3389/fitd.2022.808955

Krishnan, K. S., Raju, G., & Shawkataly, O. (2021). Prevalence of work-related musculoskeletal disorders: Psychological and physical risk factors. *International Journal of Environmental Research and Public Health, 18*(17), 9361. https://doi.org/10.3390/ijerph18179361

Kyung, M., Lee, S. J., Dancu, C., & Hong, O. (2023). Underreporting of workers' injuries or illnesses and contributing factors: A systematic review. *BMC Public Health, 23*(1), 1–16. https://doi.org/10.1186/s12889-023-15487-0

Leslie, K. T., Matshidza, S. T., & Aluko, O. (2025). Musculoskeletal injuries from gender-based violence at a tertiary hospital orthopaedic centre, central South Africa. *Injury, 56*(2), 112061. https://doi.org/10.1016/j.injury.2024.112061

Lissah, S. Y., Ayanore, M. A., Krugu, J. K., Aberese-Ako, M., & Ruiter, R. A. (2022). "Our work, our health, No one's concern": domestic waste collectors' perceptions of occupational safety and self-reported health issues in an urban town in Ghana. *International journal of environmental research and public health*, *19*(11), 6539. https://doi.org/10.3390/ijerph19116539

Marambire, E. T., Chingono, R. M., Calderwood, C. J., Larsson, L., Sibanda, S., Kavenga, F., Nzvere, F. P., Olaru, I. D., Simms, V., McHugh, G., & Bandason, T. (2024). Evaluation of a comprehensive health check offered to frontline health workers in Zimbabwe. *PLOS Global Public Health, 4*(1), e0002328. https://doi.org/10.1371/journal.pgph.0002328

Masirika, L. M., Udahemuka, J. C., Ndishimye, P., Martinez, G. S., Kelvin, P., Nadine, M. B., Steeven, B. K., Mweshi, F. K., Mambo, L. M., Oude Munnink, B. B., & Mbiribindi, J.

B. (2024). Epidemiology, clinical characteristics, and transmission patterns of a novel Mpox (Monkeypox) outbreak in eastern Democratic Republic of the Congo (DRC): An observational, cross-sectional cohort study. *medRxiv*. https://doi.org/10.1101/2024.03.05.24303395

Monteiro, T. S., & Nalini, R. (2021). Mental health at the intersections of marginalization: A conceptual model to explore the mental health concerns of women sanitation workers in India. *Asian Social Work and Policy Review, 15*(2), 102–111. https://doi.org/10.1111/aswp.12223

Odebiyi, D. O., & Udoka, A. C. O. (2023). Musculoskeletal disorders, workplace ergonomics and injury prevention. In *Ergonomics – New insights*. IntechOpen. https://doi.org/10.5772/intechopen.106031

Oza, H. H., Lee, M. G., Boisson, S., Pega, F., Medlicott, K., & Clasen, T. (2022). Occupational health outcomes among sanitation workers: A systematic review and meta-analysis. *International Journal of Hygiene and Environmental Health, 240*, 113907. https://doi.org/10.1016/j.ijheh.2021.113907

Philippe, S., Hueso, A., Kafuria, G., Sow, J., Kambou, H. B., Akosu, W., & Beensi, L. (2022). Challenges facing sanitation workers in Africa: A four-country study. *Water, 14*(22), 3733. https://doi.org/10.3390/w14223733

Rai, R., El-Zaemey, S., Dorji, N., Rai, B. D., & Fritschi, L. (2021). Exposure to occupational hazards among health care workers in low- and middle-income countries: A scoping review. *International Journal of Environmental Research and Public Health, 18*(5), 2603. https://doi.org/10.3390/ijerph18052603

Sandoval-Reyes, J., Idrovo-Carlier, S., & Duque-Oliva, E. J. (2021). Remote work, work stress, and work–life during pandemic times: A Latin America situation. *International Journal of Environmental Research and Public Health, 18*(13), 7069. https://doi.org/10.3390/ijerph18137069

Satterthwaite, D. (2021). Health: Creating healthy cities in the 21st century. In *The Earthscan reader in sustainable cities* (pp. 137–172). Routledge. https://doi.org/10.4324/9781315800462-10

Sharior, F., Alam, M. U., Zaqout, M., Cawood, S., Ferdous, S., Shoaib, D. M., Tidwell, J. B., Hasan, M., Hasan, M., Rahman, M., & Farah, M. (2023). Occupational health and safety status of waste and sanitation workers: A qualitative exploration during the COVID-19 pandemic across Bangladesh. *PLOS Water, 2*(1), e0000041. https://doi.org/10.1371/journal.pwat.0000041

Tolera, S. T., Diriba, W., Gutema, G. D., & Kaweti, G. (2023a). Determinants of occupational health and safety outcomes among sanitation workers across worldwide: A systematic review on cross-sectional studies. *Inquiry, 60*, 00469580231210525. https://doi.org/10.1177/00469580231210525

Tolera, S. T., Temesgen, S., Mulat Endalew, S., Alamirew, T. S., & Temesgen, L. M. (2023b). Global systematic review of occupational health and safety outcomes among sanitation and hygiene workers. *Frontiers in Public Health, 11*, 1304977. https://doi.org/10.3389/fpubh.2023.1304977

Tolera, S. T., Assefa, N., & Gobena, T. (2024a). Global prevalence of musculoskeletal disorders among sanitary workers: A systematic review and meta-analysis. *International Journal of Occupational Safety and Ergonomics, 30*(1), 238–251. https://doi.org/10.1080/10803548.2023.2293390

Tolera, S. T., Gobena, T., Assefa, N., & Geremew, A. (2024b). Global prevalence of occupational injuries among sanitation workers: A systematic review and meta-analysis. *Frontiers in Public Health, 12*, 1425904. https://doi.org/10.3389/fpubh.2024.1425904

Venkataraman, D., Shabani, E., & Park, J. H. (2023). Advancement of nonwoven fabrics in personal protective equipment. *Materials, 16*(11), 3964. https://doi.org/10.3390/ma16113964

World Health Organization. (2021). *Compendium of WHO and other UN guidance on health and environment.* Security Research Hub Reports [Preprint].

https://digitalcommons.fiu.edu/srhreports/health/health/61

Yamane, T. (1967). *Mathematical formulae for sample size determination*. [Unpublished manuscript].

Young, S. L., Steane, S. E., Kent, N. L., Reid, N., Gallo, L. A., & Moritz, K. M. (2022). Prevalence and patterns of prenatal alcohol exposure in Australian cohort and cross-sectional studies: A systematic review of data collection approaches. *International Journal of Environmental Research and Public Health, 19*(20), 13144. https://doi.org/10.3390/ijerph192013144

Zech, A., Hollander, K., Junge, A., Steib, S., Groll, A., Heiner, J., Nowak, F., Pfeiffer, D., & Rahlf, A. L. (2022). Sex differences in injury rates in team-sport athletes: A systematic review and meta-regression analysis. *Journal of Sport and Health Science, 11*(1), 104–114. https://doi.org/10.1016/j.jshs.2021.04.003

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