Evaluation of Health and Safety Hazards among Solid waste Collectors in Hyderabad, Pakistan: A Risk Assessment Approach

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Abstract

Solid waste management workers face several health and safety risks due to the intrinsically hazardous nature of their job. The purpose of this study is to explore the hazards associated with solid waste in a specific locality of Pakistan–Hyderabad, Sindh. Primary data were collected using a structured questionnaire from 384 solid waste collectors administered through a convenient sampling technique. Participants were asked about the likelihood and severity of various hazards faced during their work. The data were examined using SPSS (Statistical Package for Social Sciences) version 22, and hazards were classified using a risk assessment matrix. The results showed that dust and used syringes or needles were categorized as high-risk hazards. Moreover, medium-risk hazards included offensive odors, leachates and sludge containing worms, debris, bones, animal waste, dead animals and rodent carcasses, metal cans, wood, food waste, broken glass and other sharp objects. In addition, low risk hazardous substances comprised clothing, plastic bottles and glasses, rubber or leather, and paper & cardboard. In conclusion, solid waste collectors face serious risks from exposure to dust, sharp objects, and biological waste which potentially lead to health complications and safety concerns. e.g., respiratory issues, infections, and injuries. Provision of proper protective gears and training on safe handling practices are crucial to mitigate these risks which result in safeguarding workers' health and enhancing the quality of their life. Mitigating the risks associated with the municipal solid waste will also contribute to achieve sustainable development goal 3–good health and wellbeing.

Keywords: Solid Waste Management, Risk Assessment Matrix, Occupational Hazards, Occupational Health, OSH, Dust, SDG-3, Good Health and Wellbeing.

Introduction

Household waste, commonly referred to as municipal solid waste (MSW), encompasses any discarded material deemed no longer useful, whether due to damage, disuse, or obsolescence. More broadly, solid waste includes refuse generated through domestic, industrial, commercial, and

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healthcare activities. Notably, household waste—both biodegradable and non-biodegradable—accounts for approximately 90% of the total waste produced, with commercial sources contributing the remaining 10% (Asif et al., 2025). Unlike developed nations, waste disposal in many developing countries often occurs in open spaces rather than designated containers, necessitating manual collection by waste workers. While MSW is typically viewed as worthless, its mismanagement can significantly endanger both environmental and public health by contributing to the spread of diseases (Cointreau, 2006).

The global per capita production of MSW stands at 1.42 kg per day (Gowda et al., 2023), amounting to approximately 2.01 billion metric tons annually—a figure projected to reach 3.4 billion metric tons by 2050 (Mujtaba et al., 2024). This increase in waste generation is strongly tied to urbanization and population growth (Asif et al., 2025).

As the fifth most populous country (Ali & Ali, 2022), Pakistan produces around 4.9 million tons of solid waste annually, with a growth rate of 2.7% per year (Bin Shaukat et al., 2023). In Hyderabad, the second-largest city in Sindh with a population of 4.9 million, municipal solid waste generation has reached 3,478 tons daily (Asif et al., 2025). In Pakistan, collection of waste is the responsibility of local and municipal governments. Every province has a solid waste collection mechanism. In the 20 cities of Sindh province, the Sindh Solid Waste Management Board (SSWMB) manages waste. Notwithstanding these initiatives, solid waste workers stay to face several occupational safety and health risks due to the inherently hazardous nature of their job.

The issue of getting injured and illness at workplace is higher in the developing countries (Syed et al., 2024). Among those most at risk are solid waste workers, who are routinely exposed to unsafe working conditions and hazardous materials. This job can be more dangerous in waste management due to lack of training, improper practice, and insufficient implementation of occupational health and safety protocols, i.e. use of personal protective equipment (PPEs). For instance, in Kathmandu Valley, informal waste workers (IWWs) face severe occupational risks due to limited access to personal protective equipment (PPE) and lack of awareness (Sapkota et al., 2020).

These risks include exposure to harmful chemicals, cuts from sharp objects, and long-term health complaints caused by household cleaning agents and toxic substances (Al-Khatib et al., 2015; Rahman et al., 2025). A global concern reported by the United Nations in their Environment Program (UNEP. Industry and Environment., 1996) highlights that Municipal Solid Waste workers suffer musculoskeletal disorders, chemical burns, are frequently injured by sharp materials, and even poisoning. Other studies i.e., Drda et al., (2002) and Majumdar et al., (2012) reveal that solid waste workers are exposed to decomposing organic substances, solvents, microbial contaminants which can transmit diseases such as yellow fever, dengue, and chikungunya.

Leadership and proper management are essential in mitigating workplace hazards. A failure to comply with occupational safety standards, coupled with inadequate training and safety culture, heightens the risks faced by waste workers. In Pakistan, these issues are compounded by extreme heat, with temperatures soaring to 48–50°C during summer months, further discouraging PPE usage (Hamid et al., 2019).

In Kathmandu, Nepal, Marahatta et al. (2018a) investigated trash handlers' understanding of health hazards and discovered that just half were aware of workplace risks, and only 16% knew how to reduce them. Kabir et al. (2015) discovered a similar tendency in Dhaka, Bangladesh, where sweeping workers demonstrated low awareness and risk perception of health concerns.

A study in Ethiopia (Degavi et al., 2021) with 129 participants found that only 8.9% had acceptable measures to prevent occupational health risks. The majority of respondents were women, and

overall awareness and safety behaviors were noticeably poor. In Egypt, Zaky et al. (2018) observed that more than 90% of MSW workers were injured on a regular basis, with little use of PPE and a poor understanding of safety measures.

In Somalia, Omar et al. (2019) identified a gap between understanding and practical behavior regarding solid waste treatment, with the majority knowing the risks but failing to use safe techniques. Similarly, Abd et al. (2023) discovered widespread inadequate knowledge and poor safety measures among 300 street sweepers in Egypt.

According to studies conducted in Ethiopia, Nepal, Egypt, and Somalia, municipal waste workers frequently have limited knowledge of occupational risks, practice poor safety habits, and lack adequate PPE and vaccinations (Abd et al., 2023; Kabir et al., 2015; Marahatta et al., 2018a; Omar et al., 2019; Tolera et al., 2022; Zaky et al., 2018). These inadequacies cause a wide range of workplace health difficulties, including respiratory disorders, gastrointestinal ailments, and physical injuries.

Frighting, in Pakistan rate of mortality among workers is greater compared to other developing countries (Gopang et al., 2017). Still solid waste workers handle household waste manually–exposing themselves directly to health hazards–without using proper PPEs e.g. protective clothing. Due to inadequate mechanization, manual waste collection is still the standard in Pakistan (Rushton, 2003). Workers regularly handle trash without sufficient protective clothing, exposing themselves to considerable health risks.

Elmubarak et al., (2021), in a survey conducted in Khartoum–Sudan from 280 municipal workers, found that 100% were immunized against hepatitis B and C. Moreover, 67% of them reported lack of access to PPEs and the majority documented accidents and health risks. Similarly, in Kathmandu Valley, Black et al., (2018) reported increase in respiratory health problems and physical injuries, despite that only a small percentage of informal workers used PPEs and administered vaccine.

Given that Pakistan is among the less income countries that still rely on the method of handling waste collection manually, it is critical to identify, assess, and mitigate occupational hazards and health. A structured risk assessment methodology is proposed to achieve this aim.

Theoretical Reasoning

This research is grounded in three interrelated theories that offer a holistic understanding of occupational risks among waste workers:

Occupational Health and Safety (OHS) Theory

As proposed by Goetsch (1999), the OHS theory emphasizes proactive identification, evaluation, and mitigation of workplace hazards (Goetsch, 1999). Key strategies include training, the provision of PPE, and enforcement of safety regulations. Within solid waste management, this theory underscores the link between insufficient safety measures and elevated health risks.

Risk Perception Theory

Developed by Slovic (1987), this theory posits that individuals' responses to risk are influenced by their perceived probability and severity of harm (Slovic, 1987). Workers with limited knowledge or educational background often underestimate risks, leading to negligent behavior such as avoiding PPE use (Omar et al., 2024). This theory is essential for understanding behavior change and the role of awareness in fostering safer practices.

Systems Theory in Occupational Health

According to Niskanen et al. (2016), systems theory views health and safety as outcomes of interdependent organizational, cultural, and external factors. In countries like Pakistan, systemic weaknesses—including poor regulatory enforcement and limited infrastructure—contribute to unsafe working environments. Addressing these issues requires holistic policy reforms and organizational change.

Methodology

A cross-sectional study was conducted to achieve the aim, using convenient sampling to conduct surveys from 384 solid waste collectors affiliated with Sindh Solid waste Management Board (SSWMB) in Hyderabad. Hazard related to solid waste were identified through a comprehensive literature review as shown in Table 1.

Table 1: List of solid waste hazards

S.#	Name of Hazard	References
1	Animal waste	(Kasemy et al., 2021)
2	Bone	(Rojas-Valencia & Nájera-Aguilar, 2012)
3	Broken glass and other sharp items	(Kasemy et al., 2021)
4	Clothes	(Syed Mustaf Hassan, 2024)
5	Dead animals and rodent carcasses	(Kasemy et al., 2021)
6	Debris	(Clark et al., 2006)
7	Dust	(Kasemy et al., 2021)
8	Food waste	(Abd El-Wahab et al., 2014)
9	Leachates and sludge containing	(Kasemy et al., 2021)
10	Metal cans	(Abd El-Wahab et al., 2014)
11	Offensive odor	(Kasemy et al., 2021)
12	Paper and Cardboard	Korai & Mahar, 2014; Abd El-Wahab, 2014)
13	Plastic bottle and glasses	(Mohammed et al., 2020)
14	Rubber/leather	Korai & Mahar, 2014
15	Used Syringes and needles	(Kasemy et al., 2021)
16	Wood	(Korai & Mahar, 2014)

For data collection to examine the hazards, in the first step hazards associated with the solid waste occupation were identified with comprehensive literature. Risk perception depends on two factors i.e. perceived likelihood of the occurrence of harm and perceived severity of outcomes (Omar et al., 2024). In that view workers were asked about the likelihood and severity of the exposure for each hazard. For likelihood and severity of the hazard, a five-point scale was used as prescribed by (Majid & McCaffer, 1997) as shown in Table 2.

Table 2: Risk assessment matrix (Majid & McCaffer, 1997)

Likelihood	Severity				
	1 = Insignificant	2 = Minor	3 = Moderate	4 = Major	5 = Fatal
5 = Almost certain	5	10	15	20	25
4 = Likely	4	8	12	16	20
3 = Possible	3	6	9	12	15
2 = Unlikely	2	4	6	8	10
1 = Rare	1	2	3	4	5

After the data collection for the likelihood and severity of solid waste hazards, each hazard was evaluated using a risk assessment approach to examine the risk level of each hazard. Further, hazards were categorized as extreme, high, medium, and low levels as per the approach of (Majid & McCaffer, 1997) as shown in Table 3. Based on the levels a risk assessment matrix was formulated, and hazards were categorized based on the score highest to lowest. The purpose of risk assessment is to highlight health and safety of workers in working conditions. The hazards and risk level assigned to eliminate hazard or required correction action to minimize the risk (Majid & McCaffer, 1997).

Table 3: Identification of Risk level (Majid & McCaffer, 1997)

Risk Assessment Score	Level	Color code	Color
1–3	Low	Green	
4-8	Medium	Yellow	
9-12	High	Orange	
15-25	Extreme	Red	

Results and Discussion

This study aimed to identify and assess the hazards associated with the occupation of solid waste management. The data was collected from the solid waste workers belonging to Sindh solid waste management Board (SSWMB), Hyderabad–Sindh. All the respondents of this study were male. As in Pakistan this job of solid waste collectors is considered as male job. This study is like the study of (Samir Abou-ElWafa et al., 2012), conducted in Egypt which revealed that solid waste workers job was mostly provided to male. However, in Nepal, mostly female workers were hired in this occupation and had a requirement of low level of education (Marahatta et al., 2018). Further mean age of the participants were 38 years, such mean values were similar to the studies of (Aigbkhaode et al., 2011; Sabitu et al., 2009), which reported the age range of 19 to 39 years, whereasas majority of them were male.

Table 4 represents the solid waste hazards from high to low based on the risk assessment score. None of the identified hazards have received enough risk assessment score to fall into the category of extreme hazards. Notwithstanding, out of 16 identified hazards, dust received the highest score of all i.e. 10. According to the risk levels suggested by (Majid & McCaffer, 1997), as shown in Table 3, dust was categorized as a high risk. It affects the respiratory system, shortness of breath, coughing, chronic obstructive pulmonary disease (COPD) also dust's particles effect on cardiovascular system resulting in strokes and heart attacks. Dust also contributes to allergens, sneezing, eye itching, runny nose as well as lung diseases.

Next to dust, used syringes and needles received the higher score of 9. Like dust it is also categorized as a high-risk hazard based on its risk assessment score. The risk associated with used syringes and needles is transmission of a bloodborne pathogen such as HIV, Hepatitis B and C and skin infections.

Table 4: Risk assessment matrix of solid waste hazards

S. No.	Soild waste hazard	Score	Level
1	Dust	10	High
2	Used syringes and needles	09	
3	Leachates and sludge containing worms	08	Medium
4	Offensive odor	08	
5	Animal waste	07	
6	Bone(s)	07	
7	Dead animals and rodent carcasses	07	
8	Debris	07	
9	Broken glass and other sharp items	06	
10	Food waste	06	
11	Metal cans	06	
12	Wood	06	
13	Clothing	03	Low
14	Plastic bottles and glasses	02	
15	Rubber or Leather	02	
16	Paper and Cardboard	01	

According to Table 4 hazards have a sophisticated influence on human health, dust is rated as the top higher- risk hazard because it affects the respiratory system, shortness of breath, coughing, chronic obstructive pulmonary disease (COPD) also dust particle effect on cardiovascular system resulting in strokes and heart attacks dust also contribute allergens, sneezing, eye itching, runny nose as well as lung diseases. The risk associated with used syringes and needles is puncture injuries transmission of a bloodborne pathogen such as HIV, Hepatitis B and C and skin infections. Offensive odors were categorized as one of the high hazards by getting a risk assessment score of 8. Offensive odors contain volatile organic compounds (VOCs) that inhale cause nausea, headaches and respiratory problems. Prolonged inhalation affects the quality of life (Hassan, 2024).

In the high hazard category, leachates and sludge also got the risk assessment score of 8. Leachates and sludge on open surfaces lead to skin irritation, rashes and dermatitis. waste leachate and spread of odors pose a threat to public health (Al-Khatib et al., 2015). Chances of infection are increased if workers have abrasions and cuts on their skin. Solid waste collectors raise the risk of injuries, abrasions and cuts when sorting and handling heavy debris that contain heavy metals, irregular shape and sharp objects which require strong physical efforts on sorting and moving increase musculoskeletal injuries among solid waste collectors. Sharp and large bones create physical injuries among solid waste collectors such as punctures, abrasions and cuts (Hassan, 2024).

Animal waste, bones, dead animals & rodent carcasses, and debris with a risk assessment score of 07 were considered as a high-risk solid waste hazards. Animal waste produces bad offensive odors after decomposing giving birth to Parasites, viruses and bacteria which make the environment unpleasant for solid waste workers. Other pets and flies attack dead animals and rodent bodies that decompose and produce bad smell damaging the climate as well as the workplace (Hassan, 2024). The soil state in the metropolitan area has decreased, due to irresponsible debris dumping (Asif et al., 2025). The health of millions of people is at risk due to soil contamination (Asif et al., 2025).

Broken glass and other sharp items, food waste, metal cans and wood, had have a risk assessment score of 06 and are considered as high-risk hazards of solid waste. Broken glass and other sharp items are dangerous, causing injuries ranging from superficial cuts to life-threatening trauma

(Halasi et al., 2024). Injuries such as cuts or puncture wounds caused by broken glass, sharp metal edges, or discarded needles can serve as entry points for harmful microorganisms (Hassan, 2024). These wounds increase the risk of infections resulting from exposure to bacteria, viruses, fungi, or parasites. Common health issues arising from such exposure include contact dermatitis, gastrointestinal infections such as diarrhea, and various skin-related conditions (Jerie, 2016).

Food wastes are more biodegradable than those with high lignin content such as paper and plastic (Jerie, 2016). Food waste contains airborne particles that produce molds, bacteria and other pathogens that generate bad odors, and it is uncomfortable for workers to perform work (Hassan, 2024). Damage metals cane having a sharp edge increase the risk of cuts, injuries and punctures as well and metals cane. Wooden material contains sharp objects, screws, nails and splinters that cause cuts and injuries (Hassan, 2024). Large pieces of wood damage personal protective equipment as well as vehicle increase the weight of waste containers. These items need proper attention and be separated from waste (Jerie, 2016).

Clothing is a low-risk hazard, as it received a risk assessment score of 03. Likewise, plastic bottles and glass, rubber, leather, were also a low-risk hazards, as they received a risk assessment score of 02. However, sometimes zippers, sharp items, pins and needles stuck in clothes elevate risk somehow (Hassan, 2024). Plastic bottles and glasses are less hazardous compared to broken glass and pins. A study (Al-Khatib et al., 2015) have reported that health hazards including injuries and 58% of the children have been injured from glass disposed of in the streets. Paper and cardboard are marked as the least hazardous waste due to least risk assessment score of only 1. It is because they do not contain any sharp items that solid waste collectors confront every day.

Conclusion

This study assessed the occupational hazards faced by solid waste workers employed by the Sindh Solid Waste Management Board (SSWMB) in Hyderabad, Sindh. The findings highlight a wide range of health and safety risks associated with solid waste handling.

Risk assessment revealed that dust posed the highest health hazard due to its severe impact on the respiratory and cardiovascular systems. Used syringes and needles were also categorized as high-risk hazards due to the potential for transmission of bloodborne diseases. Other significant hazards included offensive odors, leachates and sludge, animal waste, sharp objects, and food waste, all of which present both immediate and long-term health threats such as infections, respiratory issues, physical injuries, and musculoskeletal disorders.

Lower-risk hazards included items such as clothing, plastic bottles, rubber, and paper, which although less dangerous, may still pose occasional risks depending on their condition and handling. These findings underscore the urgent need for improved safety protocols, targeted training, and the provision of appropriate personal protective equipment (PPE) for solid waste workers. Moreover, stricter waste segregation practices and public awareness are crucial to reducing the presence of high-risk items in general waste streams. Enhancing occupational safety standards will not only protect workers' health but also contribute to more sustainable and humane waste management practices in the region.

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