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OCCUPATIONAL HEALTH HAZARD RELATED TO MUNICIPAL SOLID WASTE MANAGEMENT WORKERS IN KATHMANDU VALLEY

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Abstract

This study explores, identifies and analyzes the occupational health hazard risks associated with the municipal solid waste management (SWM) workers in Kathmandu Valley. The issues of occupational hazards; risks, accidents and diseases are the end result of poorly managed and non-engineered SWM operations. Many concerns have been raised about the potential health hazard leading to injuries as well as morbidity. This study employed a multi-method research design that triangulates the qualitative and quantitative research paradigms. The quantitative aspect implements the physical characterization of waste differentiating the material component comprising the measurements. The qualitative component comprehends interviews, focus group discussions, and open-ended questionnaires inclusive of field observations. The study revealed that the solid waste management procedures are mainly performed manually and the lack of employer interest, non-compliance and virtually no enforcement on occupational health issues lead to health risks. The waste collectors' consensual views implied frequent burnouts, occupational injuries, and work-related stresses. The research findings suggest the development of specific plans and policies for the guidance and training practices minimizing the risks involved.

Keywords: Hazard, risks, solid waste Management, qualitative component, occupational health issues

Introduction

Currently, occupational diseases and injuries are a major global public health issue. The informal economy is normally associated with poor, unproductive and excluded workers and its significance has varied in different economic periods. The informal economy is normally associated with poor, unproductive and excluded workers and its significance has varied in different economic periods (Gërxhani 2004). The majority of the world's 3 billion workers do not have working environment that adhere to the minimum requirements and standards for occupational health and safety defined by the World Health Organization and the International Labour Organization (ILO 2019). Globally, approximately two billion workers are informally employed and not covered by statutory social and employment benefits (ILO 2018)

According to the Global Monitoring Report by WHO and ILO, from 2000 to 2016 most of the work-related deaths were due to respiratory and cardiovascular disease. Noncommunicable diseases accounted for 81% of deaths. The main risk was long working hours, which killed about 750,000 people. 450,000 people died due to workplace air pollution (particulate matter, gas, smoke). The occupational risk factor with the highest number of deaths was long working hours (55 hours or more per week) (744,924 fatalities) followed by occupational fine dust, gas and smoke (450,381 fatalities) and occupational accidents (363,283 fatalities). The health outcome leading to the greatest number of work-related deaths was chronic

obstructive pulmonary disease (450,381 deaths) followed by stroke (398,306 deaths) and ischemic heart disease (346,618 deaths;). (WHO/ILO 2021)

In the context of globalization, informal economy workers often work in the most hazardous jobs, conditions and circumstances across all economic sectors – agriculture, industry and services. (ILO n.d.) Fierce competition for scarce investment funds helps overlook safety, health and environmental concerns, as evidenced by the numerous safety incidents in developing countries. The provision of adequate housing and facilities often lags behind the development of new factories and industrial sites. The need for infrastructure has increased construction work, another dangerous occupation in fields as diverse as housing, roads, dams, power and telecommunications facilities, which not only offers many advantages, but also create problems related to modern industrial society such as traffic, noise and stress.

Protection of human health and the environment has emerged as the prominent issue for all underdeveloped, developing and developed countries. For the underdeveloped country like Nepal, with weak social protection, lack of adequate healthcare infrastructures and lack of resources, protection of human health is even more important. Municipal Solid Waste Management in Kathmandu's municipal sector involves dangerous practice of manual waste handling, unsafe transportation and unsanitary disposal which has led to human health issue for thousands of municipal waste workers and residents of Kathmandu and disposal site.

Every day Kathmandu Valley produces over a million tons of trash out of which Kathmandu Metropolitan City alone contributes over half (Ojha 2021). Thousands of workers and engaged in collection, transportation and disposal of waste. Although waste collection has been contributing greatly to human health by reducing the risk of several infectious diseases, solid waste collectors are at high risk of fatal and non-fatal injuries (Kuijer and Frings-Dresen 2004). Solid waste collectors are at a high risk of both fatal and non-fatal accidents, despite the fact that waste collection has significantly improved human health by lowering the danger of various infectious diseases.

Municipal Solid Waste Management in Kathmandu valley has been mostly managed by informal sector. Municipal solid waste in Kathmandu is either collected directly from residents' home (door to door collection) or handpicked. In both case workers manually sort them and collect waste in bigger trucks to haul them to disposal site. This indicates that workers have direct contact with solid waste, and are also exposed to emphatic working conditions. To complicate the matter, these workers neither use protection outfit nor do follow any safety protocol. The outbreak of COVID 19 has added extra sources of waste products which have ultimately triggered even more complexity in the management of SW to governments and waste workers (Tripathi A 2020).

Occupational-affiliated studies aren't enough to provide insights on prevailing practices of waste management and workers exposure to work- related hazards. Moreover, there is inadequate evidence on the prevalence of occupational-related injuries and determinant factors among municipal solid waste collectors (Gietaneh W 2020). It indicates that there's a strong need to induce substantiation on the occupational injuries of solid waste collectors to know the extent of the problems in Kathmandu Valley. This study aimed to determine the frequency of occupational injuries and associated factors among solid waste collectors. The finding of the current study can be used by the concerned associations, including policy makers, and health program itineraries to take an applicable measure to minimize the inflexibility of occupational injuries and associated threat factors.

The study has considered 19 occupational risk factors, including long working hours, workplace air pollution, asthma, carcinogens, ergonomic risk factors and noise.

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Materials and Methods

a. Study area period and design

The study was administered in Kathmandu valley from Sept 20,2022 to Oct 30, 2022. The study area was Kathmandu Valley located at 27.7172° N, 85.3240° E.

b. Source and study population

The study population consisted of the chosen solid waste collectors in each ward of Kathmandu city, whereas all solid waste collectors discovered in Kathmandu city served as the source population. In 33 wards of Kathmandu city covered in the current study, municipal solid waste collectors participated in each component of the solid waste collecting system. The study did not include solid waste collectors who were seriously ill, absent occupational injuries, pregnant, or on yearly leave. For this study 200 solid waste collectors were chosen as a part of the study.

c. Data collection method and procedures

Examining prior research helped create the questionnaire. Its purpose was to gather data on the frequency of occupational injuries as well as other work-related sociodemographic, behavioral, and other characteristics. Before the commencement of the real data collection the questionnaire was pre-tested on solid waste collectors in the Teku who are not included for the study. The data collectors received instruction on data collection methods and ethics. Face-to-face interviews were used to gather data along with organized and informal surveys. The questionnaire for the data collection were into 3 sections. Section A was about socio-demographic information, Section B was about the information of the hazards encountered and section 3 was about attitude, behavioral and control measures.

d. Study variables

The study variable included dependent and independent variables. The Dependent variable included prevalence of occupational injuries whereas independent variables included socio-demographic variables (age of the worker, sex, educational status, marital status, monthly income), Working environment related variables (work experience, occupational health and safety training, job category or work duty), Behavioral related variables. After the questionnaire risk of occupational hazard was assessed using qualitative risk assessment method using a 5x5 risk matrix. Hazard during work activities and health effects was identified through visual observations and questionnaires. The risk assessment included assessing the existing control levels in the workplace, the likelihood of the occurrence of a hazard, the severity of a hazard, and a risk score. The likelihood of occurrence is an estimate of how often a hazard event occurs. A review of historic events assisted with this determination. The likelihood of occurrence of hazard and its consequences was given a numerical rating of 1-5 (Table 1). Consequences reflects the health effect, property damage, and environmental impact due to exposure to a hazard. Rating for likelihood: 5 (almost certain), 4 (likely), 3 (possible), 2 (unlikely) and 1 (rare). Rating for consequence: 5 (catastrophic), 4 (severe), 3 (major), 2 (moderate) and 1 (minor). The risks were assessed by plotting the risk ratings on cartesian graph. Risk score for each risk was calculated from this rating using the following formula:

Risk score= Likelihood x Consequences (Purohit et al., 2018)

Risks was categorized as high, moderate, extreme and low (Table 1). Risks whose value ranges from 20-25 was categorized at extreme risk, 12-18 as high risk, 6-10 as moderate risk and 1-5 as low risk.

e. Data quality control

In order to assess the relevance, application, and clarity of the data collecting instruments, the questionnaire and observational checklist were pre-tested. The data gatherers received training on data collection methods, tools, and ethics. The accuracy of the gathered data was regularly verified.

f. Data processing and analysis

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All the data collected from the methods mentioned above was analyzed using different statistical and as well as technical methods such as descriptive analysis in tables and percentages Statistical tool such as SPSS was used for processing of data by editing, coding, classification and tabulation and also analysis of data. Qualitative and quantitative data from questionnaires, interviews and observations was critically analyzed to draw out inferences and conclusions about the occupational hazards. The assessed risk associated with solid waste management was presented in risk matrix with different color coding. The findings were also presented in tabular form, graphs, figures and photographs.

Results

a. Socio-demographic Characteristics

The sample population's sociodemographic were examined. 200 municipal workers in all were interviewed (Table 2), with 52.5% men and 47.5% women taking part. There were 98 street sweepers, 62 rubbish collectors, 30 loaders, and 10 drivers among them. 65.5% of them were illiterate, with the remaining 32% and 2.5% having only received primary or secondary school. It demonstrates that the age range of the workers was between 30 and 40 years for 60% of them, and between 41 and 50 years for 30%. The majority of them—143—were paid between Rs. 15,000 and 20,000 per month, and 51 of them made more than 20,000.

b. Behavioral and work-related characteristics of respondents

Two hundred of the study participants reported that they were working 6 days a week with holidays in Saturdays. Sixty seven percentage of the study participants were working more than 5 days per week. As represented in figure 1, the habit of changing clothes and bathing was found to be higher percentage in sweeper, collectors and loaders than in drivers. 40% sweepers, 52% collectors, 48% loaders and 4.5% of drivers used PPEs like masks, gloves or boots during work. Vaccination was found to be highest in loaders, i.e. 56%.

c. Prevalence of occupational injuries among respondents

Five types of hazards namely physical, chemical, biological, ergonomical and psychosocial hazards were recognized. Waste and its composition, nature of work and the way these works are carried out resulted in these hazards.

i. Physical hazards: Cuts and bruises were prevalent in 30%. 92% and 91% of the studied sweepers, collectors and loaders respectively. Headache and fatigue was most common in collectors i.e., 58% and 92% respectively. The reported risk of fatigue was 20%, headache was 25% and vehicle accidents was 10% in drivers (Figure 2).

ii. Biological hazard: the risk of Covid was higher in collectors and loaders with a risk score of 6. Gastrointestinal (GI) diseases were the most likely to occur with highest risk being in loaders and collectors with a rating of 8. Similarly, skin diseases had more likelihood of occurrence in waste collectors and loaders.GI diseases and skin disease were found in 54.3% and 51.9% of collectors. Drivers reportedly did not respond with having any kind of respiratory diseases and skin diseases. (Figure 2). 20.40 % of sweepers, 44.30% of collectors, 40.70 % of loaders and 10.90% of drivers responded with a risk due to recent Covid 19 pandemic (Figure 2).

iii. Chemical hazard: The risk due to chemical hazards were allergies, irritation, cancer, skin burns, nausea and vomiting. Cancer was rare to occur and allergies and irritation was most likely to occur in workers working for waste management of Kathmandu. Sweepers had lower risk to the chemical hazards than others. 40.6% of sweepers responded with having only allergies and irritation as an occupational health (Figure 2).

iv. Ergonomical hazard: Back pain, joint pain shoulder and arm discomfort were the risks associated with ergonomical hazard. Risk of back pain, and shoulder/arm discomfort was almost certain to occur in collectors with a risk score of 5. Joint pain was likely to occur in collectors, possible in

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sweepers and unlikely in loaders with a total score of 4, 3. Joint pain was absent among surveyed drivers. Shoulder and arm discomfort was experienced by 91.20% of sweepers, 93% of collectors, 91.50% of loaders and 61.40% of drivers. Similarly, 63%, 92.30%, 91% and 43% of sweepers, collectors, loaders and drivers have experienced back pain respectively in their occupational life (Figure 2).

v. Psychosocial hazards: The types of risk due to psychosocial hazards were found to be poverty, miscommunication, discrimination, abuses and depression with minor consequences. Discrimination was given a highest risk score of 4 as it was the most likely to occur among all types of waste management workers. 30% of sweepers, 38% of collector, 32% of loaders and 21.40% of drivers responded facing risk of discrimination due to the nature of their occupation. (Figure 2).

Risk assessment using matrix

The risk was determined from the Risk Assessment Matrix shown in Table 1. The intersection of consequence and likelihood determined risk score and thus the level of risk acceptability on the matrix. The risks were in the Low (L), Moderate (M), High (H), and Extreme (E) category for the specified job and hazards. According to the matrix, there are 4 categories of extreme risk due to physical and biological hazards to waste collectors and loaders. Sweepers had high risk scores for physical, ergonomical and biological hazards. Job specified to drivers mostly had low and medium risk to these hazards (Table 3).

The total risk score of identified hazards to the specified jobs of waste handling occupation were calculated from risk matrix. Waste collectors had a total risk score of 81 followed by loaders (84). Sweepers (59) and drivers (43).

Table 1: Risk assessment matrix

LIKELIHOOD		LEVEL OF RISK				
		Minor	Moderate	Major	Severe	Catastrophic
		1	2	3	4	5
Almost certain	5	5	10	15	20	25
Likely	4	4	8	12	16	20
Possible	3	3	6	9	12	15
Unlikely	2	2	4	6	8	10
Rare	1	1	2	3	4	5

LEGENDS		
Extreme Risk	20-25	Immediate action required. If possible, activity should be ceased immediately.
High Risk	12-18	Notify supervisors and safety and health representative and implement immediate action to minimize injury, remedial actions required within two working days.

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Moderate Risk	6-10	Immediate action implementation to minimize injury, Supervisor remedial action required within five working days.
Low Risk	1-5	Remedial action within 1 month (if possible), supervisor attention required.

(OSHA: 18001)

Table 2: Socio-demographic characters of respondents

Characteristics	**Category**	**Frequency**	**Percent (%)**
Sex	Female Male	95 105	47.5 52.5
Age	30-40 41-50 50 and above	120 60 20	60 30 10
Marital Status	Married Not marred	139 61	69.5 30.5
Educational Status	Illiterate Primary level Secondary level	131 64 5	65.5 32 2.5
Monthly income	Below 15000 15000-20000 20000 and above	6 143 51	3 71.5 25
Job specification	Street sweepers Waste collectors Waste loaders Drivers	98 62 30 10	49 31 15 5

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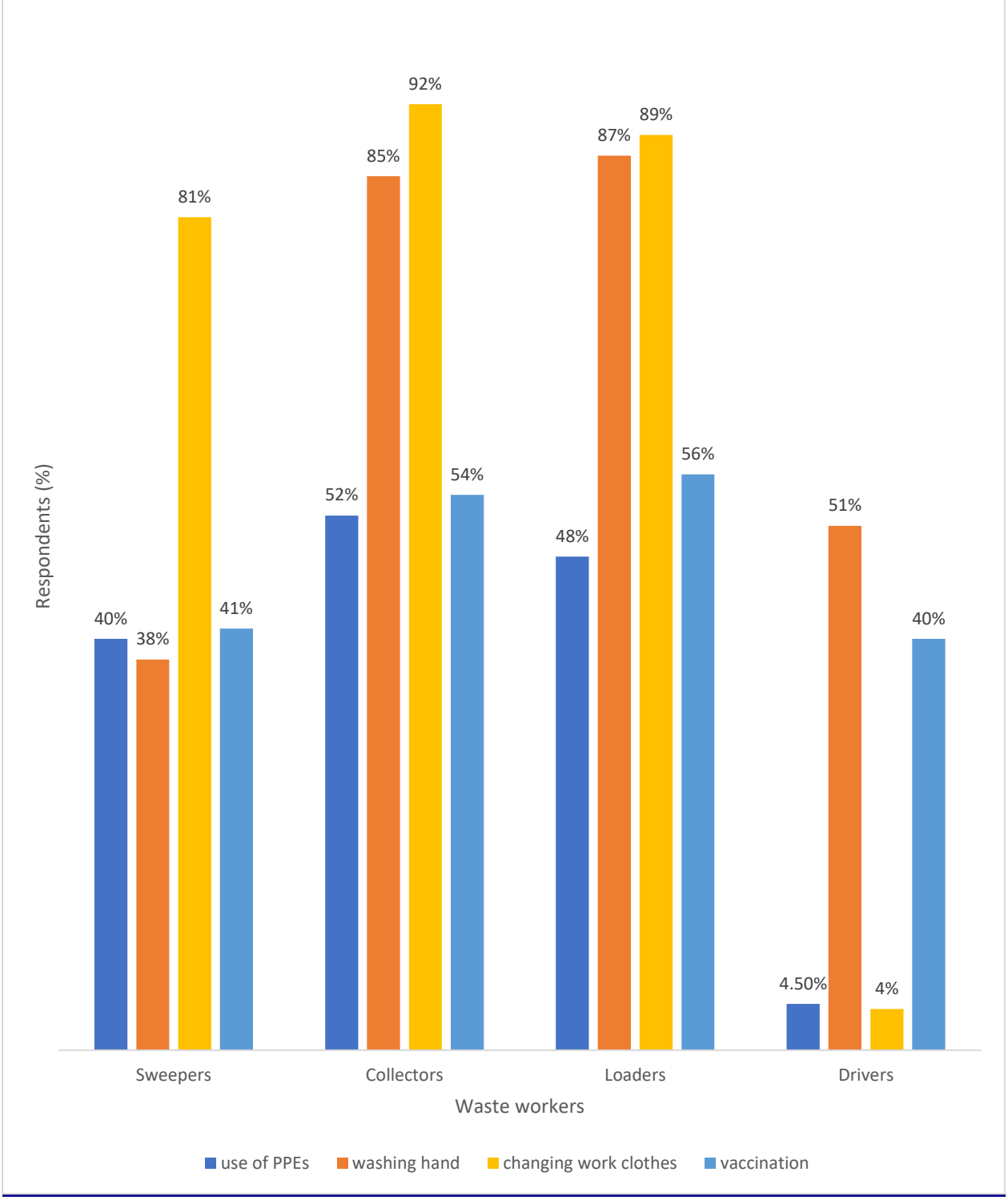

Figure 1: Personal hygiene and safety practices among waste workers

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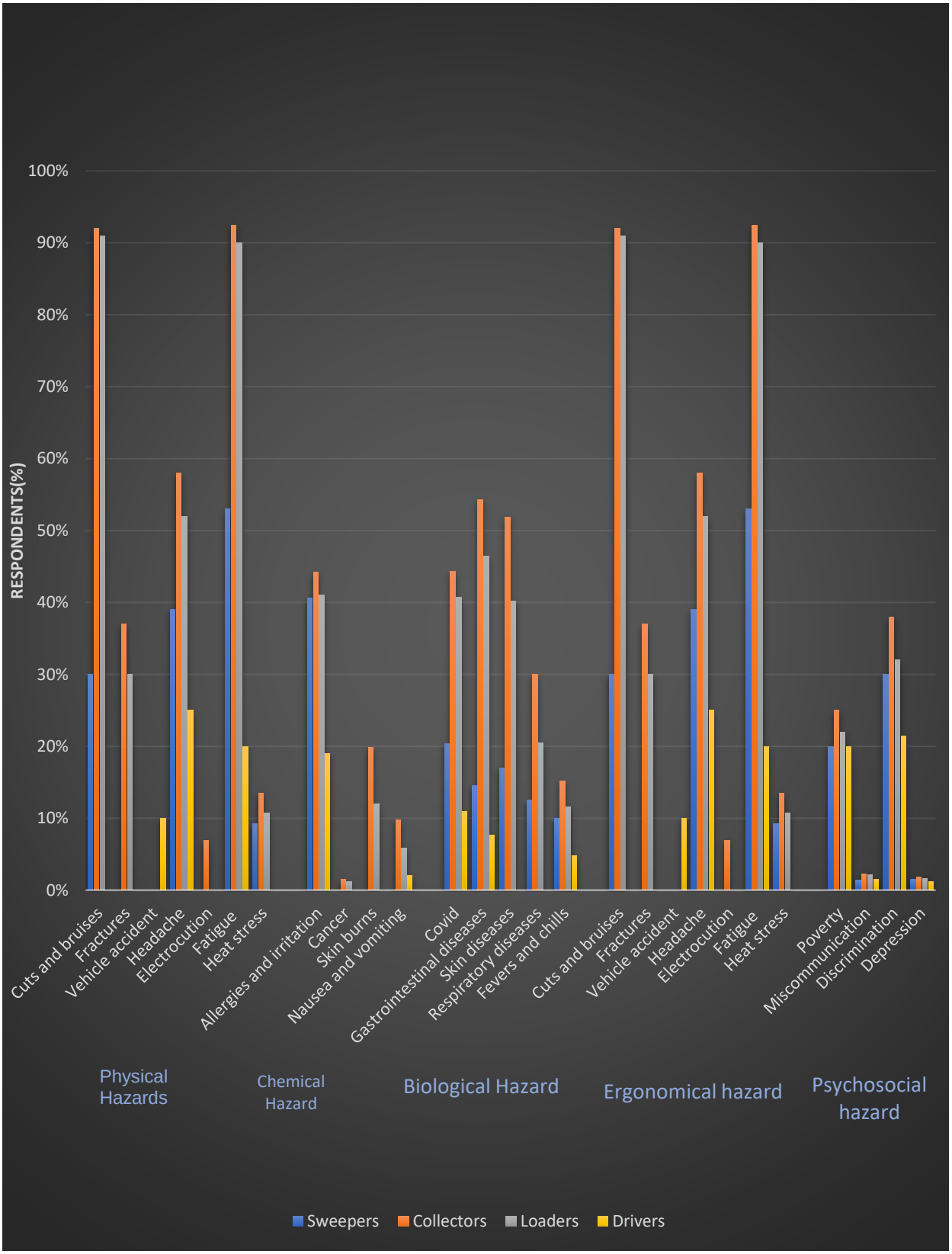

Figure 2: Risk Associated with different Hazard types

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Table 3: Risk matrix for specified jobs in waste management

Specified job	Hazards					Total risk score
	Physical	Ergonomical	Biological	Chemical	Psychosocial	
Waste collectors	25 (E)	14 (H)	25 (E)	17 (H)	10 (M)	91
Waste loaders	22(E)	10(M)	25 (E)	17 (M)	10 (M)	84
Street sweepers	14 (H)	12(H)	18 (H)	5 (L)	10 (M)	59
Drivers	10(M)	7 (M)	11 (M)	5 (L)	10 (M)	43

Conclusion

Five hazard types were recognized using hazard Identification and risk assessment technique in the job of sweeping, collecting, loading and driving in the field of waste management, i.e. physical, chemical, biological, ergonomical and psychosocial. The risk score calculated and representation in risk matrix categorized extreme risk level to physical and biological hazards in collectors and loaders. Chemical hazard risk was considered to be low and at an acceptable level. These sources of extreme danger were of an intolerable caliber, necessitated immediate safety and control measures, and, if at all feasible, the source should be stopped. Due to poor working conditions, solid trash workers at the Kathmandu municipality faced serious health risks. Unsegregated trash loads exposed solid waste workers to a variety of illnesses, injuries, and musculoskeletal ailments due to the labor-intensive systems used for waste collection. However, the hazard identification and risk assessment method was not followed by the municipality's safety actions. The provision of personal protective equipment (PPE), which is the last line of defense, is their primary risk reduction measure. There are no particular policy initiatives in place to safeguard the safety of solid waste management personnel. Because KMC did not offer enough protective equipment, and the solid waste employees who were provided it did not utilize it on a regular basis to guarantee their own safety, this intervention is ineffective.

References:

Cochran, W. G. 1997. *Sampling techniques.* Vol. 3rd Ed. Newyork. John Wiley & Sons.

Gërxhani, Klarita. 2004. "*The Informal Sector in Developed and Less Developed Countries: A Literature Survey*." *Public Choice* (Springer) vol. 120(3_4),: 267-300,.

Gietaneh W, Simieneh MM, Alene M, Asemie MA, Shitu D. 2020. " *Work related injury and its disparity across selected occupations in Ethiopia: systematic review and meta-analysis."* doi:10.21203/rs.3.rs-30759/v1. PPR:PPR168524., 1:1-9.

ILO. 2019. *Annual Report.* Document and Publications Production, Printing and Distribution Branch (PRODOC), International Labor Organization.

ILO n.d. (1996) "*Informal economy: a hazardous activity".* International Labor Organization.

ILO. 2018. *International Labour Organisation. "Women and Men in the Informal Economy: A Statistical Picture". (Third edition).* Report. International Labour Organisation.

Kuijer, P Paul & Frings-Dresen, Monique. (2004). World at work: Refuse collectors. Occupational and environmental medicine. 61. 282-6. 10.1136/oem.2002.001172.

Ojha, Anup. 2021. "*How Kathmandu's waste management emerged as a perennial problem*." Kathmandu Post. April 16. https://kathmandupost.com/valley/2021/04/16/how-kathmandu-s-waste-management-emerged-as-a-perennial-problem.

Purohit, Devdatt P, N A Siddiqui, and Abhishek Nand . 2018. Vols. ISSN 0973-4562 Volume 13, Number 10 . International Journal of Applied Engineering Research.

Tripathi A, Tyagi VK, Vivekanand V, Bose P, Suthar S. 2020. "*Challenges, opportunities and progress in solid waste management during COVID-19 pandemic*." *Case Studies in Chemical and Environmental Engineering* 2. https://doi.org/10.1016/j.cscee.2020.100060.

WHO/ILO. 2021. "*Joint estimates of the work-related burden of disease and injury",* 2000-2016: global monitoring report: Geneva*.* World Health Organization and the International Labour Organization.